



thoroughly, and weigh impartially and with intelligence the many conditions affecting success. It is absurd in any one to claim to be able to teach where others never cease to learn; and the work should be approached in this spirit, or it will not come up to the high standard required.

CORRESPONDENCE.

[Communications will be noticed only when accompanied with the full name and address of the writer. Unless specially desired, only initials will be printed. We invite criticism and comment by the readers of the ENGINEERING AND MINING JOURNAL. Replies not intended for publication should be addressed to the Editor of the ENGINEERING AND MINING JOURNAL in blank, stamped, and sealed envelopes. We do not hold ourselves responsible for the opinions of our correspondents.]

The Belt Mines.

EDITOR ENGINEERING AND MINING JOURNAL:

SIR: We are obliged for your courtesy in inserting our letter of November 15th in your issue of the 29th ultimo.

As regards the paragraph from our letter of August 21st, 1883, which accompanies it as an additional note, we would accentuate our remark that no American experts were employed on behalf of the company. The property was bought on our report, as stated by us; but its value had previously been vouched for by two American experts employed on behalf of the vendor.

To prevent any misunderstanding, we may mention that these gentlemen were Messrs. F. G. White, of the Quincy mine, and James H. Ralston, of Chicago. We are, sir, your obedient servant,

BAINBRIDGE, SEYMOUR & RATHBONE.

WESTMINSTER, LONDON, Dec. 11, 1884.

The Exports of Coal to Canada.

EDITOR ENGINEERING AND MINING JOURNAL:

SIR: In your summary of the report of Joseph Nimmo, Jr., Chief of the Bureau of Statistics, which you printed in your issue of the 13th, page 390, you state that "our exports of bituminous coal footed up to 646,265 tons, valued at \$1,977,959, of which 501,410 tons went to Canada; and further, "our exports of anthracite aggregated 649,040 tons, valued at \$3,053,550, of which Canada took the bulk, 601,891 tons." These figures, I am convinced, are glaringly inaccurate. I have, in former years, noticed these striking discrepancies between the export figures of our own Bureau of Statistics and the figures for the imports of coal from the United States into Canada as given by the Customs Department at Ottawa. The following table of the quantities of coal imported into the different provinces of the Dominion for the fiscal years ended June 30th, 1883 and 1884, will be accepted as a convincing proof:

IMPORTS OF COAL FROM THE UNITED STATES INTO CANADA.

Province.	Anthracite.		Bituminous.		Coke, etc.		Total.*	
	1883.	1884.	1883.	1884.	1883.	1884.	1883.	1884.
Ontario.....	439,586	561,592	736,176	1,013,118	7,267	9,673	1,183,029	1,599,521
Quebec.....	208,532	259,654	3,869	3,315	494	249	212,895	263,275
Nova Scotia.....	19,355	22,977	3,618	3	.....	.....	22,973	22,980
New Brunswick.....	43,911	39,759	638	748	.....	.....	44,549	40,511
Manitoba.....	13,919	4,515	90,628	19,115	129	189	104,676	23,833
British Columbia.....	356	286	373	272	2	12	731	580
P. E. Island.....	1,597	2,062	43	.....	.....	.....	1,640	2,062
	727,256	890,845	835,345	1,036,571	7,892	10,123	1,570,493	1,952,761
	727,256	727,256	835,345	835,345	7,892	7,892	1,570,493	1,570,493
Increase.....	163,589	163,589	201,226	201,226	2,231	2,231	382,268	382,268

Contrast the 501,410 tons of bituminous coal returned by Mr. Nimmo with the 1,036,571 tons recorded as imported in the same time by the Canadian authorities, and the 601,891 tons of anthracite given by the former and the 890,845 tons by the latter! Such a discrepancy is well calculated to shake faith in the accuracy of Mr. Nimmo's figures, which, above all, statistical work should inspire. It need hardly be said that the Canadian figures are probably strictly correct, because a duty is levied on the imports of coal. There is no such stimulus to close watching in the case of the exports from the United States, and the result is the atrocious negligence that alone can account for the fact that the export movement of bituminous coal is more than double that returned by Mr. Nimmo, and for the discrepancy of nearly 300,000 tons in the case of anthracite. The question naturally arises: Is the movement of merchandise from the United States, in which Uncle Sam has no interest in the way of pocketing duties as thoroughly misrepresented in other or possibly in all cases, and if so, is it not time to give the Bureau a very thorough overhauling? If the business men of this country are to be forced to study the import statistics of every country to which they ship before they can get at the facts, they ought to know it that they may act accordingly; but until they have assurances that greater accuracy is studied in our export statistics, they will cast the elaborate tables of the Bureau of Statistics aside as rubbish.

The quantities of coal and iron ore exported from Canada to the United States are given below:

COAL AND IRON ORE EXPORTED FROM CANADA TO THE UNITED STATES.

	Coal.		Iron ore.	
	1883.	1884.	1883.	1884.
Ontario.....	.....	42,508	42,745	23,434
Quebec.....	2,120	8,507	.....	18
Nova Scotia.....	110,150	111,077	.....	25
New Brunswick.....	17,670	12,469	.....	1
British Colonies.....	172,863	211,901	1,890	1,830
Total.....	302,803	386,062	44,635	25,308

The small discrepancies between these figures and those given by Mr. Nimmo may be explained by the fact that there may have been coal in transit from British Columbia to the Pacific coast ports. The figures are probably correct as far as the United States are concerned, because in this case the statisticians of the Washington Bureau have the powerful incentive of collecting a duty on the coal imported.

I may here add the following table on the shipments of iron ore from

\* In 1884, 15,221 tons were imported, classified as coal, ash, "others and dust," which was not introduced until that year. The totals in these columns are therefore larger by that amount than the total of the figures given in the three columns specified.

Canada to the United States during the first nine months of 1884. The quantity is so heavy as compared with the United States statistics, because the shipments from Trenton did not begin until July of the current year:

EXPORTS OF IRON ORE DURING THE FIRST NINE MONTHS OF 1884.

From Belleville.....	1,556 tons.
Kingston.....	15,964 "
Pictou.....	640 "
Trenton.....	22,070 "
Windsor.....	10 "
Total.....	40,240 tons.

In closing, I would recommend to your readers that for the present they rely upon the Canadian statistics for accurate information concerning the coal movement from this country to Canada, and I venture to suggest to Mr. Nimmo that he devote a little study to the import returns of other countries as a check upon the slovenly work of his subordinates. NEW YORK, Dec. 20, 1884. CANADA.

NEW PUBLICATIONS.

REPORT OF THE GEOLOGICAL SURVEY OF OHIO. Volume V. ECONOMIC GEOLOGY. 8vo, 1124 pages. With Index and many Illustrations. Published by authority of the Legislature of Ohio.

After a long pause, the Geological Survey of Ohio has again resumed the publication of the results of its work. Through the exertions of Prof. Edward Orton, the State Geologist, and N. W. Lord, the chemist of the Survey, and with the co-operation of a number of other gentlemen, many of them former students of Professor Orton, a volume has been issued that, we are sure, will silence those who have a low opinion of the practical value of the work of "fossil-hunters and rock sharps." It is no doubt a difficult matter to convince the average State legislator that a volume filled with plates descriptive of the fauna and flora of bygone ages is worth the large sums of money spent for it, and this feeling is only too generally strengthened by conversation with iron-masters and colliery proprietors, who are only too apt to depreciate the value of work that they can not understand. It would be idle to deny that there has been in the past, and is still to some extent now, some ground for the indifference or hostility of business men to the scientific work done by the State and general geological survey departments. The scientist is apt to forget that after all his efforts are only the means to accomplish a well-defined end, the profitable and safe development of our mineral resources. The ardor of the scientist or the ambition of the individual, praiseworthy as they may be, have not always been subordinate to the duties of the State employe, and the result is, that many of the stout volumes are treasured in the libraries of a few specialists who are the only ones that ever touch or profit by them. A few are able to apply the facts they contain, while they are valueless to most of those for whom they were collected. We do not know how much Professor Orton and Mr. Lord sacrificed as scientists when, in deference to the call for so-called "practical" results, they spent years of labor on the volume before us. We are convinced, however, that, though they may have a less scientific audience, they have certainly a much wider circle of readers. In years to come, the well-thumbed pages on the small shelves of a coal boss's or founder's office will tell the tale. The work may not figure frequently in the foot-notes of the latest treatise of a trained German palaeontologist; but we expect to see it a book of frequent reference in its own and adjoining States. We do not wish to be misunderstood as undervaluing the great scientific work of our surveys; but we must confess that we hail with pleasure a volume like that before us, which we are happy to say has its rivals, to say the least, in the publications notably of the Second Geological Survey of Pennsylvania.

In glancing over the work and carefully studying some of its parts, we confess that at times the eagerness to popularize has carried the writers too far. This is specially the case with Mr. Andrew Roy's paper on the method of coal mining in Ohio. It is perhaps a little too much to speak of outcrop coal as "impregnated with iron rust and earth matter," nor do we believe that the facts bear out such statements as these: "Fan ventilation is more effective in shallow than deep mines;" or that "the most fiery mines are those between 600 and 1200 feet in depth; below this zone, fiery beds of coal are met, but it is the exception rather than the rule." It is just to Mr. Roy to say, however, that his paper is on the whole an excellent one, containing a good many interesting points, even to those who need not be taught the rudiments of coal mining.

Prof. Edward Orton, the State geologist, of course furnishes the bulk of the volume. A mere enumeration of the titles of the chapters from his pen will convey some idea of the scope of the work done by him with meager means and in the intervals of leisure from other duties: I. The Stratigraphical Order of the Lower Coal Measures; II. and III., the Coal Seams of the Lower Measures; XII., the Massillon Coal-Field; XIII., the Coal Mines of Holmes County; XIV., the Mines of Coshocton County; XV., the Mines of Muskingum, Licking, and the Northern Half of Perry Counties; XVI., the Hocking Valley Coal-Field; XVII., the Mines of Vinton and Jackson counties; XVIII., the Mines of Scioto and Lawrence Counties and of the Western Part of Gallia County, all of them belonging to the Lower Coal Measures. In his preface, Professor Orton summarizes the work as follows:

"The best single service that the present volume can claim to have rendered is in the determination of the leading horizons throughout the entire coal-field of the State. Several important changes have been made in the reading of the record. The Leetonia coal has been shown to be the Lower Kittanning seam, or the first above the ferriferous limestone. The Canfield cannel seam has been shown to belong to the ferriferous limestone horizon. The Hammondsville strip vein has been shown to be the middle Kittanning seam and the Clay vein coal of the Ohio Valley the lower Kittanning seam, or the first and second seams, respectively, above the ferriferous limestone. The Steubenville shaft coal has been referred to the lower Freeport horizon. The Osnaburg coal of Stark County and the Pike Run or Dennison coal of Tuscarawas County, which are the same seam, are shown to be Middle Kittanning and not Upper Freeport in age. The Carbonale coal of Athens County has been so clearly proved to be the Nelsonville seam that the question of its age can not longer be regarded as an open one. The Waterloo coal of Lawrence County has been shown to be the Upper Free-

port seam, and not the Middle Kittanning. The clay seam of East Liverpool and the Upper Ohio Valley has been proved to be the Kittanning clay, and not the Lower Mercer. The blackband ore of Stark and Tuscarawas counties has been proved to occupy the horizon of the Upper Freeport coal. The Putnam Hill limestone has been shown to be a companion seam to the ferriferous limestone, and not this limestone itself, underlying it and almost alternating with it in its appearance, in the girdle of the old coal gulf.

"As a matter of course, a great number of other changes will follow those already named. It would be too much to expect that all of these changes should be at once adopted. The leading ones have already recommended themselves to those who are practically engaged in the development of the various fields, and the new order is proving itself a safe and certain guide in all recent explorations. In regard to its final acceptance I entertain no doubt."

We can only add that these chapters on the coals of Ohio contain a wealth of detail that can not but be of the greatest and most direct practical importance to one of the leading industries of the State.

We have perused with interest Professor Orton's chapter on the Iron Ores of Ohio. The general verdict is certainly not favorable to the native ore supply of the State. The report contains a particularly valuable review of the alleged discovery of blackband ore in Holmes County on the Coshocton branch of the Connetton Valley Railroad.

Professor Orton says: If there is any considerable body of ore, 3 feet in thickness, let alone the 6 to 10 feet reported, that will yield before calcination from 22 to 27 per cent of iron, the work of iron manufacture may be begun immediately, and its success can be guaranteed, so far as we are concerned. No such body of ore was found by the Survey. On the other hand, if the Fisher bank fairly represents the blackband of this district, then iron-making can not be successfully begun here in one day. The Hocking Valley iron ore bubble had been pricked nearly eight years ago by Mr. Edmund O. Pechin, of Cleveland. Professor Orton reviews the subject at length, and his verdict, long borne out by bitter experience, is summarized in the following sentence: "It does not, therefore, seem possible that the native ores of the valley can ever again hold as prominent a place in the iron-making of the valley as they have thus far held through its short history."

The next chapter, which we are happy to be able to speak of in the highest terms, is that of Mr. N. W. Lord, the chemist of the Survey, on the iron manufacture of Ohio. In a preface, Mr. Lord briefly but fully acknowledges his indebtedness for a part of the material to the late Mr. Henry Newton, who had been employed by Dr. Newberry for parts of several years, in the collection and preparation of materials for the volume on Economic Geology, and for whose report on the manufacture of coke iron is made in this volume. Mr. Lord gives an historical sketch of the growth of iron-smelting in Ohio, and then takes up in detail the different leading districts, discussing the conditions affecting them, their fuel and ore supplies, and the character of their raw materials. He then describes the plant and appliances of Ohio furnaces, and the technical results obtained. We can heartily recommend a careful perusal of Mr. Lord's report to iron-masters generally, and only regret that similar work has not been done by the gentlemen connected with other surveys.

Among the other chapters that we can only refer to incidentally, is a long reprint of a report on building-stones, written by Dr. G. W. Hawes, for the Tenth Census; a report on the clays of Ohio and the industries established upon them, by Mr. Edward Orton, Jr.; a valuable paper on the gas-coals of Ohio, by Mr. Emerson McMillen, Superintendent of the Columbus Gas-Works; a contribution by Prof. G. F. Wright on the glacial boundary in Ohio; and a report by C. Newton Brown, on the Meigs Creek coal-seam in Morgan, Muskingum, Guernsey, and Noble counties.

This brief summary will eloquently prove how much faithful work has been accomplished, though we understand that it does not include all that has been done. Professor Orton states that a chapter has been prepared on petroleum and natural gas, with special reference to the deep borings for the latter. We trust that it will soon be published, as it has an immediate interest. A good deal of work is, however, still before the Survey, almost the entire Upper Coal Measures, and no mean part of the Lower Measures still awaiting thorough study. If the record of the past gives any assurance, as it ought, of liberal support for the future, that support will not be lacking. We can not close without specially mentioning the large amount of analytical work done by Mr. Lord, who, we are glad to note, fully appreciates the fact that thorough sampling is the first condition of trustworthy results.

**WORKING THE RESIDUES OF DRESSING GRAPHITE ORES.**—The *Chemiker Zeitung* contains an offer of a reward of one thousand marks for a method of profitably treating annually 10,000 cwts., or the greater part of that quantity, of the tailings of dressing plumbago ores. The condition is, that the product shall not cost more than 1.10 marks for 100 kilograms at works. The successful applicant is to have from 5 to 10 per cent of the gross amount received for sales.

**THE COAL-TAR COLOR INDUSTRY.**—Some idea of the small quantity of coloring matter in the coal-tar may be obtained from the following figures referring to fuchsine, one of the leading colors made from coal-tar. On an average, 5 kilograms of coal yield 5 per cent, or 250 grams of benzole and toluole, which, theoretically, yield about 2.9 grams of aniline oil, or 3.2 grams of fuchsine. In reality, only one gram of fuchsine is obtained from 5 kilograms of coal, or only two tenths of one per cent. According to C. Engler, of Karlsruhe, Germany, the following quantities of coal-tar are worked for aniline colors annually: Great Britain, 400,000 tons; Germany, 85,000 tons; France, 75,000 tons; Belgium, 50,000 tons; and Holland, 15,000 tons. Many of the English works treat the tar only partially, selling the raw material to German works. The aniline color industry flourishes most in Germany, where there are 19 works. Lunge, in 1883, estimated the value of the products of the coal-tar color industry at 92 millions of marks, of which Germany produces 60 millions, Switzerland 13 millions, and France and England 19 millions of marks.

## THE IRON ORE RANGE OF THE SANTIAGO DISTRICT OF CUBA.\*

By James P. Kimball, Lehigh University, Bethlehem, Pa.

The south slope of the Sierra Maestra, which, east of the Bay of Santiago, forms the coast range of the island of Cuba, is for a distance at least of some thirty miles east of the bay, made up of eruptive syenite, covered with a massive overflow of trap (epidiotic diorite). This has reached the surface through innumerable dikes.

The serrated crest of the range, within these limits, appears at a distance to be uniformly denuded of diorite, as are also the foot-hills at the coast directly in front. Farther east, the range, as viewed from the sea, exhibits a topography characteristic of a trappean surface from summit to base.

Within the same limits, the immediate coast is emerged coral-reef, reposing directly on the syenite.

The Bay of Santiago corresponds to an original indentation of the coast. It is excavated from coralline, of which three terraces are preserved. These mark successive elevations of the coast range. Their combined thickness is over 300 feet above tide. The third terrace, forming the present or immediate shore, like the two elevated terraces from which the shore-line has advanced, is precipitous and practically vertical, from the undermining action of the waves.

As will presently be shown, geological traces are afforded of the former existence of corallines still farther back from the coast. These were in remote but direct succession with the subsequent uplifts as marked by the still existing terraces. Intervening corallines may have disappeared from the intermediate belt of syenite hills by erosion, to which the minor topography of the range is wholly due.

The trappean belt reaches a thickness that I estimate to be not less than 2000 feet on the slope of the Sierra, and a height of some 3500 feet. As it declines from this elevation toward the sea, it likewise thins off. Thus the upper part of the south slope is an enormous mantle of diorite resting on the syenitic body and base of the range.

The Juragua Hills, so-called, are the culmination of the foot-hills of the Sierra between the bays of Santiago on the west and of Guantanamo on the east. They constitute an alpine body of hills, distinguished from the massive body of the Sierra Maestra by their isolation as four distinct parallel ranges, successively declining in elevation with the general slope toward the sea.

The summits of the first or upper isolated range of the Juragua Hills, reaching an elevation of some 2000 feet above the sea, are mainly eroded from the dioritic mantle down to the syenite, which first makes its appearance at their lower or southern base.

The hills of the second distinct range of the same body are covered with a reduced thickness of the same trappean rock, but these are eroded well into the syenite.

It will be shown that this range as compared with the only other iron ore-bearing range, namely, the *first*, presents the more favorable conditions both for the original development of iron ore-bodies and for their preservation.

A farther east and west extension of the iron ore-bodies of the Juragua Hills is seen to have once been a pronounced feature—especially of the second range. Toward the west, these have survived the general erosion only as remnants. This is also the case with the hills themselves that they flanked. These fall off very rapidly in size from the culmination of the Juragua Hills. Thus increase the destructive effects of erosion in both directions along this range, until stayed by structural changes in the Sierra Maestra, which it is needless here to describe. The Lola and Berraco hills to the eastward, both containing undeveloped ore-bodies, are an extension of the second range under the changed structural conditions referred to. So too, still farther east, with the ore-hills of Sigua, which I have observed only from a distance.

