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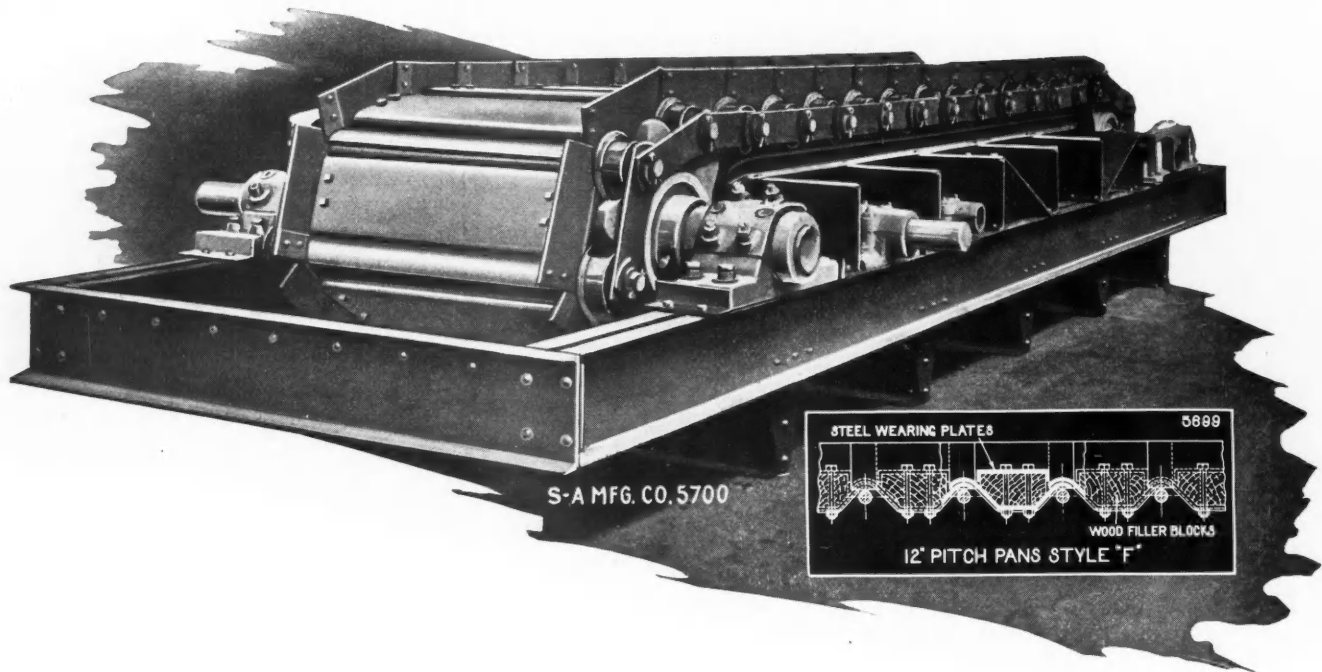
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August 5, 1922



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## Baseball at Butte

AT SIX O'CLOCK in the evening six days in the week, weather permitting—and the summer weather of Butte is quite reliable—practically all the people of the city who can leave their occupations, the mine manager his desk, the miner his machine, the housewife the kiddies, journey to the ball park on the "Flat" to watch the daily ball game between the members of the Butte Miners' League. Perhaps it's the Colo-Pitts playing the Anodes or the Black-Specs tussling with the Clarks. At any rate, interest is at a high pitch and the grandstand is filled with occupants at ten cents a head. Throughout the game enthusiasm reaches a stage that would do a college game credit and one would think that the very existence of a mining company depended on the outcome of the contest. Mine manager rubs shoulders with the shoveller and all class distinction is eclipsed by the common desire to have the company's team victorious. It's great! The next day one hears, wherever time and opportunity permit, the previous day's game discussed. "Why didn't Jones slam out a three-bagger as he usually did?" "What was the matter with Smith's fielding?" "What are the chances of the A.C.M.'s?" and so on. All of which reflects a large amount of credit upon the men who have been instrumental in organizing a baseball league in Butte and Anaconda.