The third and fourth ranges of low hills of the Juragua group are completely denuded of diorite, if indeed, as seems doubtful, they were ever covered with it. These form the syenitic coast-margin, conspicuous features of which are the very numerous dikes of highly epidiotic diorite.

This trappean rock, so largely developed upon the flank of the Sierra, may be supposed to be the present form of an originally more basic material from which large volumes of ferric oxide have been separated by metasomatism (weathering). The large masses of specular ore found along the first and second ranges of foot-hills can correspond only to a small proportion of the ferric oxide, which, together with other mineral matter, has been eliminated by chemical forces from the original igneous magma.

The unequal development of the iron ores of these two ranges of foot-hills points to unequally favorable conditions for the separation, concentration, and preservation of the ferric oxide.

The second range of hills, as above remarked, affords altogether the best type of ore-bodies. This type is well exhibited in the so-called East Mine and West Mine hills of the Juragua Iron Company, Limited. The diorite of these hills, reduced in thickness as it falls away toward the coast, is in contact along this range with the syenite. This contact, therefore, seems to have become the seat of great chemical activity—especially through the action of alkaline carbonates from the feldspar of both rocks in process of weathering.

### SECOND OR LOWER IRON ORE BELT.

The large bodies of hematite or specular oxide, together with associated ferruginous aggregates—in part of magnetic oxide, are secondary products from the decomposition of basic eruptive rocks, now represented by the epidiotic diorite that has penetrated and overflowed the syenitic base of this part of the Sierra Maestra. They are the result of the alteration or epigenesis of highly basic, and therefore unstable, rock aggregates, and of their resolution into new aggregates with the aid of surface agencies, in subordination to the new conditions met with at and near the surface. Thus, the presence of oxygen in atmospheric air, and of alkaline and earthy bicarbonates from decomposing silicates, has rendered unstable the highly ferriferous material from deep-seated sources. These aggregates were basic from excess of protox

\* Transactions of the American Institute of Mining Engineers.

ide bases, and especially protoxide of iron. Such eruptive material can not long resist further oxidation at the surface, with the result of more or less complete disintegration of the original aggregate, and its recombination into new compounds. This process of permutation is known as weathering (metasomatism). Many of the commonest phenomena of mineral veins are of this nature, and all rock masses exhibit the same on a greater or less scale. The phenomena of mineral pseudomorphism and rock metamorphism are of the same general class.

To be more specific, the eruptive material that gave origin to the iron ore consisted of proto-silicates, or silica combined with the protoxide bases, iron, lime, and magnesia, and with alumina. Under its new conditions at the surface, with access to oxygen in the atmosphere and in circulating waters, and in contact with bicarbonates of the alkalies and of alkaline earths (also circulating in meteoric waters, and derived in part from itself, but especially furnished in large proportion by still more feldspathic material like syenite in the process of weathering), the protoxide of iron became rapidly further oxidized into ferric or sesqui-oxide, which is a comparatively stable product under conditions prevailing at the surface. The oxidation of the ferrous to ferric oxide is attended with more or less complete dismemberment of the eruptive rock little by little. Silica originally combined with the ferrous oxide is isolated as silica. Silicates of lime, magnesia, and alumina, being more stable, form new aggregates among themselves, in part according to atomic proportions. Soluble material as fast as isolated enters into solution in circulating waters, and is thus at hand to assist in the work of weathering. This work of alteration has gone on until a complete change has been wrought not only in the composition but also in the arrangement of the original eruptive rock. By the law of molecular attraction, a process of concentration has gone on simultaneously with the process of weathering decay. Homogeneous material, such as ferric oxide, has collected by itself to a degree far greater than the other earthy residues, because, in the process of conversion from ferrous to ferric oxide, it has been in solution, and so in circulation, and hence becomes finally deposited under long prevailing conditions of uniform circulation. The process here briefly followed out has gone on, not on the surface but below, within the range of circulating waters. The same action at the surface is followed by waste or diffusion of the products of alteration. This is the partial explanation of the occurrence of the ferric oxide in defined positions so as to finally constitute ore-bodies. This explanation will be completed by the following very important observation:

*The best of the iron ore-bodies, including those of the East Mine, and the developed ore-bodies of West Mine, hills, are mainly, if not indeed wholly, replacements of coralline limestone.*

A second and different class of ore-bodies will remain presently to be described.

The eruptive overflow, which probably took place in part below the sea level, involved masses of littoral coralline limestone and of coral-reef. The final elevation of the Sierra Maestra was a subsequent event. It is these masses of coralline limestone that, in several instances of the better class of iron ore-bodies, including those of the Estancia location, as well as of East Mine and West Mine hills, have become replaced by a highly concentrated ferric or specular oxide. Thus the outlines of such ore-bodies, as well as their dimensions, correspond in the main to those of the original limestone masses. Hence the great difference in size and altitude, and many of the irregularities of all the ore-bodies appertaining to this class.

The replacement of limestone by ferric oxide is well understood as a not uncommon mode of origin of several familiar types of iron ore-deposits.

The process of replacement referred to may be briefly explained as follows:

Meteoric water circulating within the superficial or weathering zone of rock, takes up enough carbonic acid from the atmosphere, and under other favorable circumstances also sulphuric acid from the oxidation of pyrite, to impart to it solvent effects, especially in its action upon limestone. Coralline limestone, before consolidation and induration from crystallization, yields most readily to such solvents. As particle by particle enters into solution, its place is taken by any available substance in the process of precipitation from the same water, or from intermittent sources of water. In the case in hand, lime becomes dissolved in the same water that has taken up ferrous oxide as a bicarbonate, and that is precipitating ferric oxide. In other words, water dissolving lime as a bicarbonate has from a neighboring source taken up protoxide of iron, likewise as a bicarbonate, but which is rapidly precipitated as ferric oxide (by peroxidation), this oxide being an insoluble one. Or again, through the mediation of sulphuric acid, ferrous carbonate results from the reaction of ferrous sulphate upon limestone, and by exchanging acids and bases with other alkaline carbonates, also upon dioritic and syenitic rocks that supply these carbonates, including carbonate of magnesia. Or, still further, carbonic acid along with ferrous sulphide may follow from the reduction of ferrous sulphate by decaying organic matter. And so on through a round of permutations according to the adventitious composition of passing mineral waters.\* Hence the process of replacement is a gradual one.

Proof of the replacement of coralline limestone is afforded by fragments of ore still retaining the structure of coral. Several such specimens are in my possession. These are sufficient to establish the truth of the mode of replacement referred to. Still better proof is afforded on the ground, as something of the radial structure characteristic of coral is necessarily sacrificed to the trimming down of hand specimens to a convenient size.

Collateral proof of the truth of the general proposition, namely, that littoral coralline limestone and coral-reef have been involved in the vulcanism of the iron ore-bearing range, is to be found in the presence, exclusively within the limits of the range, of highly crystalline limestones, or white marble, in isolated bodies corresponding in size and general altitude to certain ore-bodies already instanced.

It must be borne in mind that almost all limestones have their origin in coralline material, derived directly from the consolidation or indura-

tion of coral reefs; or, to a far greater degree, from the accumulations on sea-bottoms of coralline sediments after comminution by the waves.

Why, in some instances, the coralline masses have become bodily indurated and crystallized into marble, while in others they have disappeared by dissolution and their place has been taken by specular oxide of iron, is to be explained by a difference in local circumstances, of which at least the following are easily conceived:

1. A mass of coralline limestone situated at an elevation so that drainage would be away from it, would not be subject to the solvent effect of carbonated or other acidulated waters, except upon its surfaces. Such is the topographical situation of all the marble deposits known to me in the region.

2. The period of the crystallization of the calcareous or coralline material has doubtless in some cases governed the matter in question. If originally crystallized as one of the immediate effects of igneous contact, it would be in a state to resist solvent action of circulating waters except at its surfaces. The alteration of limestone into the crystalline form of marble is a common effect of vulcanism, whether of trap-dikes or other larger injections.

3. The condition of the coralline limestone when overflowed, whether emerged and therefore to some degree consolidated, or whether still of the nature of coral-reef, is a question of some moment in its bearing on the differences to be observed among the several developments of limestone, and of the iron ores. In other words, some of the points of difference suggest the probability that, in some cases, the coralline masses involved were at least under water and parts of them still of the character of reef, when involved in the igneous flood. The presence of organic life is indicated by the pyritous ore possessing the structure of corallum at the "north shaft" (pit) of East Mine, which is near the contact of one of the great ore-bodies with the syenite.

The limestone, so far as at present known, is completely obliterated in the case of the development of large ore-bodies.

Nor have I met with it in the same hills with large bodies of iron ore. Small exhibitions of float, usually of good quality, are generally found in their vicinity, but no ledges of ore nor heavy float indicative of outcrops. The presence of limestone seems to be incompatible with the presence of considerable bodies of iron ore. At Berraco only, have I observed any crystalline limestone in the same hill along with considerable bodies of iron ore. In this instance, the limestone was found simply as a fragment, probably from a concealed ledge high up the hill; or, what seems to me still more probable, from a former ledge so situated, and now obliterated by the degradation of the hill. This probability follows from the fact of the situation near the summit of the higher hills of all such bodies of limestones that I have met with.

The iron ore-bodies of the alpine district east of Santiago are exceptional, from the fact that they are attributable to the immediate alteration of eruptive rocks, and that resulting residues, including an important portion of their original ferrous contents, have been preserved almost *in situ*.

The other great bodies of ferric oxide in North America, like the Huronian deposits of Michigan and Wisconsin, are similarly derived from the decomposition of highly but less basic rocks of *metamorphic*, and not of direct eruptive origin. Such stratified specular iron ore-bodies are believed to owe their existence to the accumulation by precipitation of ferric oxide from basins of water receiving the drainage from such basic rocks. In the bottoms of hydrographical basins, the ferric oxide is preserved in laminae and beds, along with the mechanical sediments (clay, sand, and marl) corresponding to the insoluble parts of the same decomposing basic rocks. The source therefore of the Archæan crystalline or so-called primary iron ores, including most deposits of magnetite, was basic rocks comparatively poor in ferrous oxide and rich in earthy silicates.

The Sierra Maestra ores, on the other hand, are derived without intermediate stages of development from basic silicated aggregates, particularly rich in ferrous oxide, an important proportion of which has been preserved as ferric oxide in places below the surface near its source, without ever reaching hydrographical channels of drainage. Under ordinary circumstances in past geological times, the same as universally observed at present, all but a comparatively minute proportion of ferrous oxide dissolved in circulating waters, or of sedimentary ferric oxide, must have been lost in the general drainage.

But for the presence of considerable bodies of soluble coralline limestone implicated in the littoral igneous flow, no such preservation of the ferric oxide as has taken place could under the past or present topographical conditions of the Sierra Maestra range have occurred. The related hydrographical conditions must always have been against the local accumulation or preservation of fine *détritus* of any kind in its water-channels, while no basins upon its slope can ever have existed. The southern slope comes down to the sea, the coralline coast-line having become advanced as successive elevations of the range have taken place.

The epigenesis of the iron ore-bodies of the Sierra Maestra, as above briefly sketched, is not without precedents in all but special features.

Perhaps the nearest familiar analogue to the phenomena above described, considered from a geological point of view, is the disintegration of the porphyries of Leadville, Colorado, and the local preservation of their insoluble residues, including ferric oxide of a high degree of concentration.

Parts of the well-known deposits of Pilot Knob and Iron Mountain in Missouri must, it seems to me, be referred to a similar origin.

The Huronian specular iron ore-bodies of the James River, Virginia, resemble the Sierra Maestra ore-bodies in point of derivation from neighboring rocks, but differ in their occurrence as a concentration of the ferric oxide, so derived, between divisional planes of stratification, as space has thus been provided by the shrinkage of the parent rock through loss of this and other soluble material.

A familiar example of the replacement of limestone by ferric oxide is afforded by the Clinton fossil ore-beds of the Upper Silurian of the United States as developed in the Middle and Southern States.

Still more numerous examples might be furnished of the segregation of ferric oxide as limonite and red hematite from rocks, in the gossans of mineral veins and in other classes of iron ore-deposits, all of which,

\* See a paper by the present writer, these Transactions, viii., 213. Index to vols. i.-x. (Errata), 2.

indeed, it may be said in general, are at least of secondary origin as products of decomposition from some less concentrated form of complex rock.

The irregularities that are thus far revealed by the few actual workings in the Sierra Maestra deposits are such as are not inconsistent with the explanation here given of their origin. The same may be said of their few regularities, so far as presented.

Of the nature of regularity may be considered the generally prevailing approximately east and west direction of the longer axes of the separate ore-bodies. This, it seems to me, follows from the advance of the flow of the lava-sheet from the north in a line parallel with the coast, and the consequent overflow of the surface of corallines, between *playas* or mouths of streams. With the subsequent elevation of the chain, the inner edge of the coralline would naturally correspond to its upper edge in elevated positions.

Irregularities, on the other hand, are numerous. These are differences of size; of degree of erosion (or, *vice versa*, of preservation); of topographical relations; and of quality. On all these points, much remains to be proved by excavations, as explorations are continued, and as the workings of the Juragua Iron Company, Limited, are advanced.

The workings of this company alone are the only ones at present worthy of mention. Of the whole number of "mines" thus far discovered and denounced between Santiago and Berraco, some eighteen miles in longitude to the east of that port, those alone of the Juragua Iron Company, Limited, have yet proved of immediate economic value or importance, especially when considered with reference to transportation within reasonable limits of practicability. The limits of the orange, as far as known, are Sigua at the east, and Sevilla at the west, the longitudinal distance between these two points being some eighteen miles.

#### GENERAL QUALITY OF THE ORE.

The type of ore, thus far described, is physically characterized by a high degree of polarity and by the absence of cleavage. It occurs in all forms of red hematite, including micaceous, amorphous, granular, and sub-crystalline varieties. The last-named variety is commonly studded with minute crystals of magnetite and martite. Variations in the color of drillings, from red to black, imply unequal distribution of altered hematite or of unaltered magnetite, of water of hydration, and of manganese oxide. The dense and amorphous character of the ore precludes the recognition of pseudomorphic effects. As the earthy admixtures are mainly chloritic and epidotic, these ores are essentially basic, especially in comparison with other types of well-known speculars, like those of Lake Superior, whose jaspery intercalations render them more or less acid; or those of the James River, whose acid property springs from segregated quartz. Their proximate chemical constitution is partially shown by the following percentages:

Moisture.....	0.240	0.810
Silica.....	5.000	10.500
Iron.....	61.000	68.500
Phosphorus.....	0.009	0.065
Sulphur.....	0.045	0.248

Many grades of ore occur within the iron range, including, besides those already described as complete replacements of limestone, other ferrous combinations in great variety, but which fall below the grade of shipping ores. These are notably quartz aggregates containing large proportions of iron in the form of magnetite, and garnet rock similarly charged with anhydrous ferric and magnetic oxides. These ferruginous compounds are the metasomatic association which oxide of iron has formed when bodies of dissolving corallines have not been at hand to receive ferric oxide from passing chalybeates, and to preserve them free from other extraneous mineral substances.

Such earthy impurities as were present in the coralline material when overflowed remain, in part, as impurities in the ore. Wide differences in quality of the ore are to be thus explained. Difference in the quality of the original corallines is to be explained by the numerous sources of *detritus* from mountain streams discharging into the sea at every few miles, as at present.

It will be proper to note here a point having an important geological bearing, namely, that, in this part of the Sierra Maestra at least, the denudation has probably kept pace with its successive elevations. Feldspathic rocks, like diorite and syenite, which enter principally into its structure, especially yield to weathering action. The effects of this are very pronounced on the whole southern slope as seen from the sea, the same as back of Santiago. The successive elevations, as above stated, are shown by successive terraces of emerged coralline, and by the occurrence so far inland of remnants or fossils of coral, and of isolated bodies of crystalline limestone or marble.

It is by the complete replacement of very pure coralline that ferric oxide of extraordinary purity is afforded by at least parts of every ore-body in the region whose relations may be traced to coralline. It seems probable, too, that the best ore is through the replacement of masses of coral-reef as distinguished from coralline limestone; and that, on the other hand, some of the large deposits of impure ore correspond to the replacement of coralline of the later class. This explanation seems the more probable from the fact that there proves to be in association with ore-bodies of this description a type of rock nowhere else seen in the region, which I take to be the altered form of sedimentary deposits locally associated with littoral corallines. These are especially seen at the Lola (west) and Berraco mines. They are soft quartzose but somewhat basic rocks, weathering rough, with a ferruginous surface of brown oxide at the Lola, and red oxide at Berraco.

Another circumstance already referred to as supporting the above view is the presence of sulphur in some of the ore free from earthy impurities. This suggests the effect of organic and, especially, of animal matter. So far as has been observed within the present stage of development, there seems to be a decrease of pyrite, and also of copper salts (from copper pyrite), as the interior of ore-bodies is reached. This might be supposed to arise from the circumstances that the reducing power of organic matter would not survive its ultimate destruction, and that therefore this power would be exerted early in point of time and near the exterior of any coralline body.

#### SHAPE AND SIZE OF ORE-BODIES.

What is simply known as the weathering of rocks embraces the phenomena above described. The process is the same whether in a rock upon

the surface or in a body of rocks in place. The process goes on from the surface in the measure of its exposure to weathering agencies. Surfaces are presented to weathering action underground in rock-masses by the various divisional planes that traverse them, and which practically separate a mass into blocks.

In dense eruptive rocks, joints and cleavage present even more divisional surfaces of this kind than stratified rocks, in which they are likewise developed.

Weathering of a prismatic block, whether on the surface, or *in situ*, goes on from the outside inward. The tendency of this action, when attended by loss of cohesion, as in the weathering of crystalline rocks, is to produce a scale on the outside with perhaps little cohesion. Hence the rounding of such blocks upon the surface. Thus boulders are produced. These may often be seen *in situ* in southern latitudes where the weathered zone rock near the surface has not been swept off by glacial erosion. Nowhere in greater perfection can be seen such phenomena of weathering action than on that part of the coast of Cuba under description. The highly feldspathic syenite of the Sierra Maestra foot-hills is visibly weathered to a depth of nearly 100 feet, its composition within this zone being mostly of rounded masses, or cores of blocks that have thus far resisted complete dissolution, the wide interstices being filled out with disintegrated syenite. The numerous railroad cuts of the Juragua Iron Company, Limited, through such material required but little blasting, except to break up the larger of such boulders.

The tendency to concentric scaling or weathering is seen to perfection in such boulders, many being found with the scale still adhering; while with others the scale develops very rapidly on exposure to the atmosphere.

These phenomena are recalled to illustrate the formation of the iron ore-bodies, or such at least in the region as have given it importance as a source of shipping ore. I allude to those ore-bodies that I have referred to as essentially replacements of coralline masses.

It is not supposed that such an ore-body is a cast of the original coralline. On the other hand, it is almost certain that the coralline was but a nucleus, the rapid dissolution of which gave space and freedom for the circulation of subterranean waters, and for the play and localization of chemical or metamorphic forces. With the loss of material and change of form, shrinkage of the weathering eruptive mass took place, so that every ore-body referred to probably conforms in size and outline approximately only to the original coralline.

But every ore-body showing an actual terminal surface likewise shows the concentric structure referred to as characteristic of weathering masses of rock.

The result of this structure is to constitute what is known as a boss of ore, resembling an onion, with divisional surfaces very suggestive of bedding, and easily mistaken for stratification. This is well shown by the northeast ore-body at the East Mine, and by the two openings at the West Mine less perfectly, but at the more northerly quarry very clearly.

The result of this configuration is to produce a lenticular outline. All sections of ore-bodies, therefore, whether longitudinal, transverse, or oblique, if projected to terminal outlines, result in approximately elliptical figures. Assuming the surface of the underlying syenite to retain its original undulating topography as left by erosion, this surface, regarded as the base of ore-bodies, would tend to complete their lenticular outlines—however it may be as to the prevalence of the concentric mode of deposition within their deeper as well as in their more superficial parts.

In projections of outlines of the several ore-bodies,\* I have represented them as symmetrical. Although somewhat forced at certain points, no other plan seems to fulfill the purpose of diagrams. This, in the present state of development, must be limited to what alone is practicable, namely, to indicate the kind of outline rather than the outline itself. In thus representing the geological and topographical relations of the several ore-bodies, a wide margin must be allowed in each case for their actual limits.

Still another result of concentric structure is outer foliations of impure ferric oxide beyond the limits of the original coralline, within the territory of the weathering rocks, and occupying some divisional plane of least resistance near the boundary of the *locus* of deposition.

This, at least, is my reasoning from analogy to account for such outer divisions of ferric oxide of from 1 to 5 feet thick, as may be seen at the north drift of East Mine, and which I have good grounds to believe to be likewise presented at the northeast working of West Mine. The analogy is drawn from the weathering of smaller masses. This may be illustrated by the concentric alteration of clay iron-stone into sphaeroidite, and of this into limonite.

The practical result of such a structure would be to invest the ore-bodies with a sort of shell.

*Pari passu*, it would follow that the interior of such ore-bodies would be the best. This, I venture to believe, on the scanty evidence yet afforded, and by the reasoning above followed in brief.

Yet this remark refers especially to the ends rather than to other parts of ore-bodies, and to such ends only as are strictly terminal, that is, inclosed or surrounded by rock. For the tops of most of the known ore-bodies have been more or less eroded, so that really their upper surfaces correspond to what originally were interior parts. Reference therefore is made only to still buried portions of ore-bodies, but not less perhaps to the sides or walls parallel with their longer axes than to the ends.

The general term chlorite has been locally applied to the rocks incasing the ore-bodies, and perhaps is as descriptive as any. They are of a pronounced magnesian type, bleached free from notable proportions of iron oxides, comparatively soft, and exceedingly shelly from a high degree of cleavage. As residues of decomposition, their true classification would refer them to their unaltered form that they no longer resemble.

The shape and size of none of the bosses of specular iron ore have yet been fully revealed. They appear to be elongated masses, the longer axes of which take approximately an east and west course throughout the region. Reference to this fact has already been made, and an explana-

\* Geological Report to the Juragua Iron Company, Limited, August, 1884.

tion attempted. The deeper drainage channels or streams, having a general southerly course from their sources high up the slope of the Sierra Maestra, the ore-bosses generally lie transverse to the ridges of the several summits in which they are found; or, what is the same, transverse to the general course of the streams. They seem to rib the slopes on which they occur, the ore being so hard and compact, compared with the incasing chlorite, as to form subordinate divides between the water-courses of the hillsides, which, as usual, have eroded their way in the softer material.

The smaller ore-bodies of the East Mine correspond to fragmental bodies of corallines. These seem to be actual casts of such fragmentary corallines, as shown by the peculiar warped surface characteristic of their fracture in considerable bodies. This peculiar fracture may be observed to good advantage along the coast, where large masses have become detached from the escarpment of the middle terrace.

All the large bodies of ferric oxide, the origin of which may be traced as above, are incased in such portions of the chloritic or iron-bearing formation as are immediately in contact with the underlying syenite. The Juragua River, on which is West Mine of the Juragua Iron Company, Limited, and its branch, the Benevolencia, on which is the company's East Mine, follow the same contact where they pass these localities. This is a significant fact in its bearing on the theory of the relation of the main ore-bodies to coralline, as above sketched.

Aggregates of magnetic oxide with magnesian silicates, and with granular quartzite, also occur in the immediate vicinity of the bosses and ribs of ferric oxide, together constituting the East Mine. These seem to occupy divisions of jointing or cleavage of the altered chlorite, and are thus found in plates of limited extent, and have as yet proved of no economic importance.

At least the lower ends of the bosses and ribs of ferric oxide of East Mine are, at several points already uncovered, variously traversed by irregular courses of chlorite a few feet in thickness, and characterized as "horses" by the miners. A similar occurrence is seen at the south opening of West Mine Hill. If, as there seems some reason as above stated to conclude, these intrusions of rock within the body of the ore are limited to the outer portions, which thus would form a sort of shell to the inner portions, trouble from this source will become less as workings advance. This is borne out by the fact that, as far as the quarry has advanced, these intrusions have become less and less.

The practical question arises as to the conditions in depth of the iron ore-bodies corresponding to replacements of corallines.

While the phenomena that they exhibit are such as have been produced by essentially superficial agencies, comparatively understood, it seems to me, if the reasoning here followed out be sound, that the ore-bodies of this class will be found to rest upon the underlying syenite, or at least to extend to an horizon not far from this contact. The intervention between the ore-bodies and the syenite of a zone of decomposed silicates representing a lower belt or residuum of earthy silicates, such as circumscribe other surfaces, may be argued from analogy, general as well as special.

In the case of East Mine and West Mine hills, the syenite contact is at their bases, or near the beds of the streams.

The inclination of the plane of this contact doubtless follows the original slope of the syenite, more or less modified by erosion according to the topography of syenite when overflowed.

A good part of the small ore-float, of excellent quality, found toward the head of the ravines on the divides between streams, and near the summits of hills covered with the iron-bearing rocks, may be believed to proceed from small ore-deposits of the nature of plates or of scale, on the contact of bodies of crystalline limestone with the incasing iron-bearing rocks. Bodies of such limestone, with marked cleavage, but without stratification, occur near the summit of West Mine Hill; and on the opposite culmination of the East Mine Hill, to the north of the comparatively low hill on which are the several workings of this mine. Together with these ledges of crystalline limestone, or marble, and likewise inclosed within the iron-bearing formation, occur ferrous aggregates, already described as quartzite and garnetiferous rock, highly charged with magnetic and specular oxides. These have already been referred to as the forms assumed by the alteration in such elevated localities, or remote from the syenite contact, of the original basic rocks from which all the ferrous compounds have been derived.

#### ORE-FLOAT.

I now come to one of the most striking features in the region, namely, the great profusion of so-called ore-float on the hillsides and in the ravines.

Probably more iron ore, and this is generally of the best description, is thus found as float than has yet been exhibited *in situ* in the form of ledges or bosses.

This phenomenon is one of the wide series of phenomena, so richly afforded by the whole range, of deep weathering of surface rocks, and of their erosion under circumstances of steep slopes and a high rain-fall.

It can not but be believed that, in more instances than are clear, excellent bodies of ore have practically undergone complete destruction, while all that come to the surface have suffered heavy loss by the gradual falling away of their outcrops. Fragments up to many tons in weight lie scattered upon and below the outcrops, often obscuring the ledge, and gradually working down hill into the ravines. Slopes and ravines so richly strewn with blocks and boulders of first-class ore would under circumstances of less difficult transportation, become productive sources of supply.

Instances have come to my notice, as at the Lola east mine (not of the Juragua group), where the erosion of the hillsides has taken place in the best of ore. At this locality, the ore is exceptionally soft and porous, and hence has yielded to erosion more readily than the incasing rock. Thus, only the remnants of a once fine body of ore still exist, and these only as float upon the sides and bottom of a deep ravine, which occupies the place of the former ore-body, none of which is left above drainage level. It must have conformed to the type above described. The float from this body of ore, which is abundant, is characterized by a weathered surface, highly suggestive, in the case of large blocks, of coralline structure.

At Sevilla, what was once an elevation containing a boss of iron ore is seen in the last stages of dissolution, iron ore-float being all that is left, and this lying directly on the disintegrating syenite.

Like the occurrence at Sevilla, many of the lower syenitic foothills, in line with the second range, in which are developed all the ore-bodies known to be extensive, although eroded of dioritic overflow, still bear upon, or just below, their surface, remnants of ore. The nearly vertical dikes of epidotic diorite exposed in such hills, stripped of their former mantle of the same rock, are very numerous.

#### SILICEOUS PRISMATIC ORES.

A second prominent type of ore-body remains to be described especially noticed on the first range of foot-hills.

On West Main Hill, following the one per cent gradient from the explorations in North or Dry Arroyo upon an ore-body of this type, a number of ribs of iron ore come to the surface, including at least two that physically differ from the developed ore of East and West mines.

The specular oxide of these mines is quite free from cleavage, and in weathering assumes a rounded outline.

The second type of ore referred to weathers in prismatic blocks, and possesses the structure of dense trappan rocks, such as abound in the form of dikes both within the syenite and the altered overlying iron-bearing rocks. Ledges of this description are uniformly rich at exposed surfaces and so is their *detritus* or float.

Such occurrences are the result of the decomposition *in situ* of basic eruptives by the dismemberment of silicates, followed by the concentration of ferric and magnetic oxides. This action is essentially superficial.

I therefore argue on general grounds that such deposits, even under exceptional circumstances, are not likely to be permanent in depth, while the majority of them must be expected to prove of a very shallow character. The fact that most of the deposits of this type are simply veneered with the anhydrous oxides of iron, although of extraordinary richness, has been made clear to me in a number of instances both within and beyond the company's territory.

The genesis of ore-deposits of this type is to be explained, with reference to what has already been said, as follows:

The concentration of ferric oxide *in situ* from basic traps differs from the process of replacement of limestone, from external sources, chiefly in point of time required in the two cases. The circulation of chalybeate waters through dense trappan rocks would necessarily be so much retarded as to induce the peroxidation of the ferrous oxide *in situ*, or at least soon after entering into solution. Its greater insolubility, as compared with the proto-silicates when liberated from their original bond, and especially with quartz under certain conditions of temperature and pressure, ultimately leads to the elimination of all but difficultly soluble silicates. These still remain as earthy impurities of this imperfectly concentrated mixture of ferric and magnetic oxides. Magnetic oxide, as a stable or difficultly soluble mineral originally present as such in basic eruptives, has likewise been left as a residuum. This occurs in admixture with ferric oxide. Such changes are the inevitable result of metasomatism of unstable rocks, such as highly basic eruptives, which must have been the source of all the concentrated forms of iron oxides above noticed.

The occurrence of iron oxide in both types of deposits mainly as ferric oxide, and not as ferric hydrate, is the result of gradual dehydration more or less complete.

It will be perceived that, unlike the great Archæan deposits of specular oxide, both classes of ore-deposits above described have undergone a process of concentration without going through the intermediate stage of sedimentation. In other words, they are products in the one case of the segregation of ferric oxide, in part from immediate sources; and, in the other, of alteration *in situ* of oxide basic rocks by peroxidation of their most unstable base, namely, ferrous oxide. Hence, while in the case of the ferric replacement of corallines the phenomenon of segregation is presented on a large scale in common with all mineral veins, all further resemblance to mineral veins fails from the absence of the phenomena of fissures, like brecciation, intermittent or successive deposition of miscellaneous minerals and friction surfaces.

The superficial effects of the weathering of all the rocks that have come under my observation on the Sierra Maestra slope are of the same general kind characteristic of all southern latitudes.

Yet the decay and bleaching of the rocks above hydrographical drainage must be greatly promoted by such an absorbent as the superficial zone of *detritus in situ*. That it possesses a high capacity for absorption, is shown by the total absence within its limits of visible sources of water, like springs, notwithstanding periods of excessive rain-fall. The marked saline property of water in flowing streams of the range is another proof of still active decay of its covering.

It should be distinctly noted that the ores above described as replacements of corallines in close proximity to the outcrop, or contact with, decomposed syenite, including those of the Juragua Iron Company's East and West mines, and of its Estancia and Juraguacito tracts, occupy the second distinct range of foot-hills from the main body of the Sierra Maestra range.

These deposits of soft high-grade ore occupy in fact the thinning edge of the great body of eruptive rocks that overspreads the syenitic flank of the Sierra. From the next or third lower range to the south, the trappan rocks, if ever developed as an overflow, have entirely disappeared by erosion, and in part by thinning. It is under such circumstances that much of the work performed in the metasomatism of the rocks of the second range of foot-hills, resulting in the formation of the best class of iron ore, is here ascribed to the influence of weathering syenite and the action of alkaline bicarbonates from this additional source.

#### FIRST RANGE OF IRON ORE-DEPOSITS.

Still another or third group of iron ore-deposits remains to be described. These have much in common with the second class already described as occurring on West Mine Hill.

I refer to those that occur within the first range of foot-hills next below the summit of the Sierra Maestra, and distinct from its immediate south flank. This flank, which has a breadth of some three or four miles, together with the first range of hills referred to, is dis-

tinctly covered by one expanse of epidotic and dioritic trap, the topography of which has been produced by erosion. This assumption rests on the belief that the summit of the Sierra is syenite, and on the fact that it appears again at the base of the first range of foot-hills referred to, whence southward toward the coast, the surface is sculptured out of the same formation.

This great formation of epidotic diorite appears to be in close relation to the very numerous injections of the same kind of rock, throughout all exposed parts of the syenite. This overlying formation it may be believed, had its origin in the overflow of just such dikes in great number, if not indeed of great size.

In the first range of hills referred to, and within the development of the mantle of epidotic trap, occur bodies of ferric oxide more or less magnetic from admixture with magnetic oxide. Such are the ore-bodies of La Folie tract of the Juragua Iron Company, and of tracts not belonging to this company.

Nothing has been done to explore any of the ore-bodies referred to. While all afford hand-specimens of first-class ore, especially from the immediate surface, the bulk of so much of their product as can be seen falls as a rule below the standard of even a second-class ore of East and West mines.

I am not indeed prepared to say that inclosed masses of coralline have not likewise determined the *loci* of even these masses of ore found within the first range of trapean foot-hills. Garnetiferous rather than distinctly ferri-ferrous aggregates occur at the Yuca ore-body, resembling corallum structure, while the base of the ore-body itself is distinctly of trapean structure and origin. Hence the possibility arises that, while corallines have given place to secondary deposits, concentration of ferric oxide has taken place only imperfectly and tardily beyond the compass of such calcareous centers, after these, perhaps, have been replaced by available mineral matter of which ferric oxide was but a minor part. Yet the presence of coralline in process of replacement, it may be imagined, would be sufficient to determine the *locus* of metasomatic activity—involving even adjoining parts of the dioritic mass. Or again, the condition of excessive impurity from admixture of siliceous with coralline sediments in such cases, may be sufficient to account for the rocky character of the fragments found at the Yuca suggestive of corallum casts.

From the above description, it follows that the most favorable conditions for the development of large bodies of highly concentrated specular oxide in the iron region of the Sierra Maestra are to be found toward the edges of the expanse of trapean rocks, where reduced in thickness by erosion, near their contact with the underlying syenite. Apparently only under the influence of alkaline carbonates from the syenite, has the trapean mass been submitted to that kind and degree of alteration and epigenesis, which have resulted in the formation of iron ores through the intervention of involved coralline similarly situated.

The location of such ore-bodies thus determined is comparatively low in the hills. The higher hills often bear toward their summits less concentrated forms of ferric and magnetic oxides, and occasionally also bodies of crystalline limestone. These elevated positions, it has already been observed, are beyond the reach of alkaline carbonates, while lower positions have received the benefit of their drainage and of mineral matter, thereby transmitted.

This general proposition is borne out on the one hand by the ore-bodies of East Mine and West Mine hills, and by those of the Estancia tract as far as determined, and by that of Juraguacito. All these are found near the base of the Juragua Hills. To this class of ore-bodies belongs also the Lola east ore-body, of which traces only remain. On the other hand, the circumstances governing the conditions of higher altitudes and positions remote from the syenite contact are illustrated by the higher parts of West Mine Hill deposit and by the Yuca, and by some of the ore-bodies at Berraco.

The bleached dioritic or so-called chloritic rocks found in association with the better class of ore-bodies near the decomposed and, in place, kaolinized syenite are distinctly recognized, whenever they occur, as in a far more highly weathered condition than the general mass of dioritic rock, forming the first range of hills, as well as the immediate southern flank of the Sierra, where, overspreading the syenite as a mantle, it has protected the latter rock from weathering, while all the drainage of the syenite at the base of the first range of diorite hills is directly to the water-courses. Hence the lack of alkaline carbonates, except from the diorite itself, back of the second range of foot-hills to assist in the disintegration of the mantle of diorite, and in its alteration under the conditions of a thin development as witnessed at the base of the Juragua range of hills.

As bearing upon the observation of the depth to which exposed parts of the syenite are weathered, and thus rendered soft and porous so as not to admit of the presence of springs, may be mentioned the fact that, on the other hand, springs are a feature of the first range of diorite foot-hills, as seen in La Grande and Yuca hills. This fact is important in relation to the supply of alkaline carbonates from decomposing syenite, as these are believed to have been one of the most powerful agencies in determining the *loci* of metasomatic activity such as has resulted in the concentration of ferric oxide from basic rocks.

While the massive epidotic diorite of the Sierra is to be regarded as the altered product of the original still more basic material, under the less favorable conditions, the more thoroughly altered forms of the same material found in association with the iron ore-bodies correspond to the more favorable conditions. The lithological identity of both forms is clear. Only in close proximity to ore-bodies developed within the massive diorite of the first range of foot-hills, at the southern base of which alone the syenite is visible, is the great expanse of epidotic diorite seen to be unequally altered. In such proximity, the diorite is seen to be bleached and weathered, but in a way different from its weathered appearance under conditions of reduced thickness near its contact with the syenite.\*

This is another auxiliary fact going to justify the importance here given to the effect of the alkaline carbonates. In determining the range of their influence, we determine the limits of at least one of the most

favorable conditions under which the best bodies of specular oxide occur. This, I think, has practically been done. The results of other favorable conditions have, in a general way, likewise been assigned. If such conditions have, in the main, been correctly recognized, the propositions here brought forward will go far to render practicable a discrimination between the different classes of iron ore-deposits in the region, with direct reference to their practical value.

#### POWER NEEDED IN OPERATING THE CABLE ROAD ON THE BROOKLYN BRIDGE.\*

By A. E. Matheson, M.E.

Taking the cable road on the New York and Brooklyn Bridge for an illustration, it will be found that the cars are drawn across with about half the power that would be necessary for any other system.

The bridge cable road is provided with two 26 by 48-inch steam-engines that are run with a piston speed of about 480 feet a minute, and are fitted with clutch-couplings for the purpose of using one or the other as condition requires. The boiler pressure is carried at about 70 pounds and the initial pressure in the cylinder is 60 pounds. One engine is found to be ample for all the work called for, and would be more than sufficient if the work was more evenly distributed. As it is, the variation of power in an interval of one minute is over 200 horse-power. The cable system is best suited for small, single cars, and, if the travel demands, they may be dispatched as often as desired. By such a method, the variation of power will not be so great if one or two cars are released from the cable at the same time, or if it happens that there are a few more cars on one side of a summit than on the other. It ought to be a rule that the steeper the grade, the smaller the cars. If this rule is neglected, there is danger that the cars will run away with the machinery. It approaches this condition on the bridge at present, and certainly will do it if the intention of running four cars in a train is carried out. The reason why the system of running trains instead of single cars on the bridge is adopted is, that when there is more than one grip attached to the cable they can be more relied upon, and also that the peculiar construction of the grip in use is not suited to be drawn around the curve on the Brooklyn station. On this account, it is necessary to employ locomotives for switching, and as the distance over which this switching is done is several hundred feet, it requires about two minutes for two locomotives to switch the cars from the point where they are unloaded to the other track, where they are attached to the cable. With a suitable grip, single cars can be dispatched as fast as they are loaded.