In establishing this league the copper mining companies have created a community of interest among mine executives and miners that may produce more beneficial results than are generally realized. It is a decided step forward in welfare work and that it is appreciated by the rank and file of Butte the filled grandstands are a visible testimonial. All such work is highly desirable in mining camps and almost invariably pays dividends but not always in dollars and cents. Baseball at Butte, sponsored by the companies, is participated in by the miners, shovellers, mechanics and the host of other workers in and around the mines. The companies have agreed to offer no pecuniary inducement such as a bonus or higher wage rate in order to attract players to their teams and although now and then one hears charges to the effect that this rule is being violated, there is little doubt but that the spirit of this regulation is being scrupulously observed by the companies. The players share in the gate receipts obtained from charging ten cents admission to each game, a low enough admission to attract everyone to the ball park. The players are handicapped by a short season, an abrupt change from winter to summer with little spring intervening, and the fact that practice must take place after the shift goes off. On the other hand the long summer twilights—Butte has no need of daylight saving—permit a full game to be played before darkness, unless the batting of the contending teams becomes too heavy and an excess of runs is scored. The teams are fairly evenly matched

and any inequality in the amount of material from which to select a team is compensated by two companies supporting one. Thus the Anaconda Copper Mining Co. has one team at Butte recruited from its many mines, whereas the Davis-Daly and the East Butte have had to join hands to form one team known as the "Colo-Pitts" (Colorado mine of the Davis-Daly and the Pitts-mont of the East Butte). The reduction works of the Anaconda Copper Mining Co. are represented by the "Anodes."

It is a pity that Great Falls and Helena are too far away to enter the league, as they have the material available and the enthusiasm to make up a team which would introduce more sectional rivalry. Perhaps they will challenge the winners of the Butte pennant. All sorts of possibilities suggest themselves. Perhaps the Montana copper camps will challenge the southwestern ones—or if the movement grows, perhaps we shall have to run a sporting page with cartoons and special sport "dope" about the mainstays of the various teams in order to keep each section advised of its competitor's standing.

## The Faulting of Ore

THE FAULTING of orebodies and of ore-bearing beds is of hardly less interest to miners than the orebodies themselves. To distinguish a fault, and to be able to detect the direction and distance of the movement which has taken place along it, is an accomplishment which is a matter of absolute necessity to the miner.

To begin with, it is necessary to lose the conception that a fault is something technical and geological, and therefore not to be understood, except after a college course. As a matter of fact, college geologists have not distinguished themselves by being especially intelligent about faulting: at the best, they have small advantage over others. A fault is a very simple thing: it is a plane-like crack which runs through the rocks and which has acted as a gliding-plane for the rocks on one side to move past the rocks on the other side. Any rigid body will crack if subjected to strain; and if subjected to variable and unequal pressure, any such rigid and cracked body will adjust itself by movement, one part moving past another, all through the rock; and this is exactly what has happened in faulted rocks. One wall may have moved past another in any direction—up, down, horizontally in either direction, or obliquely in either direction. In fact, imagine such a block of cracked rock under pressure, and one will perceive that the variations of movement are infinite. One wall may even be rotated with reference to another, so that at a certain pivotal point there will be no movement, and on one side of this point the hanging wall of the fault, let us say, will have moved upward with reference to the foot wall, with an increasing fault-movement as the

distance from the pivotal point increases; and on the other side of the pivotal point, the hanging wall will have moved downward with reference to the foot wall. This is a movement like that of a pair of scissors, and such a fault may be called a *scissors fault*. Certain classifications of fault-movements are very old. When the hanging wall has moved down over the foot wall, its faulting is *normal*; when it has moved up, the faulting is *reversed*. This classification is not to be borne too strongly in mind, for when the main fault-movement is horizontal, the relative movement as seen on a vertical plane may have very little significance, and may indeed be very misleading. Each fault must be regarded as a problem in differential movement, all by itself; and its solution should be attempted without bothering to place it into any empirical classification, or steering by any book rules. First, find the direction of movement, which is not always easy. Striations or gougings made by the travelling of one block past another are valuable indexes of direction; but even this is not so simple, for in some cases the hanging wall, let us say, has first moved past the foot wall in a certain direction: and at a later recurrence of stress it has slipped in quite a distinct and different direction. What has been the net result of these movements? For what the miner wants to know is where to find the continuation of his vein, that has been cut off by the fault. After establishing the direction of faulting, it is necessary to find the distance; and then the problem is solved. Astoundingly accurate results have been obtained at times in the solving of difficult fault problems. The student must use every available local clue to this movement: and it is a science so variable that, like the art of being a detective, it cannot be taught in books, much less in a correspondence school.

Faulting is typically a slow process; often a recurrent process, induced by repeated movements along the same plane at different times. Sometimes a vein has been faulted, and in the fault-fissure a new vein has been formed: then we say that one vein faults the other.

At the Esperanza mine in El Oro, Mexico, the veins were traversed by a fault, and a movement of 300 ft. took place along the fault. Then the surface was levelled off to a plane by erosion, and thereafter a lava flow covered the levelled outcrop of vein and fault. Then the fault-movement was resumed and amounted to 150 ft., so that the lava flow was faulted 150 ft., but the vein and all the pre-lava rocks 450 ft. A rich ore-body was cut off at the fault; and exploration on the other side, undertaken on the belief that the fault-movement was 150 ft., failed to find the ore. The detection of the actual 450-ft. movement, which was made from very meagre data, lead to a two-years' program of development, at the close of which the lost ore was found and yielded many millions of dollars. This is an example of the practical value of the study of fault-mechanism.