That part of the bridge over which the cars are drawn by cable is about 5600 feet long. The grade,  $3\frac{1}{2}$  per cent. The speed of the cable is a little over 10 miles an hour, which is about 900 feet a minute. The two cars that are connected in a train weigh 10 and 8 tons respectively, and when loaded, the average weight of a train will be about 26 tons. At two-minute intervals, three trains will constantly be attached to the cable on each track, which makes six trains in the circuit. The total weight of the six trains is about 156 tons; and, if the maximum car axle and rail friction is taken at 1 per cent, it will require a tension on the cable of 3120 pounds from this cause alone. The grade upon which the cars rest is  $3\frac{1}{2}$  per cent; the total weight that is suspended by the cable and rests on the carrying-sheaves is about the thirtieth part of 156 tons, or 10,400 pounds. The carrying-sheaves are 15 inches in diameter, and their journals 1 inch, consequently the leverage is 1 to 15. If the journal friction is taken as 10 per cent, the power to overcome the journal friction from the weight of 10,400 pounds on the sheaves will be the 150th part, or about 70 pounds. When the trains are dispatched at two-minute intervals, it locates them 1800 feet apart; the summit of the bridge being about 2800 feet from the starting-point, every other minute will bring two trains on one side and one train on the other side of the summit. This being the case on both tracks, it will throw two unbalanced trains against or in favor of the power; if against the power, the tension on the cable of 52 tons on a grade of  $3\frac{1}{2}$  per cent has to be added to the above resistance, which is 3466 pounds. The friction of these two unbalanced trains has been added to the above for the reason that it is a constant whether in favor of or against the power. The 3466 pounds, added to the total friction of 3190 pounds, gives a tension on the cable of 6656 pounds. To this must be added the journal friction of about 200 pounds on the driving machinery that is caused by this tension, independent of moving itself and cable. The total of these resistances is then 6856 pounds moved with a velocity of 900 feet a minute, which is equal to about 214 horse-power. If the two unbalanced trains are on the side of the summit to favor the power, the tension of 3466 pounds must be subtracted from the 3190 pounds of frictional resistances, and the difference subtracted from the power to propel the machinery and cable.

Indicator-cards that have been taken under the above conditions show that the maximum power exerted by the engines is about 270 horse-power. It appears then that 56 horse-power are required to drive the machinery and cable, which is about 20 per cent of the total power exerted. The minimum power shown by another indicator-card is 54 horse-power, or two horse-power less than that necessary to drive machinery and cable. It will be noticed by the above figures that the trains exert a tension of 3416 pounds on the cable; while all the resistances caused by friction of the cars outside of the driving machinery was 3190 pounds, a difference of 276 pounds, equal to about 7 horse-power. By my calculation, it would require only a maximum of 265 horse-power, where it indicates 270 horse-power, and a minimum of 49 horse-power, while it indicates 54.

I pointed out at the beginning of this article that, if four-car trains were to be run on the bridge and distributed as they now are, they would run away with the machinery. I think that the conclusion that one draws from the diagram of the indicator-card of the minimum power points that way.

The average power to draw the six trains will be the mean of 270 and 54 horse-power, which is 162 horse-power. The coal account in the bridge engine-room shows a maximum consumption of about 4000 pounds in eight hours, which is 500 pounds an hour, and about 3 pounds an hour for each horse-power. What other system will do this work with this expenditure of power?

\*American Machinist.

\* For further lithological references, see Geological Relations and Genesis of the Specular Iron Ores of Santiago de Cuba, by the present writer, in the American Journal of Science, xxviii, 1884 (and in the Engineering and Mining Journal of December 20th, 1884, p. 406).

## THE BARRACLOUGH OLIP-PULLEY.

Our illustration, for which we are indebted to the *Colliery Guardian*, represents a pulley that has been devised and arranged for the purpose of communicating or transferring power to wire ropes on inclined planes, both underground in collieries and on the surface, as well as for pumping water and driving machinery by means of ropes. It is manufactured by Mr. Joseph Barraclough, of the Union Foundry, Barnsley. The pulley is grooved, with flanges, inside of which are placed a number of tapered pockets opposite to each other. Working inside these pockets, are two sliding jaws, hollowed at the bottom to receive the rope. As the weight or burden is thrown on the sole of the sliding jaws, the duty thus thrown upon them presses them down into the tapered recess inside the rim of the pulley, thus causing them to grip the rope equally for three fourths of its diameter without undue pressure or injury; indeed, the special feature of this pulley is, that it does not injure or flatten the rope, which is gripped with a steady, even pressure over the greater part of its circumference. Under the sliding jaws, is a spiral steel spring, which assists in relieving the pressure on the rope, as the weight is taken off the sliding jaws, which causes the working to be noiseless. The pulley is made in two halves, and can be regulated to take any size of rope in a few minutes; it can be supplied with a brake-ring if required; it will work in any position, and will run equally well either backward or forward; the jaws can be replaced without the rope being taken off or the pulley taken to pieces. This friction gearing has been made for fourteen years, and can be applied to winding or hauling drums, as well as clip-pulleys, and is so arranged that it can be put in and out of gear while in motion, and so adjusted that the engine-man can tell when the corves get off the road or an extra load is put on. It comprises lever, screw, and wedge motion combined, as shown in Fig. 2. *A* is a set of cast-iron arms, which are keyed fast on shaft, to which are attached three sets of wrought-iron levers *F* and *H*, Fig. 3, these levers working the three cast-iron *V* segments *c*. The levers are moved by the sliding coupling *b*, working the links *D* and *E*, Fig. 2, and regulated by the couplings *L*, Fig. 3, with right and left-hand threads as the *V*s wear down. The couplings *L* are readjusted, also the rim with groove *K*, which is inside the brake-ring, and is so arranged that the *V*s will be worn completely away. The arms *J*, carrying either drum or clip-pulley, work loose on shaft *C*. In the boss, are four brass steps *B*, Fig. 1, which are set up by set-screws *d*, as they wear. The sliding coupling *b*, Fig. 2, can be worked either with a horizontal or vertical shaft, with fork lever or clams attached to the loose coupling or clam in groove *H*. These pulleys have been at work for six years at some of the principal collieries, under very heavy loads and steep gradients, and have, we are informed, given the greatest satisfaction. Mr. Barraclough writes us that references can be given to firms that have three and four working, up to 8 feet diameter.

## THE WELSH COPPER SMELTING PROCESS.—I.\*

By A. M. Levy, Namur.

Since the publication in the *Annales des Mines* of the paper by M. le Play, on the metallurgy of copper in Wales, the greater number of authors have been content to reproduce the description of the process as given by the French metallurgist. Percy, whose work has become classic in France as well as in England, gives only very incomplete information on the subject of one of the most difficult metallurgical processes. This is, to some extent, due to the extreme reticence of the managers of the Welsh works. Visits to the works are only permitted rarely, and usually the questions of visitors are answered in a very evasive manner. This is particularly the case in regard to refining, which was long kept a secret. The old Welsh refiners transmitted the process from father to son, and did not permit the presence of any stranger in the buildings in which the process was carried out. When I was employed as chemist at one of the large works in the Swansea District, I was able to make a thorough study of the different phases of the metallurgy of copper. I carried on these observations during the years in which I was in charge of the works.

**Ores.**—The ores that supply the Welsh works are derived in great part from two sources: one, the most important, is the ore market of Swansea, a market that is held at tolerably regular intervals; the other source is Cornwall, where many operations of some importance are carried on. The ores sold in Swansea come from many different quarters, and the import and sale of these ores rank as the principal business of the town. The sales are made by ticketing to the highest bidder. The ore, when it arrives, is put through a crusher, is reduced to uniform size, and thoroughly mixed. The percentage of metal is determined by a corporation, the "Cornish Assayers," which has a monopoly. According to the percentage of copper and the purity of the ore, the assayers establish a basis price. In doing this, they employ a formula that only the members of the corporation know, and which is based on the quotations of the different ores during a long series of years. The works employ one of these assayers, who bids according to the requirements of the works he represents and according to the character of the ores it has in stock. After the ticketing, no reclamations are possible on the score of assay or quality.

The ores sold at Swansea vary considerably in percentage of copper. They rarely go below 6 per cent, and sometimes reach 35 per cent. The percentage generally varies from 6 to 14, according to the origin of the ores. Considerable quantities of Cape ore are also sold. It is a very pure cuprifera pyrites carrying from 25 to 35 per cent of metal, and entirely free from arsenic, antimony, and nickel. This ore is much sought after, and brings high prices. The Cornish ore is a poor pyrites, averaging from 3 to 4 per cent. It carries a good deal of sulphur, and has arsenic, antimony, and tin. It is comparatively cheap, but always necessitates preliminary calcining, to rid it of the excess of sulphur and a part of the other impurities. All the ores treated at Swansea are sulphurets, carbonates and oxides being hardly ever received. Besides the ores, Chili bars, precipitate, regulus, and rich matte are imported.

\* *Revue Universelle des Mines*, Vol. 26, No. 2, p. 286.

The ores are always assayed by the dry method, which, it is true, does not give as accurate results as the wet method, but which has the advantage of being carried out under the same conditions as those governing the industrial operation. It is, in fact, noticed that the results of the dry assay differ more from those of the wet method, when the ores are poor and impure. Now, these ores are the very ores that in practice give the lowest yield. It will be noted that the smelter has an advantage in this method of assaying, as he is not obliged to pay for metal that he can not extract.

The results of the assay are, however, lower than those obtained in actual smelting. As a general rule, the furnaces extract from the ore a quantity of copper that is greater by about 12 per cent of the percentage of the metal in the ore than the result of the assay.\*

The supply varying, it is necessary to modify the composition of the ore mixtures. It is not always possible to get the most suitable lot of ore, and it is often necessary with what can be obtained from certain speculators who hold large quantities of ores. It will be understood, therefore, how difficult it is to follow a uniform plan and to be guided by the requirements of a process like that described by M. le Play. The smelter must endeavor to obtain by the ore smelting a matte as uniformly rich and pure as possible. Thus, he has for his subsequent operations an almost uniform raw material. This is one of the first conditions of good work, and the final product is rendered less dependent on the skill of the workmen.

**Refractory Materials.**—As all the slags produced in the working of the ores are siliceous, it will be understood that the materials of construction employed must be rich in silica, and that the higher is their percentage of silica, the better will they resist the corroding action of the slags. In Wales, Dinas brick are universally used for the arches of the furnaces. A good quality of Dinas brick is white and porous, and contains from 96 to 98 per cent of silica, the remainder being ferric oxide, a little clay, and often also a little lime that has been used to bind the material in making the brick. It is pretty soft, and is easily trimmed. The manufacturers make ordinary brick and key-brick for the arches. When their quality is good, they possess the peculiarity of expanding when exposed to heat. The best are therefore always used for the roof, and the expansion is so marked that the brick stays of the furnace often break during the first days of the firing. The mortar used contains less silica than the material from which the brick is made. It must be well ground, and is always used very thin. It is less refractory than the brick, and softens a little in the heat, thus to a certain extent binding the masonry together.

**Furnaces.**—With the exception of the roasting-furnaces, all the furnaces in the Welsh works have a uniform type. The dimensions alone vary, and it is the general practice to make all the matting-furnaces of the same size. The refining-furnaces are smaller. Since the extraction of copper is based on the expulsion of sulphur by roasting, the hearth is usually very wide, and the roof is low, so as to be able to direct a strong current of air upon the materials in the furnace. At the Cwm Avon works, with which I was connected, the ore and matting-furnaces were 16 feet long and 12 feet wide at the widest part. The hearth has an oval shape, and its greatest diameter is at a point at one third of its length, measured from the fire-bridge. The furnaces have two doors. The working-door, 18 by 12 inches, is situated at the front of the furnace at the flue end, and the form of the hearth is adapted to the two angles of the door by curves of large radius. The other door is located at the side of the furnace at the point of the greatest diameter of the hearth. It is used for introducing the cakes of matte, and at certain stages of the process is opened to facilitate the calcining of the material in the furnace. The air carried into the furnace by the draught of the chimney thus passes over the entire surface of the hearth, and oxidizes the sulphur in the charge. The fire-place is very large—4 feet square. The grate is  $3\frac{1}{2}$  feet below the upper edge of the fire-bridge. The roof is horizontal above the fire-place; but, beginning at the fire-bridge, it inclines rapidly toward the flue, being only  $3\frac{1}{2}$  feet above the hearth at that point, while it is 7 feet above it at the fire-bridge. The longitudinal section of the roof closely approaches an ellipse. In transverse section, the roof is an arc of a circle, the maximum spring being 10 inches, diminishing with the width of the roof. A circular flue passes through the bottom of the furnace, one end opening in the ash-pit. It serves to cool the hearth, and makes it easier to clear away the charge, when it happens to have broken through the hearth, an accident that is unfortunately quite frequent in matting-furnaces. All furnaces, with the exception of the refining-furnaces, are provided with a tap-hole located in the middle of one of the side-walls.

One of the greatest practical difficulties to be met is to make a good and durable hearth. The replacing of a defective hearth is a long and costly operation, in view of the heavy consumption of fuel that it entails and the stoppage of the furnace that it leads to. Let it be supposed that a hearth is to be put into a new furnace. Before the masonry is dried out, a layer of siliceous clay from 3 to 4 inches thick is spread over the hearth. This clay may become very useful. In reality, after running for a number of years, the sand hearths have absorbed considerable quantities of matte. They become very rich in copper, and they are smelted to extract the metal, and thus the carrying of a considerable dead capital is avoided. The clay makes it easier to remove the hearth by preventing its adhering to the foundation. It is generally found intact.

First, a light fire is started in the fire-box, and the masonry is dried as slowly as possible. When no more steam rises from the roof, the making of the lower part of the hearth is proceeded with. It is made of sand, and the greatest care must be exercised in choosing this material. Any sand that may contain lime or clay must be rejected. The Welsh works use sea sand, carefully cleared of algae or other sea plants that are found in it. This sand is spread over the clay in a layer of from 12 to 15 inches, and is thoroughly dried. The sand is then scraped so that a perfectly horizontal surface is obtained. The doors are closed and the firing

\*This Swansea method of making returns is a relic of practices of former centuries that should not be tolerated. It looks too much, to use a plain American term, like gouging. If Mr. Lévy is correct, and we have evidence corroborating him from other quarters, the actual losses of copper in smelting are very small indeed. Let smelters adopt a straightforward course, base returns on actual contents found by simple chemical methods, and make deductions in the quantity paid for, or on the price paid per pound, according to the quantity of impurities that they dread so much. Let them deduct so much per unit for every per cent of antimony, arsenic, etc., in the ore, so that the seller can figure out for himself before he ships what he is going to get. The same should be the case in the payments for silver. American sellers do not like to "go it blind."—EDITOR ENGINEERING AND MINING JOURNAL.

pushed gradually until a white welding heat is reached in six or seven hours. This temperature is maintained for from five to six hours. If the heat has been high enough, the surface of the sand will be agglutinated and has become firm. The furnace is allowed to cool a little, and pieces of very siliceous slag are then carefully put on the hearth. It takes about from 1.5 to 2 tons of this slag. The firing is again pushed, and the slag melted and kept fluid until the hearth ceases to absorb any more of it. The excess is drawn out with a rabble. The furnace is allowed to cool down for an hour, and then the sand is introduced that is to form the hearth proper. It will not do to be hasty in beginning the upper part of the bottom, and the lower part must be allowed to cool sufficiently. In fact, the two parts of the bottom must not too strongly adhere to one another. The upper part of the hearth becomes defective after running for a while, and it must be removed. If it adhered too strongly to the lower part, the operation would be a difficult one, and there would be danger of injuring the lower hearth. In matting and ore-furnaces, the hearth is so made that all its parts dip toward the casting-hole, and it must be possible to tap the matte produced in every operation. The upper part of the bottom is sintered in the same manner as described above. It is from 1 to 1½ feet thick. However well sintered it may be, the sand still forms a very porous mass, which would rapidly absorb the materials melted in the furnaces if the precaution were not taken to saturate it beforehand. As the character of the materials that compose the hearth has a great influence on the

yielded dust containing as much as 30 per cent of copper. In the case of the other furnaces, the grade of the dust naturally declines in proportion to the grade of the material treated in each group of furnaces. It seems that in the case of the system of separate chimneys a large part of this dust must be lost.

The draught must in any case be strong. It is necessary to keep in the grate a thick layer of fuel, so that the air drawn in by the chimney meets a pretty strong resistance in its passage through the fire-place. The gases of combustion must always be free from oxygen. Whenever it is necessary to have an oxidizing atmosphere, the air must be introduced through the side-door. During the melting operations, the flame in the furnace must be reducing or at least neutral.

Before passing to the description of the operation, it may be useful to recall the principles upon which the metallurgy of copper is based. The metals that it is the aim to separate from the copper all have a less affinity than copper for sulphur. When, therefore, the sulphur is removed from a mixture of molten sulphides, containing sulphide of copper, of iron, of nickel, etc., the copper will always satisfy its affinity at the expense of the other metals, and the latter will be scorified, provided care is taken to have present an agent that can combine with their oxides. The rôle of scorifier is played by the silica taken from the hearth or from the slags that are made to constitute a part of the smelting mixture. The foreign metals are, therefore, gradually eliminated, and finally a sulphide of copper is obtained that is almost free from the sul-

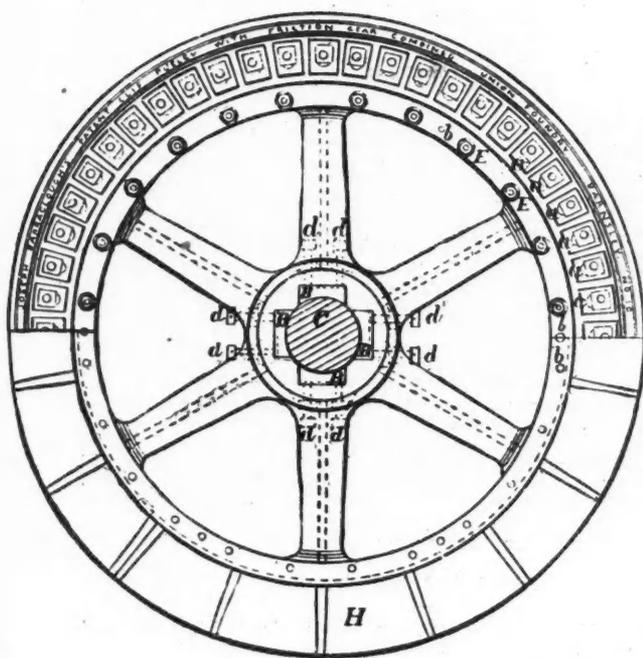


Fig. 1.

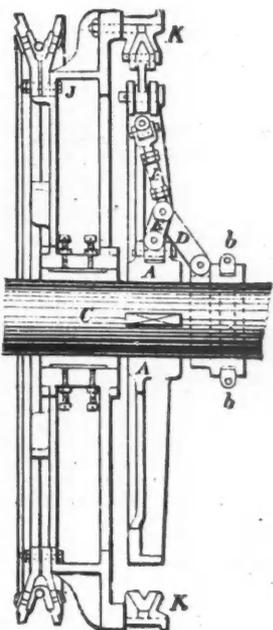


Fig. 2.

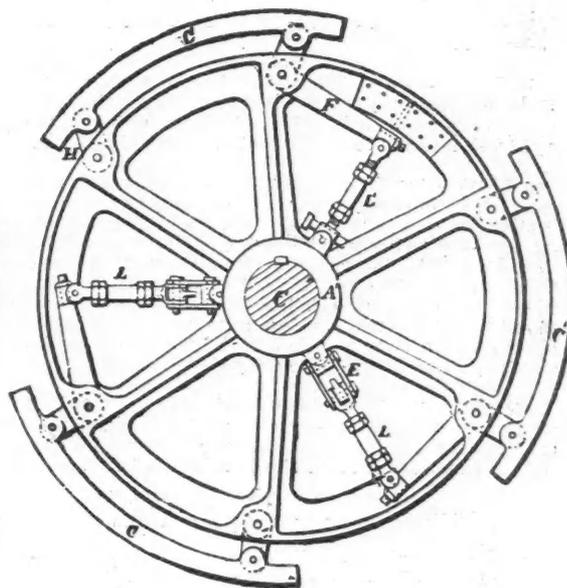


Fig. 3.

THE BARRACLOUGH CLIP-PULLEY.

purity of the matte made in the furnace, the substance that is to render the hearth impermeable varies with the use to which the furnace is put. For ore-smelting furnaces, the poor cinder from these furnaces themselves is employed, the most siliceous slags being chosen. For matte furnaces, the first operation is to melt in it a charge of matte obtained in the process preceding the one to which the furnace is to be devoted; for those furnaces that are to be used in making white metal and blister copper, a charge of the matte obtained in the process preceding by two stages the material to be made. Then the furnace is worked for two or three days, to make the matte that immediately in the process precedes the making of white metal in the one case and of blister copper in the second. The reason for this method of operation is rational. It is preferable to saturate the hearth with a poorer material, and consequently with one requiring less trouble in use than the matte, which the furnace is reserved for. The more care has been taken to calcine the sand before melting the matte, or, in other words, the better the sand is sintered, the less material will be absorbed by the hearth. I have often been able to obtain matte during the first operation. In spite of all precautions that have been taken, the hearths absorb a little matte during every melting. Therefore the date at which every hearth has been made is noted, and a fixed addition to the quantity of copper in the bottom is counted annually for every class of furnace.

In the greater number of the Welsh works, every furnace, or at least every group of two furnaces, has an independent chimney. In some cases, all the furnaces are served by a single very high chimney that has a very strong draught. I prefer the single chimney because the gases, in traversing a greater distance in the flues, more completely deposit the dust that they carry with them. At Cwm Avon, where the flues constitute a very extensive system, considerable quantities of flue-dust are found, which are removed annually. The flues of the refining and blister furnaces have

phides of the other metals. It is only necessary, then, to separate the sulphur from the copper. This is brought about by calcining under proper conditions, aided by a reaction that plays a part also in the metallurgy of lead. From the beginning, the calcining of sulphide of copper produces a certain quantity of oxide of copper. The latter reacts upon the undecomposed sulphide of copper; sulphurous acid is formed, which escapes and copper is free. Since the melted sulphide of copper is much more fluid than the oxide of the same metal, the mixture is allowed to cool in such a way that the two substances are prevented from separating in the order of their density. When the mass has become pasty, the furnace is fired up and the reaction is brought about. All the copper is thus finally obtained, after the process of alternately cooling and heating has been repeated a greater or less number of times.

Calcining.—The calcining-furnaces are very similar to those used for roasting blends in the Liège District. As a general rule, they have only one hearth, and their dimensions are large. The charge is introduced at intervals through the roof of the furnace. The aim of the operation is not to roast dead, it being simply the object to expel the greater part of the sulphur. A very important effect of this roasting is to expel the arsenic and antimony. They are volatilized as sulphides during the first hours of the calcining, when the sulphur is still present in great quantity and when the oxidation has not as yet proceeded very far. Therefore the furnace must be kept at a low temperature for a long time, in order to avoid the formation of arsenates and antimonates. As soon as the material begins to grow poor in sulphur, and the temperature rises, no more arsenic and antimony are volatilized. They are then transformed into arsenates and antimonates.

It must be noted that all copper ores are not indiscriminately roasted. Only those of them undergo this process that are very sulphurous and that at the same time contain notable quantities of arsenic and anti-

mony. Sometimes, also, certain rich and pure ores are roasted. Such is the case with the Cape ore, which assays by the dry method as high as 35 per cent of metal. This ore contains a good deal of sulphur, and smelting it crude would yield a matte containing a good deal of iron. The smelting mixture is partly made up of calcined ore and partly of raw ore, and thus a greater part of the iron is got rid of at once. One of the works in Wales works this ore almost exclusively, being the property of the mining company, and it proceeds in this manner.

The regulus obtained in ore smelting is also calcined in most of the works. Reference will be made to this subject farther on.

At Cwm Avon, where only ore from the Swansea makers is treated, the ore calcining has been abandoned. The bulk of the ores that we had to work only contained a limited quantity of sulphur. We succeeded, by a suitable mixture of the different kinds, in producing a sufficiently pure and high-grade matte without ore calcining.

In one of the largest Welsh works, the matte is roasted in furnaces similar to the Gerstenhöfer, the sulphurous acid produced being utilized in the manufacture of sulphuric acid. This acid finds a ready sale in the country, in view of the large number of tin-plate works, which use it for pickling.

We shall now proceed to the description of the different processes that lead to the production of marketable copper, either as ingots or as slabs for rolling.

**NEW ELECTRIC RAILROAD COMPANY.**—At a meeting of the American Electric Railroad Company, it was decided to issue an invitation to all reputable holders of patents relating to the subject of electric railroad propulsion to assign the exclusive rights under their several patents for electric railroad purposes to the new company, and to receive from the board of arbitration their proportionate share of the stock according to the value of such patents. Those who do not avail themselves of the offer before December 31st are to be excluded from the advantages of the arrangement.

**COAL LANDS.**—Mr. Dolph recently introduced in the Senate a bill that provides for amending the Revised Statutes relating to the sale of vacant coal lands belonging to the United States, reducing the price one half. The bill was referred to the Committee on Public Lands.

**THE KRIVOI-ROG IRON MINES.**—The famous Krivoi-Rog iron mines in Russia, which were some years ago examined on behalf of Philadelphia capitalists, are now the property of a French company whose annual report has been recently published, covering the period from August 1st, 1882, to July 31st, 1884. During that time, 28,198 tons of ore were mined and 11,472 tons sold to the Donetz furnaces, to which access has been obtained by the Ekaterine Railroad. During the year, an apparent profit of 74,942 francs was made, being, however, chiefly in ore on hand, valued at 123,638 francs. The nominal capital of the concern is 5,000,000 francs, of which 1,713,500 francs have not yet been called in.

**THE QUICKSILVER PRODUCTION OF CALIFORNIA FOR THE FIRST ELEVEN MONTHS OF 1883 AND 1884.**—Mr. James B. Randol, of New Almaden, Cal., has computed the following interesting table on the quicksilver production of California for the first eleven months of 1883 and 1884:

	1883.	1884.	Increase.	990
Guadalupe.....	84	1,074	Decrease.	1,321
Great Eastern.....	1,613	292	"	527
Great Western.....	3,527	3,006	"	1,611
Napa & Etna.....	5,616	4,005	"	646
New Idria.....	1,519	873	"	915
Redington.....	1,760	845	"	1,757
Sulphur Bank.....	2,549	792	"	76
Various.....	83	7	"	5,893
	16,751	10,888	"	8,563
New Almaden.....	26,703	18,140	"	8,563
	43,454	29,028	"	14,426

**ARTIFICIAL AERATION OF WATER.**—Dr. William H. Wahl, Secretary of the Franklin Institute, in his last monthly report, alluded to the experiments that were conducted under the direction of Chief-Engineer Ludlow, of the Water Department of Philadelphia, with the object of purifying the water supply by a system of artificial aeration. These experiments had proved very encouraging, and promised to yield important practical results. The plan employed, which is that suggested by Dr. Albert R. Leeds, differs from others that have been employed for a similar purpose. Laboratory experiments made by Dr. Leeds indicated that the advantageous action of atmospheric air in modifying and, in part, removing the impurities of water in contact with it, was greatly increased by producing the intermingling of the two fluids under pressure. The greater the pressure, the greater is the absorption of oxygen, and consequently the greater the reduction of the impurities. The precise measure of this increase has not yet been ascertained. In order to try the experiment on a larger scale, and in such a manner as to afford some evidence of its value in practical operation, one of the Fairmount turbine-engines (No. 8) was altered so as to convert it, in part, into an air-pump, by simple mechanical artifices unnecessary to describe. The result reached by the action of the pumps thus modified was the delivery of about 20 per cent by volume of free air into the water discharged into the main, this proportion being that that had been shown by experiments of Professor Leeds to be sufficient to surcharge the water. By subsequent comparison of samples of water from the Fairmount pool taken into the pump, and of the water discharged into the Corinthian basin after passing through 3600 feet of main, the results of the experiment were made apparent. The percentage of oxygen in the aerated water was 17 greater than before; that of carbonic acid was 53 greater; and that of the total dissolved gases 16 greater. The percentage of free ammonia was diminished to one fifth of its former amount. The percentage of free oxygen represents the excess over and above what was required to effect the oxidization of the organic impurities. These results are most favorable, and point clearly to the entire feasibility of reducing the percentage of organic matters contained in water unduly contaminated with sewage, within the limits of safety.

## FURNACE, MILL, AND FACTORY.

The plant of the Malleable Iron-Works, at Youngstown, Ohio, will be sold by the receivers on December 31st. The buildings are nearly new, and it is expected that the bidding will be lively, as a number of parties desiring to purchase have already examined the property.

The Gem furnace of the Shenandoah Iron Company is in blast, making over 100 tons daily from native ores from the company's mines.

The rolling-mill of the Dover, New Jersey, Iron Company is working steadily.

The Spaulding Iron-Works, at Brilliant, Ohio, which were closed down for some time, resumed in all departments December 22d.

After an idleness of several months, the steel-works of Hussey, Howe & Co., of Pittsburg, Pa., started up December 22d.

The iron manufacturing firm of Kimberley & Co. is embarrassed and has closed its mills at Newcastle, Greenville, and Sharon, Pa., throwing about 1200 men out of work. The firm will not make an assignment. It is stated that every creditor is secured, and that the men will not lose a cent of their wages. It is thought that work will be resumed in a few weeks.

The mills of Trumbull Iron Company, at Girard, Ohio, are again in operation, and are running on full-time.

Every department of the Youngstown Rolling-Mill Company, Ohio, is run to its full capacity.

The Sharon Iron Company's mill and one blast-furnace have been put in operation.

A supplementary report of the Gun Foundry Board has been transmitted to the Senate. The board thinks that two foundries should be established, one for the army and one for the navy, to cost \$1,000,000 each, and it recommends that steel manufacturers be called on to furnish material. For this purpose, it recommends an appropriation of \$15,000,000, one half for the army and the other half for the navy, to be expended only in payment for steel accepted and delivered. The board says further that, from personal intercourse with prominent steel-makers, it knows that proposals issued on this basis will be responded to, but that it will be necessary to appropriate the entire amount recommended in order to induce responsible steel manufacturers to erect and complete the necessary works. As it will require two years to erect and equip the factories, the appropriations for them should be made as early as practicable. The total estimate of \$17,000,000, in the opinion of the board, will complete the steel-producing plant, establish and equip the steel gun factories, supply the guns for six and a half years, and begin the manufacture of steel in large masses in the United States.

The United States Telephone Manufacturing Company, of New York, and the McDonough Telephone and Telegraph Company, of New Jersey, filed a bill in the United States Circuit Court at Trenton, New Jersey, December 22d, asking for an injunction against the American Bell Telephone Company, of Boston, and the Domestic Telegraph and Telephone Company, of Newark, for an infringement of a patent and for an accounting.

The steel and rail departments of the Cleveland Rolling-Mill, Ohio, one of the largest in the country, shut down December 21st, throwing about 1000 men out of employment. It is also said that the entire mill will be closed before long.

The various departments of the National Tube-Works Company at McKeesport, Pa., closed down December 24th. Scarcity of orders is the reason for the suspension.

The Lidgerwood Manufacturing Company has been awarded the gold medal for superior excellence in hoisting-engines, boilers, and small stationary engines, at the Exhibition of the Massachusetts Charitable Mechanic Association, held at Boston, Mass.

## LABOR AND WAGES.

At Cannelton, West Va., the diggers of cannel coal receive \$1.14, \$1.28, and \$1.42 a ton, and the men working block coal 50 cents a ton. The miners, it is said, average from \$60 to \$70 a month.

The Pittsburg Iron-Works Company, at Verner's Station, Pa., December 22d ordered a reduction of 12½ per cent in the wages of all employed except those governed by the Amalgamated Association scale. The reduction was accepted.

The 1200 coal miners of Coal Creek, El Moro, Walsenberg, and Cameron, Colorado, resumed work December 22d at the old rates.

Eight hundred men along the line of the Schuylkill Canal have been thrown out of work for the winter in consequence of the suspension of navigation.

The wages of the steel-workers in Pennsylvania will be agreed upon on the 1st of January, or as soon after that date as possible.

The latest reports from up the river indicate that the miners' strike in the Pittsburg District is a failure. In the second pool, many of the miners refused to strike; and in the third and fourth pools, it is reported that a majority has signified its intention of returning to work.

## RAILROAD NEWS.

The Delaware & Hudson Canal Company has restored the coal rates at the Sound ports, where there had been a cut of 35 cents a ton, which interfered with the New York & New England coal business at Fishkill-on-the-Hudson.

The State of Alabama has entered a suit against the directors of the Alabama & Chattanooga Railroad Company, which became bankrupt in 1872, for \$3,000,000 damages, alleged to have been sustained by the State through mismanagement. It has been decided that the United States Supreme Court has original jurisdiction in the case.

The \$326,000 which the Philadelphia & Reading owed to W. H. Vanderbilt has been paid.

The litigation that has been dragging on for years between Col. Simon P. Kase and the Danville, Hazleton & Wilkes-Barre Railroad Company was settled December 20th in a brief opinion by Judge Thayer, in the Court of Common Pleas, Philadelphia, Pa., affirming the master's report of George Junkin, who decided that, so far from the railroad company owing Colonel Kase \$500,000, he was indebted to the company in about that amount.

The Denver & New Orleans and the Pacific railroad companies have been incorporated. It is proposed to form a junction with the lines of these two companies. A branch of the Missouri Pacific now extends west as far as Wichita, Kan., and this branch is to be extended through the southern tier of counties of Kansas to the Colorado State line, and at that point will connect with the extension of the Denver & New Orleans Railroad. The latter road is now completed south from Denver to Pueblo, and the company has contracts made to extend its lines south to make connections with the New Orleans line at Trinidad, seventy-five miles south of Pueblo. It is projected to extend a branch eastward to con-

nect with the western branch of the Missouri Pacific. The distance by such a line from the Missouri River to Denver will be only a little greater than by the Santa Fé road. It will open a valuable country. The directors of the new company are John Evans, Cyrus W. Fisher, David H. Moffatt, William Bard, S. H. Elder, J. S. Brown, George Fritch, and Charles B. Kountz, of Denver, and Jay Gould and Russell Sage, of New York. The capital stock is \$3,000,000, divided into 30,000 shares of \$100 each.

The elevated railroad companies of this city have awarded the contract for furnishing coal during the ensuing year to the Lehigh Valley Company at \$3.04 a ton.

## COAL TRADE NOTES.

### ALABAMA.

The directors of the Sheffield Iron and Land Company and the stockholders of the Alabama Improvement Company had a joint meeting December 20th at the new town of Sheffield. All differences were adjusted, and it was unanimously voted to at once begin the building of the Sheffield & Birmingham Railroad, and contracts were awarded to build forty-five miles within the next twelve months to extensive coal tracts, and then extend the line to Birmingham. A blast-furnace will be at once built at Sheffield.

### COLORADO.

It is reported that a vein of coal has been discovered about six miles east of Fort Collins.

### MISSOURI.

M. L. Wolfe, Mine Inspector, of Bates County, in his annual report, states that the number of mines operated during the past year for local and general use approximates 225. Most of them are operated by surface mining, and only for a short time in the year. The Rich Hill mines are the most prominent, and the output of these, as well as of the other mines in the county, is steadily increasing. The miners are paid 3 cents a bushel for all coal passing over the screen; laborers are paid from \$1.50 to \$3 a day; man and team, \$2.75 a day; engineers, \$70 a month; firemen, \$40 a month.

### OHIO.

The Pine Hill mine, at Weathersfield, has shut down. The mines about Mineral Ridge are averaging about half-time. The Leadville shaft has worked but two days this month. The Church Hill mines have shut down.

### NATURAL GAS.

A number of Pittsburg capitalists have leased tracts of lands near Steubenville, and will bore for gas.

### PENNSYLVANIA.

#### ANTHRACITE.

The report of a cave-in near the Lance colliery, at Plymouth, December 17th, the property of the Lehigh & Wilkes-Barre Company, has been denied.

The reports of the Mine Inspectors for November are as follows: Pottsville District—Samuel Gay, Inspector: Accidents, 6. Total number of employes, 6839; average number of days employed, 21; number of tons of coal shipped, 200,661.

Shenandoah District—Robert Mauchline, Inspector: Accidents, 11; killed, 4; injured, 7. Total number of employes, 12,896; average number of days employed, 21; number of tons of coal shipped, 472,234.

Shamokin District—James Ryan, Inspector: Accidents, 18; killed, 5; injured, 13. Total number of employes, 13,361; average number of days employed, 22; number of tons of coal shipped, 404,007.

Another vein of coal has been penetrated at the Pettebone colliery of the Delaware, Lackawanna & Western Coal Company on the flats. The shaft is now down about two hundred feet.

While a party of miners were at work improving the ventilation in the Barnum mine, near Pittston, December 22d, a miner rushed through one of the chambers with a naked lamp, igniting the gas, which caused a terrific explosion, by which one man was killed and two were injured.

#### BITUMINOUS.

A fire occurred December 23d at the Paintertown coal mine, situated one mile north of Irwin's, operated by the Pennsylvania Gas-Coal Company. It is thought that it may be several weeks before work can be resumed.

#### COKE.

The Loyalhanna coal-works, near Latrobe, which have been running at half their capacity for some time, have fired up eighty more ovens.

#### NATURAL GAS.

The Fuel-Gas Company has entered proceedings at Harrisburg against the Philadelphia (Westinghouse) Gas Company. The arguments will be heard on the 29th. The Fuel-Gas Company will endeavor to establish the fact that its charter gave it the prior right to furnish gas for fuel to the people of Pittsburg, and further, to prove that the charter of the Philadelphia Company is not valid. Both companies have been preparing for such a struggle.

On December 23d, the Consolidated Natural Gas Company, Pittsburg, Pa., reduced price of gas to 15 cents a thousand cubic feet.

Natural gas has been playing sad havoc at different places in Western Pennsylvania. Reports of explosions, attended with fatal and serious results, have been received from various quarters.

#### OIL.

The land suit to recover oil property worth \$100,000, with ex-Congressman Watson as plaintiff and Grandin Brothers, of Pittsburg, and the Ballston Oil Company as defendants, has been decided against Watson in the Forest County courts.

A charter has been granted to the Butler County Pipe Line Company, of Butler. The company proposes to lay down, construct, and maintain pipes, tubing, tanks, offices, and such other machinery and devices or arrangements as may be necessary to fully carry out the transportation and shipping of petroleum from the oil-producing territory of Butler County to the boroughs of Butler, and also claim the right to enter upon, take, and occupy such lands and other property as may be requisite for the purpose of the corporation. The capital stock is \$10,000.

### WEST VIRGINIA.

At the recent annual meeting of the stockholders of the Consolidated Coal and Mining Company, Captain John Sheridan was elected president of the company, and John Wilson secretary.

## GENERAL MINING NEWS.

### ALASKA.

Lieutenant Abercrombie, of General Miles's staff, has returned to Portland, Oregon, from Alaska. He explored the Yukon River for twenty-seven hundred miles, and found rich placers for a thousand miles up; but the season is short and mining difficult. He says that the fisheries are excellent.

### ARIZONA.

#### COCHISE COUNTY—TOMBSTONE DISTRICT.

CONTENTION.—The company has a force of men employed, and will have the mine in order by the time the Grand Central starts its pumps, when it will put some 300 miners at work.

GRAND CENTRAL.—The company has contracted with the Union Iron-Works, of San Francisco, for the immediate furnishing of two fourteen-inch Cornish pumps. The pumps will be set in place and every thing in working order by the 1st of April, when the work of draining the lower levels will begin in earnest.

GIRARD.—The dump has been leased, and two Duncan concentrators are erecting to work the tailings.

#### GILA COUNTY.

OLD DOMINION.—Numerous improvements are making that will greatly facilitate and cheapen the handling of the ore. Probably the most important item is the straightening and enlarging of the main tunnel, over 1000 feet in length, and the laying of a track through it, which has just been finished. Near the mouth of the tunnel, a substantial ore-bin, with a capacity of 200 tons, has been erected. This bin is to be connected with the dump by a trestle, work on which will be begun immediately. It is expected that this will be completed by January 1st, and all the ore from the Old Globe mine, which is now raised from the main air-shaft, will then be delivered into the new bins through the tunnel. This change will make a considerable saving of labor and expense in handling the ore. On the Alice claim, controlled by this company, a new shaft is sinking, with the view of better developing that property. It is now proposed to sink a shaft 400 feet ahead of the extremity of the present works, in order to better open the mine.

#### GRAHAM COUNTY.

ARIZONA COPPER COMPANY.—At the recent meeting of the reconstructed company, the chairman, Mr. G. A. Jameson, said: On the last occasion they met, the directors had put before them a state of affairs as the result of very intricate negotiations, which showed that, after every thing was got from every quarter, there was a deficiency of \$35,800 to meet, and the directors had pointed out or indicated, although they did not think it necessary to express, that the only source from which that money could be got was by the shareholders or some other body subscribing for the unissued capital of the Mortgage Company, which was available just to that extent. The directors had remained under that impression, and he had on every occasion when he had had the opportunity so stated it to individual shareholders that it would be essential in that manner to supply the deficiency, but the deficiency, he regretted to say, came to more than \$35,800. By the agreement made in America, the debt to the contractors of the railroad was \$162,000. They found, on coming to settle with the contractors, from no fault on their part, but from actual fact, that the debt due them was \$50,000 more, and the directors had questions as to who was liable for that, which he need not at present discuss. In reality, therefore, they had \$45,800 of a deficiency to deal with. The directors communicated with their representatives in New York, and until Monday last he was under the belief that they had arranged the matter on this footing, that they should pay \$50,000 on Monday, and that the contractors would wait for the remainder, taking it by regular installments out of the produce of the company's business. And they were enabled, he was glad to say, to present such a prospect to these men as to induce one of them to be content to rest on that security along with what he had. That was to say, the company was due them now \$165,000; if they were paid \$50,000, they were ready to take the remainder as the company itself produced the money in extinction of the debt. So the matter remained until Monday last, when the directors received a telegram, which somewhat dismayed them, to the effect that they would not consent to settle with the company on that footing; for one of the partners, who had been absent in the far West, and whose consent had been reserved in the negotiations of which Mr. Blair was a party in New York, refused to assent to what his co-partner had virtually agreed to, and that they now required payment of \$75,000 on the 5th of this month, and the balance virtually within three months. This was a state of matters that had caused the directors much uneasiness. They had had conferences with the directors of the Mortgage Company, and they were not without hope that they would be able to comply with the first part of the stipulation, reserving for the future how they were to deal with the remainder. The fact of the matter was, that from the resources of the company itself they had been enabled to meet no unimportant part of the considerable deficit. This had not been attained, however, by any great profit in the manufacture of copper; under the circumstances, that was impossible. It had to a great extent been derived from the fact that they had been enabled by the working of the mines to turn into gold what was lying as useless copper. They had manufactured a considerable quantity of copper that had been turned out during the earlier months of the company's career, and they had no difficulty whatever in selling it at prices that at any rate paid all the expenses of producing it; and that meant the repaying of the money expended in wages before, and the paying of the cost of transit upon their own railroad, which had been an important contribution to the company. At the beginning of their operations, they had in stock 10,327 tons of various kinds of copper ore, some of it being of very inferior quality. During the period up to November 1st, they smelted 10,962 tons, and they put out 5298 tons. The result was, that they had diminished the stock of copper ore in hand from 10,327 to 4663 tons. In January, 1881, the price of copper was \$70 10s.; it was now about \$51 or \$52, and when he said that, he said enough to prove to them that any profit that they could be making just now directly from the manufacture of copper would bear a very inconsiderable relation, indeed, to the great capital of the company. But they were converting into money what had already been paid for, and they were getting a very considerable return from their railroad, which was now developing.

#### FINAL COUNTY.

OWL'S HEAD.—Machinery to develop the mine is contracting for in the East. VEKOL.—It is stated that some capitalists are at present examining this mine, with the view of purchasing it. The price asked for the property is \$300,000. The present owners have erected a ten-stamp mill, and are shipping selected ore to the smelters at Kansas City.

### CALIFORNIA.

#### MONO COUNTY—BODIE DISTRICT.

BODIE CONSOLIDATED.—During the week ended December 15th, 60 tons of ore were worked at the mill; the average assay value of the pulp was \$30.60 per ton. Twelve per cent is lost in the tailings. The mill was shut down and cleaned up on the 18th instant.

STANDARD CONSOLIDATED.—The company has closed down the Standard-Bu 1 wer mill engaged upon working the company's ore and tailings.

#### SAN BERNARDINO COUNTY.

BARBER.—The mill will soon be ready for operations. TAGGART.—The mine has been bonded with a working lease.

## SAN DIEGO COUNTY.

**STONEWALL.**—The mine has been sold for \$7500. Pumping machinery is erecting to pump out the mine. A ten-stamp mill will also be built.

**HUBBARD.**—The mill is running on ore sorted out of the waste-dump, and pays from \$10 to \$12 a ton.

## SIERRA COUNTY.

The Cleveland & Sierra Hydraulic Mining Company, and the Sierra & Union Water Company, whose claims embrace a large area of valuable placer mining ground in the vicinity of Scales Diggings, have consolidated. It is the intention of the company to start a tunnel very soon at the lower end of the Cleveland mine, and run it along the channel, working the ground by the drifting process. The gravel lead embraced in the consolidated ground is three miles in length, and if it proves profitable as drifting ground, the whole distance will eventually be tunneled and drifted. Underground haulage by cable is to be introduced. The water-power used for this purpose will also be used in washing the gravel. The Cleveland mine has heretofore been worked by the hydraulic process.

## COLORADO.

A State Silver Convention is to be held in Denver on January 28th.

## CHAFFEE COUNTY.

**SEDALIA.**—Some fine carbonate of copper and copper glance ores are produced. The question of the erection of a smelter to handle the bodies of copper ore is discussed.

## CLEAR CREEK COUNTY.

**ATLANTIC-PACIFIC.**—It is currently reported that this tunnel will be started up again, on or about the first of the year. It will be diminished in size, from 18 feet by 10 feet to 7 feet by 5 feet, and will probably be run a farther distance of 1000 feet. The tunnel has already attained a distance of 1600 feet.

**PAY ROCK.**—The mill has shut down for the season. Operations at the mine continue.

**BAKER.**—The mine has been leased for two years, and will be worked extensively.

## CUSTER COUNTY.

**BASSICK.**—The addition of works, new machinery, and other improvements of a necessary character, has caused the expenditure of a large surplus over and above the amount required to run the mine. Hence the accounts of the employes have not been settled promptly.

**BULL-DOMINGO.**—The mine is at present in the hands of the constable, by reason of attachments, and is not doing much; but as soon as the debts have been liquidated, it will start out at its full capacity. This property, says the *Silver Cliff Tribune*, has been subjected to great mismanagement on the part of the Eastern managers. When the fact becomes understood that it requires money to develop a mine, those who have been endeavoring to run this property without it, at the expense of the miners, will have begun to learn something about mining. The great value of the Bull-Domingo property is unquestioned, but in order to put it in a position to pay its way, will require not less than \$20,000, and the sooner the Eastern managers understand this the better it will be, not only for the property, but for the stockholders.

## DOLORES COUNTY.

The miners of Rico are forming a company to cut the Puzzle and a number of other veins that are known to exist in Expectation Mountain, from a certain point on Horse Gulch, by driving a tunnel toward Iron Gulch. The length of this tunnel will be 3000 feet, and it is to be completed in three years.

**PASADENA.**—Owing to scarcity of fuel, the Pasadena water-jacket furnace was forced to blow out December 14th. As soon as a sufficient supply of coke and coal can be had to keep it in constant operation, the furnace will again be blown in, which will be about the first of January. In the mean while, ore is daily received and sampled at these works.

## ELBERT COUNTY.

Considerable work has been done on the placers west of Elizabeth during the year.

## GILPIN COUNTY.

**STANTON & BRAINARD SMELTING COMPANY.**—Articles of incorporation have been filed by this company. The main office is to be located in the town or city of Black Hawk, with branch offices and works in Arapahoe, Clear Creek, Lake, Pueblo, and San Juan counties, when the company so directs. The number of shares of the capital stock are to be twenty-five—one thousand dollars a share—fully paid up and non-assessable. The company is to exist for twenty years.

## GUNNISON COUNTY.

**LONE ELM.**—This smelter at Gunnison has blown out for want of lead ore. Refining-works are to be added next season.

## LAKE COUNTY.

**ADAMS.**—Mr. Samuel Adams has succeeded Mr. Finnerty as general manager. **MORNING AND EVENING STAR.**—The lessees of the Adams shaft on the Forsaken, of this property, have encountered some very fine ore, and will begin shipments soon.

## LA PLATA COUNTY.

**BARCONTO.**—The new tunnel of this group, which has been started on the vein 280 feet farther down the hill, is just coming into solid formation, and will catch the same ore-body shown in the upper workings in a much more accessible place. It is reported that an English company is negotiating for an interest in this group.

**SANDS-PELTON.**—This tunnel is now in 500 feet, in a large body of iron pyrites, supposed to be the lode for which it has been driven.

## LARIMER COUNTY.

The discovery of mica at Fort Collins has caused great excitement in that neighborhood.

## OURAY COUNTY.

**BIG SAN JUAN.**—The company's property on Yellow Mountain has been leased and the stamp-mill and sampling-works at Ophir have been sold.

## PITKIN COUNTY.

William Pemberthy, a mechanical engineer, of Leadville, will probably erect machine-shops and iron-works in Aspen.

A rumor states that the American Smelting Company, of Leadville, will erect a smelter in Aspen in the spring.

**ASPEN VS. EMMA.**—Suit will be commenced by the lessees of the Aspen against the Emma mine to recover \$20,000 worth of ore.

## SAN JUAN COUNTY.

**LAKE MOUNTAIN.**—This mining, milling, and smelting company's mill at Mineral Point is in running order. Operations will probably not begin before May 1st.

**SILVER PEAK.**—Work will probably be resumed on the Bonanza tunnel, the property of this company. The tunnel was started for the development of a group of twenty-two properties. Some three years ago, legal complications arose, and work was suspended. Since then, nothing has been done, but the superintendent has been called to New York.

## SUMMIT COUNTY.

The machinery has all been removed from the Groer smelter, at Kokomo, to Leadville. Negotiations are in progress toward converting the Vulcan smelter into chlorination-works.

## DAKOTA.

## LAWRENCE COUNTY.

**FATHER DE SMET.**—Reports dated December 4th: Inclosed find express company's receipt for bar No. 197, containing 1280'60 ounces of gold, the result of clean-up of the mill for final run in November, making a total of 2385'20 ounces for the month's yield. The mine presents no new features this week, and while our ore is perhaps running a little lighter than it has, the outlook is practically unchanged. The different ore-bodies in and around the open cuts are holding out well, and are yet very extensive. The same may be said also of underground chambers on the second and third levels. There is nothing of any importance to note in the way of change in either of the cross-cuts on these levels. Every thing is running well and in full blast. The report for the week ended December 15th shows ore extracted from first, second, and third levels, 2100 tons. Ore milled, 2100 tons. West cross-cut, third level, advanced 7 feet. Total length, 18 feet.

## GEORGIA.

## LUMPKIN COUNTY.

There is plenty of water in the ditches for all mining purposes, and work has been resumed at the Columbia, Ivey, Fish Trap, Garnet, Chestatee, and other mines. The scarcity of water caused a suspension of work for two or three months.

## IDAHO.

**IDAHOAN.**—The first payment of \$150,000, due from the English parties who hold a bond on the property, was due at McCormack & Co.'s, Salt Lake City, December 15th. The *Herald* says that not much faith is entertained that it will be paid.

## MEXICO.

The following items are taken from the *Mexican Financier*: Angel Guerrero is about to erect three smelting-furnaces at a spot near the Magdalena Mountains, about eighty miles south of El Paso on the Mexican Central Railroad. The blower and fixtures ordered are of American manufacture.

The success of the Montezuma mining camp, near the Mexican Central station of the same name, continues. The latest strike has added one more to the number of mines already known and in process of development there. The Dunlap mine still appears to be rich, and the Webb mine has received flattering returns from the smelter in Socorro, New Mexico. The ore is testing at the Chihuahua furnaces.

The Real del Monte Mining Company has taken possession of the San Juan and San Patricio mines, situated in the town of San Juan; also the water of the stream that crosses the mining properties of Santa Clara and San Guillermo and that of the pond of Todos Santos and the arroyo of La Blanca, in the same town.

The new machinery that was ordered some time ago by the Real del Monte Company has arrived at Vera Cruz, and will be brought up immediately to the mine at Pachuca.

The Alta Gracia mine, at Pachuca, is still sinking its shaft, and will continue until the end of this year, with a good prospect of striking more ore before that time. On the 1st of January, they will begin taking out the ore struck about six weeks ago and averaging 18 marks per monton.

## MICHIGAN.

## COPPER MINES.

**NONESUCH.**—Work on the silver vein in this copper mine has been temporarily suspended. It is claimed that enough has been done to show that the vein will pay for working.

**RIDGE.**—A force of miners has gone to work on the tribute in this mine. They will confine their operations to the upper levels.

## GOLD MINES.

**MARQUETTE.**—This company has been organized, and it is the intention to develop the tract covered by the J. W. Spear option, adjoining the Smith Moore prospect, within the corporate limits of Marquette City.

**ROPES.**—A contract has been let to sink the shaft another 60 feet, and work on it has already begun. This additional 60 feet added to the workings, a third level will be started.

## IRON MINES.

The Marquette, Houghton & Ontonagon Railroad carried from January 1st to December 1st, 1884, 764,459 tons of ore and 5407 tons of pig-iron.

**LAKE ANGELINE.**—The new plant of machinery for this mine, manufactured by the Iron Bay foundry, of Marquette, is in place and working smoothly.

**MICHIGAN LAND AND IRON COMPANY.**—Over forty applications for options on lands owned by this company, and which are presumed to be rich in gold and silver-bearing rock, have been filed with the company during the past few days.

## MONTANA.

## MEAGHER COUNTY.

**MAIDEN.**—The new mill has started up.

## SILVER BOW COUNTY.

**LUELLA.**—The company has received a car-load of machinery for the new hoisting-works that are building at this mine, four miles northeast of Melrose.

## NEVADA.

## EUREKA COUNTY.

**RICHMOND CONSOLIDATED.**—The new furnace at these works for smelting speiss has started up and works satisfactorily.

## STOREY COUNTY—COMSTOCK LODGE.

According to the *Virginia City Chronicle*, the work of stripping the levels below the 2700 has begun. The removal to the 3100 has been effected. The hoisting of pumps, air-pipes, car-tracks, and other material from the 3100 to the 2900 has begun. It will be ten or twelve days before the entire material is transferred and the complete abandonment of the lower levels accomplished—leaving the water in undisputed possession below the 2700 level. The ground at and above that point will be thoroughly explored as soon as the retreat has been effected.

Work has been suspended on the 250 level of the Hale & Norcross, owing to low-grade ore recently encountered in the E-street tunnel winze.

Work at the Keyes mine is vigorously prosecuted. Three shifts are employed in sinking the shaft, which is sent down to the 300 level as rapidly as possible. The formation in the bottom of the shaft is becoming much softer.

At the Alta mine, work has begun on the upper levels. No attempt will be made to drain the water from the lower levels at present, as there is a strong and growing doubt, according to San Francisco exchanges, as to the ability of the management to collect the assessment recently levied.

## WASHOE COUNTY.

**PYRAMID LAKE.**—The company has ordered a water-jacket furnace to be built. Work will be continued through the winter.

**FINANCIAL.**

New York, Friday Evening, Dec. 26.

In consequence of the preparations for the past and coming festivities for the holidays, business at the Mining Exchange has been almost entirely neglected. The market has been devoid of interesting features, the transactions have been small, and prices have remained about the same.

As in the past weeks, Horn-Silver again shows the largest business; the sales have amounted to 11,779 shares; the price continues its downward course, and closed at \$3.40.

The price of Plymouth Consolidated has been higher, at from \$15.75@16.25, and the sales amount to 1650 shares. The stock at present seem to be one of the most preferred on the list of high-priced stocks. Standard Consolidated's price has been higher at from 60@52c., with sales amounting to 2600 shares. Consolidated Pacific's price also shows an upward tendency at from \$1@1.15; 1650 shares changed hands. Bodie Consolidated records but a small business at from \$2@2.05. The Colorado stocks show the usual business, and sales of Amie, Breece, Chrysolite, and Little Chief are recorded.

The Comstock shares show nothing of special interest. A small business was done in all the stocks excepting Consolidated California & Virginia and Sutro Tunnel. The former's price ranged from 35@36c., with sales of 6500 shares, and the latter's from 10@11c., and sales of 2900 shares. One thousand eight hundred shares of Albion changed hands at from 12@13c.

Silver King, Central Arizona, Homestake, and Caledonia show occasional transactions. The sales this week have amounted to 38,264 shares, as against 44,100 shares for the preceding week, showing a decrease of sales of 5836 shares. A complete summary of the market will be found elsewhere.

**MEETINGS.**

The annual meetings of the following companies for the election of trustees and the transaction of business will be held at the times mentioned:

Bonaparte Hill Gold and Silver Mining Company, office of Eugene Du Bois, No. 23 Park Row, New York City, January 7th, from twelve M. to four o'clock P.M.  
Cambria Iron Company, No. 218 South Fourth street, Philadelphia, Pa., January 20th, at four o'clock P.M.

Grand Central Mining Company, Youngstown, Ohio, January 20th.

Old Dominion Copper Company, of Arizona, No. 83 Maiden Lane, New York City, January 22d, from twelve M. to one o'clock P.M.

Promontory Consolidated Mining Company, No. 35 Broadway, New York City, January 13th.

Republic Iron Company, No. 1 Atwater Building, Cleveland, Ohio, January 21st, at ten o'clock A.M.

Sterling Iron Company, No. 6 Perkins Building, Cleveland, Ohio, January 19th, at ten o'clock A.M.

Valencia Mica Company, Room 113, No. 115 Broadway, New York City, January 6th, at twelve o'clock M.

**DIVIDENDS.**

Boston & Colorado Smelting Company, of Colorado, has declared a dividend of 2½ per cent, payable January 1st.

Calumet & Hecla Mining Company, of Michigan, has declared a dividend of \$5 a share, payable February 1st. Notice is given that in future dividends will be paid as the financial results of the company may warrant.

Contention Consolidated Mining Company, of Arizona, has declared an extra dividend (No. 187) of twenty-five cents a share, payable December 15th.

Lexington Mining Company, of Montana, has declared a dividend of ten francs a share, payable January 1st, at Crédit Mobilier 15, Place Vendôme, Paris, France.

New Pittsburg Mining Company, of Colorado, will pay coupon No. 3, due July, 1882, of the bonds of this company, on and after December 24th.

Valencia Mica Company, of New Hampshire, has declared the regular quarterly dividend of two dollars and a half a share, for January 15th, and an extra dividend of the same amount for December 25th. The combined dividend of five dollars a share will be payable December 30th.

**PIPE LINE CERTIFICATES.**

The following table gives the quotations and sales at the New York Mining Stock and National Petroleum Exchange:

	Opening.	Highest.	Lowest.	Closing.	Sales.
Dec. 20	\$0.77½	\$0.77½	\$0.75½	\$0.75½	4,551,000
22	.76½	.76½	.74½	.74½	4,636,000
23	.74½	.75½	.74½	.75½	2,981,000
24	.75½	.76½	.74½	.75	1,804,000
25	.75	.75	.73½	.73½	2,140,000
26	.75	.75	.73½	.73½	2,140,000
Total sales					16,112,000

**SAN FRANCISCO MINING STOCK QUOTATIONS.**

Daily Range of Prices for the Week.

NAME OF COMPANY.	CLOSING QUOTATIONS.					
	Dec. 19.	Dec. 20.	Dec. 22.	Dec. 23.	Dec. 24.	Dec. 25.
Albion						
Alpha						
Alta	.15			.20	.15	
Argenta						
Bechtel						
Belcher	.60				.60	
Belle Isle						
Best & Belcher	.75	.80		1.37½	1.50	
Bodie	2.00	2.00			1.87½	
Bullion						
Bulwer						
Chollar	2.50	2.50		2.62½	2.62½	
Con. Pacific	1.12½	1.12½		1.12½		
Con. Cal & Va.	.35			.40		
Crown Point	.75	.75		.80		
Day						
Elko Cons.						
Eureka Cons.				1.62½	1.62½	
Exchequer						
Gould & Curry	1.12½	1.12½		1.25	1.25	
Grand Prize						
Hale & Norcross	3.00	3.12½		3.87½	4.00	
Independence						
Martin White						
Mexican	.70	.70		.75	.75	
Mono						
Mount Diablo						
Navajo	2.00	2.00		1.87½	2.00	
Northern Belle						
North Belle Isle						
Ophir	.70	.65		.65	.70	
Overman						
Fotosi	.85	.85		1.00	.85	
Savage	1.25	1.25		1.62½	1.75	
Scorpion						
Sierra Nevada	.75	.75		.75	.80	
Silver King						
Tip-Top						
Union Cons.	.65	.65		.75		
Utah		.45		.40	.30	
Wales Cons.						
Yellow Jacket	1.00			1.12½	1.00	

**Boston Copper and Silver Stocks.**

[From our Special Correspondent.]

BOSTON, Dec. 24.

The feature of the copper stock market is the advance in Calumet & Hecla of \$3 a share, to \$145, in the face of a decline in ingot copper to 11c. a pound. There seems to have been a number of orders in the market the past week to buy the stock, and it has been bid up evidently for the purpose of sustaining the price, when all the conditions point to much lower figures. The instructions given by Judge Baxter to the Receiver of the Ohio Central Railroad in the matter of abiding by the terms of a pooling agreement is of interest to the parties to the Lake copper pool, whose regulations have been disregarded by the Quincy Company, and which regulations the Calumet & Hecla seeks to enforce. Quincy continues to decline, with but little stock sold. Sales to-day at \$26½ show the lowest price of the year. The stock is freely offered at \$27, and, if there should be any pressure to sell, it would doubtless go to \$20 without much effort. Franklin declined to \$6, on a sale of 50 shares only, and is offered at \$6½, without any bidders. Osceola declined on a small lot from \$9 to \$8. There is nothing doing in the rest of the list, and the market, with the exception of Calumet & Hecla, closes weak.

In silver stocks, Catalpa sold at 25c. Bowman Silver is a shade better at 11@12c. Dunkin is dull at 18@20c. Consolidated Pacific sold at \$1.15, but is a shade off to-day, with sales at \$1.05.

3 P.M.—The market was treated to another surprise this afternoon; this time, that the Calumet & Hecla Company had declared a dividend of \$5 a share, which accounts for the firmness of the stock the past week, resulting in an advance from \$145@150½@150; sales at both figures being made this afternoon, closing \$147 bid, \$150 asked. Quincy was heavy, and offered at \$26 with \$25½ as the best bid. Atlantic \$5 bid, \$6 asked. Osceola, offered at \$8½—no bid. Franklin, unchanged.

**BULLION MARKET.**

New York, Friday Evening, Dec. 26.

DATE.	London.	N. Y.	DATE.	London.	N. Y.
	Pence.	Cents.		Pence.	Cents.
Dec. 20	49 9-16	107½	Dec. 24	48½	107½
22	49 9-16	107½	25	Holiday	Holiday
23	49 9-16	107½	26	Holiday	107½

**BULLION PRODUCTION FOR 1884.**

MINES.	States.	Month of November.	Year from Jan. 1st, 1884.
*Alice, g. s.	Mont.	\$ 93,410	\$ 1,136,116
*Belmont.	Mont.	10,767	57,572
*Black Bear, g.	Cal.		19,600
Bodie, g.	Cal.	84,038	493,822
*Bonanza King, g.	Cal.		191,881
*Boston & Montana, g.	Mont.	28,643	391,132
*Caledonia, g.	Dak.		73,511
*Chrysolite, s. l.	Colo.	5,973	137,514
*Consolidated Bobtail, g.	Colo.		79,030
*Contention, s. g.	Ariz.		293,607
*Deadwood-Terra, g.	Dak.		423,918
*Derbec Blue Gravel, g. s.	Colo.	12,335	144,659
*Father de Smet, g.	Dak.	39,389	431,308
*Grand Prize, s.	Neu.	37,101	111,776
*Head Center Cons.	Ariz.		1,273
*Head Center & Tranquillity.	Ariz.	3,587	23,916
*Hecla Cons., g. s. L. C.	Mont.		972,952
*Helena, g. s. L. C.	Mont.		941,036
*Homestake, g.	Dak.		1,059,754
*Hope, s.	Mont.		70,472
Horn-Silver, s. L.	Utah.	228,000	2,371,087
*Iron Silver, s. L.	Colo.		606,472
*Kentuck, g. s.	Neu.	438	22,849
*Lexington, g. s.	Mont.	59,923	1,058,032
*Little Pittsburg, s. L.	Colo.	1,997	79,091
*Mammoth Bar, g.		2,908	4,799
*Moulton, g. s.	Mont.	56,491	733,095
*Mount Diablo, s.	Neu.		24,820
*Murchie, g. s.	Cal.		19,000
*Navajo, g. s.	Neu.	56,792	439,381
*New Pittsburg, s.	Colo.		51,224
*North Belle Isle, s.	Neu.		5,874
*Ontario, s. L.	Utah.	191,857	2,008,000
*Original, s. c.	Mont.		29,724
*Oxford, g.	N. S.	2,050	35,142
*Paradise Valley, s. g.	Neu.		103,850
*Plymouth Consolidated, g.	Cal.	86,818	945,828
*Rooks, g.	Cal.	6,778	55,434
*South Yuba, g.	Vt.		22,708
*Stormont, s. L.	Utah.	13,134	148,637
*Syndicate, g. s.	Cal.	10,006	111,276
*Tombstone, s. L.	Ariz.	66,661	517,433
United Gregory, g.	Colo.		7,174

Total amount of shipments to date.....\$16,423,289

\* Official. † Assay value. ‡ Not including value of lead and copper; G., gold; S., silver; L., lead; C., copper. — No bullion produced. Silver valued by the different companies from \$1.05@1.29-29 per ounce; gold, \$20.67.

**METALS.**

New York, Friday Evening, Dec. 26.

**Copper.**—The event of the week has been the closing of a contract by the Lake companies with consumers for at least five months, and probably a larger supply of Lake copper. The quantity is presumably at the rate of from two to two and a half millions of pounds per month. The most interesting feature in connection with this contract is, that it is based on average prices of Chili Bars in London, the average of the quotations of the 10th to the 25th of the preceding month to determine the price which consumers are to pay. The price is not to be less than 10½c. when Chili Bars have averaged £48 or under, is to advance one tenth of one cent for every ten shillings increased average, until £53 or over is reached, when the maximum price is to be 11½c. The buyers are the usual coterie of privileged large consumers and dealers, the smaller fry and the unfaithful being left out in the cold to shift for themselves. We understand that the sale is coupled with the same conditions exacted once before during this year, that the buyers shall not purchase any other copper. It is a somewhat difficult matter to understand why the companies insist upon attaching Lake copper to the Chili Bar kite. It may be urged that it assures to consumers here that they will not be called upon to pay more for their copper than their foreign competitors to whom the same raw material is sold, and that, since the foreign sales are based on Chili Bars, the home sales should fluctuate with them. On the other hand, Chili Bars is notoriously the speculative brand of copper. The supply is not so large that it can not be manipulated with comparative ease. It is subject to some conditions that have little to do with the copper market in this country, or even with the market for recognized brands abroad. To fix the price on such a basis is, to

say the least, unfortunate. It robs Lake copper of one of its distinctive advantages, its standing as the very best raw material which can be obtained anywhere. In many respects, Lake copper does not seek the same market, and advantages are abandoned abroad that might have well been worth holding on to.

Our market here is of course regulated to a large extent by the markets of the world; but it is not surely so abjectly dependent upon it that we must go to the speculative element in the trade in London to fix our prices. It is of course clear that the Lake companies have made the arrangement in order to guard against the reimport of their own copper previously exported. Their clause forbidding the purchase of other brands is a direct blow at the outside producers, whom they aim to drive out of the home market, and they have a pretty good grip on those consumers who are in the pool, because they could at any time exclude them as a penalty from their supplies of a material that they must have for certain purposes. We question the wisdom of the policy, however, of forcing a manufacturer to use a high-grade raw material, when ordinary copper would suffice.

The effect of this new lowering of price will undoubtedly be first to close down all of the small Lake Superior mines, as soon as their present stock of supplies, which must be paid for, are exhausted. Some of the Western mines will do well to follow suit. Their mines are not deep, their plant is not likely to suffer from a little rest, their force is small and is readily collected when wanted, and the future may bring them advantages in the way of lower wages, which are inevitable throughout the whole West. They can afford, many of them, to wait quietly for better times, and if the tide does turn, they can take advantage of it at short notice.

If the Lake companies, or practically the Calumet & Hecla, are content to wage war, let them fight their battles. What position the Quincy will assume, remains of course to be seen. Judge Lawrence has not as yet rendered any decision in the case before him. If the Quincy is free, it will find probably little difficulty in getting good figures from the smaller consumers.

The market is nominally 11c. for Lake, with none on the market.

Chili Bars are cabled to-day £47 15s., and Best Selected, £54.

Lead.—Absolutely nothing has been done during the week. We quote nominally 3'60@3'62½c.

From St. Louis, Messrs. John Wahl & Co. telegraph to us as follows to-day:

Our market does not reveal any activity, but on the other hand shows no sign of weakness, holders having quite frequent inquiries for small lots and maintaining prices fairly well. Stocks in the hands of holders are only limited. Sales for the week sum up to 200 tons of Corroding lead at 3'40c., and 100 tons of Chemical lead at the same figure.

From Chicago, Messrs. Everett & Post send us the following dispatch:

Our market is firm at 3'45c. There is not much doing.

Tin.—We quote here 16'40@16'50c. for Straits spot, while England cables £74 17s. 6d.

Spelter.—The low offerings from the West continue.

Antimony.—There has been no change.

## IRON MARKET REVIEW.

New York, Friday Evening, Dec. 26.

According to the Board of Trade returns, the exports from Great Britain to the United States for the first eleven months of 1884 were as follows:

	1884.	1883.	1882.
Iron—Pig.....	Tons. 151,154	Tons. 269,395	Tons. 458,137
Bar, angle, bolt, and rod...	4,171	8,328	20,375
Railroad, of all sorts.....	17,829	69,269	191,056
Hoops, sheets, and plates..	19,867	28,115	36,011
Cast or wrought, and all other manufactures un- enumerated.....	2,440	4,692	6,347
Old, for remanufacture.....	24,812	42,005	83,877
Tin plates.....	195,973	201,790	199,526

American Pig.—The week has been a comparatively quiet one, with no features of special interest.

As yet, the figures between standard and outside brands have not been generally adjusted.

We quote \$18@18.50 for No. 1 Foundry; \$17@17.50 for No. 2; and \$16@17 for Gray Forge, standard brands, tide-water delivery. Bessemer pig is dull, with Foreign nominally quoted \$19, while bids do not go higher than \$18.50. There has been no business in Spiegeleisen, which we quote \$30 for 30 per cent, \$26 for 20 per cent, and \$22 for 10 to 12 per cent.

Scotch Pig.—Some of the iron coming in is going into store. We quote ex ship and to arrive: Coltness, \$21.50; Langloan, \$21.50; Gartsherrie, \$21; Summerlee, \$20.50@20.75; Eglinton, \$19@19.25; and Glengarnock, \$19.50.

At the Metal Exchange, the following cables were received to-day: Coltness, 56s. 6d.; Langloan, 57s.; Summerlee, 53s.; Gartsherrie, 52s. 3d.; Glengarnock, 49s.; Dalmellington, 48s.; and Eglinton, 43s. 6d. Warrants were cabled 42s. 7d. to-day.

Steel Rails.—There have been some small sales. We quote \$28 at mill.

Old Rails.—These are dull at \$18.50@17.

Philadelphia. Dec. 25.

[From our Special Correspondent.]

Pig-Iron.—The furnace-owners are not pleased with the course of the market in crude iron. The drop to virtually cost limit has not brought the amount of business into the market that was expected. Buyers in some instances have made liberal purchases. Special irons have been snapped up at good prices; but for the general run of anthracite irons, especially for mill purposes, the demand is irregular and disappointing. Considerable Foundry has been purchased for forward delivery at \$18.50@18, but Forge is weak at \$15@16 for standard brands, and \$14@14.50 for Pipe iron. There seems to be a feeling that we have not yet reached bottom prices.

Foreign Irons.—More inquiry prevails for Bessemer, and for best qualities good prices are named for large lots.

Blooms.—A lot of Anthracite were contracted for at \$41.50.

Merchant Bars.—The general situation is bad. Prospects are no brighter. Manufacturers comfort themselves by saying this extreme dullness can not last much longer. Capacity is very low. Buyers are not about. Prices are steady because there is no room for a further drop. The President of the Amalgamated Association has visited several iron centers in the eastern end of the State, to effect an understanding that will lead to more harmony in the future between the puddlers in the eastern and western ends of the State. Store lots are selling at 1'80c.

Nails.—The quotations on nails are \$2 for ordinary lots and \$2.10@2.15 for Steel nails, though better terms can be made. The factories have shut down this week, and some of them will not start up until January 5th.

Sheet-Iron.—A moderate movement is in progress at nominal card rates.

Wrought Pipe.—No new orders are reported, and business is at a stand-still.

Plate and Tank.—Mills are short of business, and figuring has been very close on what little business has been secured.

Standard Shapes.—The promise of business for next month is made. Nominal quotations are 2@2'10c. for Angles; Tees, 2'75c.; Beams and Channels, 3'25@3'50c.

Steel Rails.—No large sales have been made, and, apart from some small business for the trunk lines, there is nothing of special importance. Quotations are \$28@29 for standard sections. Light sections, \$32@33. One or two large mills may possibly come to single turn.

Old Rails.—Small lots have been in demand at \$17.50.

Scrap.—The yards are overstocked with all kinds, and some low prices have been named to induce buyers to carry some of it away.

## COAL TRADE REVIEW.

New York, Friday Evening, Dec. 26.

### Anthracite.

Although the trade has been quiet during the week, the prospect of a patching up of some arrangement between the companies has had a salutary effect. The meetings held thus far are reported to show a favorable progress to the arrangement of an allotment

plan, but they have developed one danger that may lead to a complete rupture. The Lackawanna, Pennsylvania Coal, and Reading, but particularly the first, are known to insist that they will not enter into any agreement of which the Pennsylvania Railroad is not a party, and it remains to be seen whether the latter can be satisfied without arousing the antagonism of all the others.

The closing of the elevated railroad contract with the Lehigh Valley Company at \$3.04 practically settles the fact that the larger sizes, and naturally also the pea and chestnut, will unquestionably range lower in price during the coming year, and it would only be natural for the domestic sizes to participate in the downward tendency to some extent. The anxiety of the Lehigh Valley Company to secure the contract mentioned will be better understood when it is stated that it has now in stock about 200,000 tons of coal, of which about 80,000 tons is broken coal.

### Bituminous.

The Pacific Mail Steamship Company has closed a contract for \$3, alongside, taking Elk Garden coal. Bituminous coal continues weak.

Philadelphia. Dec. 25.

[From our Special Correspondent.]

The week has been a quiet one in coal trade circles, and in the regions. The season is over. Stocks at Port Richmond are 171,000 tons, largely broken and pea sizes. But few vessels are loading. Inquiries are not numerous. Some sales have been made; but as a rule, buyers have temporarily withdrawn from the market. Heavy sales are quietly predicted for January. Stocks in New England and Western markets are known to be away below the average. The coal trade of 1885 depends altogether on events to happen hereafter. Industrial requirements may be large or small, and this determines practically every thing. Present prospects point to an improvement in general demand. Textile manufacturers here and throughout New England, iron-makers, furnace companies, machinery makers, railroad companies, all give evidence that their requirements will be of considerable dimensions. The Coal Committee is working slowly through its difficult task of reorganizing the coal trade, for it is substantially this. No statements have been made on authority, except that the allotment plan is assured, and the percentages as announced will be those finally recommended and adopted. The fundamental difficulties surrounding the trade have been fully commented on, and are not insurmountable. The iron men are interested and look for cheaper coals. The companies themselves are credited with entertaining a friendly disposition to such concessions as facts and conditions may warrant. There is the question of Southern iron, Western iron, and of bituminous coal. The bituminous operators feel that they have a chance to increase their sales; for it is admitted that a ton of bituminous will raise more steam than a ton of anthracite. A great revolution has been going on in the minds of Eastern consumers, and it will show itself during the next sixty days in the closing of large contracts for bituminous, unless in the mean time the anthracite managers shall have reduced prices. This they will do. They can not afford to break up the larger sizes, and will not do it; for that unduly increases the smaller sizes, which will come in competition with anthracite for steam purposes. Next year's bituminous prices will in all probability decline from \$2.50@2.60 alongside to \$2.25@2.35, and this of necessity calls for some decline in competing sizes in anthracite. The necessity for greater economy will drive many to take bituminous even at a trifle in cost less. The announcement was made in a local daily that the Pacific Mail had contracted for 1,500,000 tons Cumberland coal at \$3 a ton. The Pacific Mail has three vessels, and as the contract is for six months' requirements only, the vessels must have a rapacious capacity for coal. The quantity is, perhaps, 20,000 tons, and the coal bought is the Elk Garden coal. The heavy anthracite contracts will be made in about thirty days, and by that time every thing will be settled. The basis will be thirty million tons. Each company will mine to suit its convenience. The Pennsylvania will join in with mental reservations. The Reading will try it another year. Outsiders endeavor to argue that the bands that weld the anthracite interests together are not so strong as heretofore,

NEW YORK MINING STOCKS.

DIVIDEND-PAYING MINES.

NON-DIVIDEND-PAYING MINES.

NAME AND LOCATION OF COMPANY.	HIGHEST AND LOWEST PRICES PER SHARE AT WHICH SALES WERE MADE.												SALES.	NAME AND LOCATION OF COMPANY.	HIGHEST AND LOWEST PRICES PER SHARE AT WHICH SALES WERE MADE.												SALES.																					
	Dec. 20.		Dec. 22.		Dec. 23.		Dec. 24.		Dec. 25.		Dec. 26.				Dec. 20.		Dec. 22.		Dec. 23.		Dec. 24.		Dec. 25.		Dec. 26.																							
	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.			H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.																						
Alice, Mon.																									Albin																							
Amie Con. Co.	.03																								American Flag			.12																				
Argenta																								Barcelona, G.																								
Bassick, Co.																								Belvidere																								
Belle Isle, Ne.	.10																							Big Pittsburg, S. T.																								
Bodie Cons. Co.		.10																						Bradshaw, S.																								
Breece, Co.	.15	.15	.15																					Brul-Domingo, S. L.																								
Bulwer, Ca.																								Cal., B. H., G.	1.00																							
California, Ne.																								Central Am. M. S.																								
Cal. & Hecla, Mich.																								Climax Co.																								
Castle Creek																								Colorado Central																								
Chollar																								Cons. Imperial																								
Caryolite, Co.					.80				.85															Con. Pacific	1.10																							
Cons. Cal. & Va.																							Decatur																									
Cons. Va., Ne.																							Durango, G.																									
Dunkin, Co.																								Eastern Oregon																								
Eureka Cons., Ne.																								Goodshaw, G.																								
Father de Smet, Dk.																								Harlem M. & M. Co.																								
Findley, Ga.																								Hortense, S.																								
Gold Stripe, Ca.																								Lacrosse, G.																								
Gould & Curry, Ne.																								Mariposa Prof., G.																								
Grand Frize, Ne.																								Com. G.																								
Green Mountain, Ca.																								Mexican, G. S.																								
Hale & Norcross, Ne.																								Mono																								
Hall-Anderson, N. S.																								North Standard, G.																								
Homestake, Dk.																								N. Horn-Silver, S. T.																								
Horn-Silver, Ut.	4.25	4.05	4.10	3.95	4.05	3.90	3.95	3.90															Orin's & Miller, S.																									
Independence, Ne.																								Rappahannock, G.																								
Iron Silver, Co.																								Red Elephant, S.																								
Leadville C. Co.																								Ruby, of Arizona																								
Little Pittsburg, Co.																								Silver Cliff, S.																								
Martin White, Ne.																								Sonora Con.																								
Monitron																								South Bodie, G.																								
Navajo, Ne.																								South Bulwer, G.																								
Northern Belle																								South Elie																								
North Belle Isle, Ne.																								South Pacific																								
Ophir, Ut.																								State Line, I & S.																								
Plymouth	16.00	15.75	16.00	15.88	16.13	16.00	16.13	16.00															" Nos. 2 & 3, S.																									
Quicksilver Pref. Co.																							Sutro Tunnel																									
Com. Ca.																							Taylor Plumas																									
Robinson Cons. Co.																							Unadilla, S.																									
Savage, Ne.																							Union Cons., G. S.																									
Sierra Nevada, Ne.																																																
Silver King, Ar.																																																
Spring Valley, Ca.																																																
Standard, Ca.	.57	.54	.60			.60	.52																																									
Stormont, Ut.																																																
Tip Top, Ar.																																																
Yellow Jacket																																																

Tables giving dividends and assessments will be printed the first week of each month. Dividend shares sold, 31,490. Non-dividend shares sold, 6765.

owing to the changing conditions. The Pennsylvania Railroad, with its new road, wants more traffic, and the manufacturers are anxious to have it stand alone.

The coke interests anticipate a considerable improvement in their Eastern business, and negotiations will soon close for increased shipments. The local coal traffic is better. The line trade is dull. Western shipments have greatly fallen off.

The Clearfield shipments for the week were 63,370 tons, against 57,933 for the same week last year—an increase of 5037 tons; for the year, shipments were 3,097,706 tons, against 2,819,003 tons—an increase of 278,703 tons. The Cumberland shipments were 33,706 tons, and for the year, 2,802,301 tons.

**Boston.** Dec. 24.

[From our Special Correspondent.]

The cold snap has naturally stirred up trade a little, and more demand is reported from retailers. The anthracite market, as a whole, remains very dull, however. Every one seems to take it for granted that coal will be no higher next year, while it may be lower even under the most harmonious circumstances. Inasmuch as that harmony is not yet assured, and as there is a present overproduction of anthracite coal, it is easy to see how retailers run along with light stocks and are not nervous over the situation. This inactivity is true of pocket trade as well as city trade. The former seems to be getting each year more into the habit of allowing the pocket dealer to carry the stocks until needed. Even tide-water localities, though better supplied than those dependent upon pockets, are nevertheless carrying lighter stocks than usual.

Stove coal is firm at \$4 f. o. b. at New York. Broken pea, and chestnut are extremely dull. Egg is fairly firm. It looks as though the companies intended to force chestnut, buckwheat, pea, and dust into sharper competition with bituminous, and we hear reports of very low prices.

We quote f. o. b. prices as follows:

At New York, Stove, \$4@4.15; Broken and Egg, \$3.50@3.65; Pea, \$2.40; individual coals, \$3.90 for Stove, \$3.25@3.50 for Broken and Egg. At Philadelphia, \$3.90@4 for Stove, \$2.20 for Pea, \$3.30@3.50 for Broken and Egg. Special coals, \$4.85@5 for Broken, \$5.35@5.50 for Stove.

All signs point to a speedy decision as to the pro-

gramme for anthracite mining another year, on the allotment basis, which has much to commend it, notwithstanding its failure in 1877. Any plan will fail after a while. The present system of united restriction worked well until it outlived its usefulness.

A light trade is noted in bituminous coal. Some offers to buy at \$3.25 delivered are reported, but of course no one expects to buy at that price for the present. It is 25 cents below the lowest prices of the season, but it is not an impossible figure for all that. It is only a question of competition. Bituminous operators do business for fun, and let the anthracite men do business for profits. With bituminous coal, claimed to be worth 50 cents per ton more than anthracite for steam purposes, it is strange that such low prices should be considered possible. Stray cargoes continue to sell at \$3.5

pendently. Unless 7 per cent of the total production is conceded, the independent course of action will be taken. The directors of the railroad have also under consideration the settlement of the difficulties regarding the bituminous coal tonnage into Buffalo, concerning which the Erie, the Buffalo, New York & Philadelphia, and the Rochester & Pittsburg have been at loggerheads for many months.

The following paragraph is going the rounds of the press; pass it along: "Some men thoroughly posted on the coal trade assert that, before the year 1885 is half over, coal will be selling in New York as cheap as it has sold any time in the past ten years. Coal, in fact, will have to take its turn with wheat, corn, and iron."

Such of your readers as are desirous of being posted on our State canal system should read ex-Governor Seymour's views. They were published in the New York Tribune on Saturday last.

It is understood that a committee representing the anthracite coal interests is in session arranging a plan for the coming year relative to prices, production, etc., etc. Your readers are probably posted on the present situation of the trade from private and public sources, and having nothing new to relate in the way of "sensational items," I dismiss the subject.

It is asserted that the actual displacement of anthracite by bituminous coal during the year has aggregated 800,000 tons, and the indications are, that this is only the beginning of the end. As a retaliation, it is proposed to continue selling buckwheat and pea sizes at a very small advance over the cost of transportation.

The West-bound railroad coal tonnages from Buffalo for eleven months ended November 1st, 1884, as reported by Commissioner Fink, aggregated 615,946 tons, as follows:

Railroads.	Tonnage.	Per cent.
Lake Shore & Michigan Southern.....	90,488	14.7
Nickel Plate (from April 1st only).....	169,284	27.5
Canada Southern.....	236,219	38.4
Grand Trunk, of Canada.....	40,867	6.6
Great Western Branch, of Canada.....	79,088	12.8
<b>Totals.....</b>	<b>615,946</b>	<b>100.0</b>

It was distributed as follows:

To Chicago and points beyond.....	234,603 tons.
St. Louis.....	42,711 "
Illinois.....	59,873 "
Michigan and Indiana.....	137,262 "
Detroit.....	89,229 "
Toledo, Cincinnati, and Ohio.....	52,268 "
Other points not enumerated.....	20,000 "
<b>Total.....</b>	<b>615,946 tons.</b>

**STATISTICS OF COAL PRODUCTION.**

Comparative statement of the production of anthracite coal for the week ended December 20th, and year from January 1st:

Tons of 2240 lbs.	1884.		1883.	
	Week.	Year.	Week.	Year.
<b>Wyoming Region.</b>				
D. & H. Canal Co.....	99,581	3,888,431	†	3,975,630
D. L. & W. RR. Co.....	113,319	5,073,930	†	4,874,475
Penna. Coal Co.....	27,128	1,296,370	†	1,443,909
L. V. RR. Co.....	45,881	1,375,872	†	1,363,134
P. & N. Y. RR. Co.....	5,074	220,149	†	210,269
C. RR. of N. J.....	*	*	†	1,202,078
Penn. Canal Co.....		430,708	†	486,663
North & West Br. RR.....	21,981	826,943	†	500,582
	312,964	13,112,403	†	14,056,740
<b>Lehigh Region.</b>				
L. V. RR. Co.....	112,621	4,608,005	†	4,846,819
C. RR. of N. J.....	*	*	†	1,126,889
S. H. & W. B. RR.....	1,669	140,962	†	43,614
	114,290	4,748,967	†	6,017,322
<b>Schuylkill Region.</b>				
F. & R. RR. Co.....	273,304	11,152,432	†	9,475,508
Hamokin & Lykens Val.....	*	*	†	950,363
	273,304	11,152,432	†	10,425,871
<b>Sullivan Region.</b>				
St. Line & Sul. RR. Co.....	1,829	75,943	†	66,255
<b>Total.....</b>	<b>702,477</b>	<b>29,069,745</b>	<b>†</b>	<b>30,566,188</b>
Increase.....				
Decrease.....				

\* Included in tonnage of the Philadelphia & Reading Railroad.  
 † Reports not published.  
 ‡ The decrease is about 2,100,000. The figures for the week ended December 22d, 1883, were not published, and consequently we are unable to state the exact amount.  
 The above table does not include the amount of coal con-

sumed and sold at the mines, which is about six per cent of the whole production.

Total same time in 1879.....	25,526,172 tons
" " " " 1880.....	27,408,527 "
" " " " 1881.....	27,991,164 "
" " " " 1882.....	28,860,764 "

The increase in shipments of Cumberland Coal over the Cumberland Branch and Cumberland & Pennsylvania railroads amounts to 214,748 tons, as compared with the corresponding period of 1883.

Belvidere-Delaware Railroad Report for the week ended December 20th:

	Week.	Year 1884.	Year 1883.
Coal for shipment at Coal Port (Trenton).....	2,487	122,696	126,403
Coal for shipment at South Amboy.....	19,515	674,895	587,601
Coal for distribution.....	22,104	828,222	809,216
Coal for company's use.....	5,344	183,915	159,904
<b>Total.....</b>	<b>49,450</b>	<b>1,809,728</b>	<b>1,683,129</b>
Increase.....		126,599	
Decrease.....			

**Comparative Statement of the Production of Bituminous Coal for the week ended December 20th, and year from January 1st:**

Tons of 2000 pounds, unless otherwise designated.

	1884.		1883.	
	Week.	Year.	Week.	Year.
<b>Cumberland Region, Md.</b>				
Tons of 2240 lbs.....	33,707	2,862,302		2,412,686
<b>Barclay Region, Pa.</b>				
Barclay RR., tons of 2240 lbs.....	4,204	283,527		320,910
<b>Broad Top Region, Pa.</b>				
Huntington & Broad Top RR., of 2240 lbs.....	3,290	189,672		187,680
East Broad Top.....				41,321
<b>Clearfield Region, Pa.</b>				
Snow Shoe.....	3,785	179,298		246,206
Karthus (Keating).....	2,064	56,307		
Tyrone & Clearfield.....	64,061	3,085,652		2,738,227
<b>Alleghany Region, Pa.</b>				
Gallitzin & Mountaintain.....	7,117	392,991		435,229
<b>Pittsburg Region, Pa.</b>				
West Penn RR.....	6,035	279,127		377,177
Southwest Penn. RR.....	1,654	121,166		118,961
Pennsylvania RR.....	3,234	263,130		504,368
<b>Westmoreland Region, Pa.</b>				
Pennsylvania RR.....	26,406	1,293,876		1,432,454
<b>Monongahela Region, Pa.</b>				
Pennsylvania RR.....	2,750	155,588		
<b>Total.....</b>	<b>158,307</b>	<b>9,102,636</b>		<b>8,907,219</b>
Increase.....				

**Comparative Statement of the Transportation of Coke over the Pennsylvania Railroad for the week ended December 20th, and year from January 1st:**

Tons of 2000 pounds.

	1884.		1883.	
	Week.	Year.	Week.	Year.
Gallitzin & Mountaintain (Alleghany Region).....	4,020	135,063		78,579
West Penn. RR.....		24,865		116,112
Southwest Penn. RR.....	34,793	2,026,502		2,015,926
Penn. & Westmoreland Region, Pa. RR.....	4,703	197,321		211,450
Monongahela, Penn. RR.....	184	70,051		
Pittsburg Region, Pa. RR.....		136		21,897
Snow Shoe (Clearfield Region).....	384	22,742		18,002
<b>Total.....</b>	<b>44,084</b>	<b>2,476,680</b>		<b>2,461,966</b>
Decrease.....				

† Reports not published.  
 ‡ See note above.

FREDERICK G. CORNING, M.E., RETURNED from his professional work in Bolivia November 14th. He may be addressed relative to further mining and metallurgical matters at his office, 78 Broadway, Room 54, New York.

**FREIGHTS. Coastwise Freights. Per ton of 2240 lbs.**  
 Representing the latest actual charters to December 24th.

Ports.	From Philadelphia.	From Baltimore.	From Elizabethport, Port Johnston, South Amboy, Hoboken, and Weehawken.
	Alexandria.....	90	
Annapolis.....			
Albany.....	56¢		
Bangor.....			
Bath, Me.....	1.25		1.00
Beverly.....	1.30		1.00
Boston, Mass.....	1.25@1.35	1.25@1.50	1.00
Bristol.....		1.10	
Bridgeport, Conn.....		1.05	
Brooklyn.....			
Buffalo, N. Y.....			
Cambridge, Mass.....	1.35¢		
Cambridgeport.....			
Charleston, S. C.....	.90	1.00	
Charlestown.....	1.25		
Chelsea.....	1.25		1.00
City Point.....			
Com. Pt., Mass.....			1.00
E. Boston.....	1.25		1.00
East Cambridge.....	1.25@1.35		
E. Greenwich, R. I.....	1.10		.70
Fall River.....	1.90	2.00	
Galveston.....			
Gardiner, Me.....			
Georgetown, D. C.....	.90		
Gloucester.....	1.45		
Hartford.....			
Hackensack.....			
Hudson.....			
Lynn.....			
Marblehead.....			
Medford.....			
Millville, N. J.....			
Milton.....			
Newark, N. J.....			
New Bedford.....	1.05@1.10		.80
Newburyport.....		1.10	.60
New Haven.....			.60
New London.....			
New Orleans.....			
New-Berne.....			.70
Newport.....		1.00	
New York.....	.60		
Norfolk, Va.....			.70@.75
Norwich.....			
Norwalk, Conn.....			
Pawtucket.....			
Philadelphia.....			1.00
Portland, Me.....	1.00*	1.25	1.00
Portsmouth, Va.....	.60		
Portsmouth, N. H.....	1.35	1.35	1.05
Providence.....		1.10@1.15	.70@.75
Quincy Point.....	1.50		
Richmond, Va.....	.75		
Rockland, Me.....			
Rockport.....			
Roxbury, Mass.....			
Saco.....			
Sag Harbor.....			.80
Salem, Mass.....			1.00
Saugus.....			
Savannah.....	.90@1.00	1.00	
Somerset.....	1.10	1.25	.80
Staten Island.....		.90	
Trenton.....			
Troy.....			
Wareham.....			
Washington.....	.90		
Weymouth.....			
Williamsbr., N. Y.....		1.05	
Wilmington, Del.....			
Wilmington, N. C.....		1.00	
St. Thomas, W. I.....			

\* And discharging. † And discharging and towing. ‡ 3c. Per bridge extra. § Alongside. ¶ And towing up and down. \*\* Below bridge.

**MAPS.**

ARIZONA AND NEW MEXICO.—This map shows all the Township Surveys, Private Land Claims, Post-Offices, and Settlements. It also exhibits the Explorations of other Government and Private Expeditions, including the facts developed by the Surveys for the Routes of Projected Railroads, etc., 1881. Scale, one inch to thirty-three miles Colored, 24x17 inches. Pocket form, \$1.

COLORADO.—Cannon's Map of the Mineral Belt of Colorado. Taken from the Records of the Surveyor-General's Office, and other reliable Official Sources. Showing, in colors, the Mineral Belt, Gold Districts, Silver Districts, Coal Districts, County Lines, and Boundaries of Land Districts. There are also given the Capital, County Seats, Township Lines, Railroads, and Projected Railroads. Scale, 1 inch : 10 miles. Size, 26x30 inches. Pocket form, \$1.50; as a wall-map, \$2.

MAP OF MINING CLAIMS ADJOINING LEADVILLE, California Mining District, Lake County, Colo. By Edward Rollandet. 1879. Mounted on muslin, \$2.50. In cloth-bound covers, \$2.

**THE SCIENTIFIC PUBLISHING CO.**  
 27 Park Place, New York.  
 P.O. Box 1833.