### The Unspeakable Russian

**W**E SUFFER nowadays from too much information. We are bombarded on all sides with facts, near facts, and opinions about a hundred thousand matters, with the result that the average citizen is hazy about everything. Take Russia, for example. A library of information is currently published about Russian conditions, yet there are many white-browed

men and women citizens who have escaped this information, and reading Tolstoi, as of old, turn their faces reverently to the East and bless Lenine.

Just to crystallize what is actually going on in Russia at the present moment: the Belgian Socialist leader, a radical and internationalist, Emile Vandervelde, recently went to Moscow as a counsellor for the defense of some Socialists brought before the revolutionary court. He says in his description of the trial:

"No jury. The tribunal is composed of magistrates in plain clothes, one of them even wears a workman's overalls. They take their places unceremoniously and begin smoking their cigarettes right away.

"Facing me is the dreadful Krylenko, who acts as public prosecutor. Near me are the three accused, all Revolutionary Socialists who had been deported to Siberia under Czarism and who have passed ever so many years in prison under the old regime. They are accused of having conspired against the Soviets and, in particular, against Lenine.

"Krylenko is opposed to allowing some of the witnesses to be heard by the tribunal. I discuss the matter, but I hear a Communist lawyer interrupting me with this extraordinary phrase: 'It is not necessary to hear the witnesses of the defense. The witnesses of the prosecution are enough for establishing the truth.'

"Yet another occurrence: At a given moment during the debate the president of the tribunal retires and to my astonishment I see Krylenko take his place. Thus the public accuser suddenly transforms himself into a judge. I protest and declare that in no European country is it given to see justice rendered in such a manner. But Krylenko replies that, although an accuser, he will be able to examine the facts objectively, and that, besides, whether it pleases me or not, the trial will proceed and that the accused will be judged all the same.

"Not for one moment had I the impression of being before a court of justice and that I stood a chance of making truth prevail. Neither did the unfortunate accused ones have any illusion for a single moment as to the fate awaiting them. They knew very well that they were condemned before having been heard. The justice of the Czar with whom they had to deal might pardon, but the justice of Lenine never pardons."

"And in fact," writes the Editor of *Le Matin*, in reporting Vandervelde's story, in the *New York Tribune*, "the accused were condemned and shot, at the same time as five priests who had refused to deliver the sacramental cups of their churches to be sold."

### Detachable Drill Bits

**T**HE LATEST number of the United States Patent Office *Gazette*, that of July 11, 1922, shows that two patents have been issued to Arthur L. Hawkesworth, of Butte, covering two detachable drill bits. Mr. Hawkesworth's invention has attracted much attention and, so far as we have been able to ascertain, has borne up excellently under the tests to which it has been subjected on a small scale. The Anaconda Copper Mining Co. is now putting the bit through the most exhaustive test to which it has been subjected, and should the bit weather the test satisfactorily, the result may be far reaching in its consequences. For that reason a full description of the bit and a discussion of its work appears in this issue.

### Team Work in the Non-Metallics

IT IS PERHAPS UNFORTUNATE but none the less true that a small but well-organized group can sway the action of our legislators at Washington to an extent out of all proportion to its size. The trouble is that the unvirtuous as well as the virtuous, the undeserving as well as the deserving, take advantage of the fact. This only makes it more important that those whose projects will ultimately result in benefit to the public in general should use concerted effort in presenting arguments, or at least in making known the facts. If a cause has real merit, if it deserves support, publicity of the truth ought to be enough to carry it through, although frequently this is not sufficient. This is particularly true in the matter of getting appropriations from Congress. The only way to reduce Federal taxes is to spend less money, and it devolves upon Congress to adjust appropriations as best it can.

The Appropriations Committee of the present Congress has seen fit to save by curtailing the scope of the work on the "non-metallic" mineral industries that had been planned for the fiscal year that commenced July 1. These plans involved investigations by the Bureau of Mines of the methods of producing, refining, grading, and marketing many of the important non-metallic mineral products. We believe that one reason for the action of Congress in this particular instance was the lack of even a general knowledge of these industries and a consequent failure to appreciate their importance. It is not generally known, for instance, that, as pointed out by Raymond B. Ladoo, the value of non-metallic minerals produced in the state of Pennsylvania, excluding petroleum and oil, was greater in one recent year than the value of *all* the mineral products of such prominent mining states as Utah, Missouri, Colorado, Idaho, and Nevada. Nor is it generally known that these minerals are required in the making of dozens of common manufactured articles and products that are used by everybody every day. Paper, paint, cotton cloth, plaster, china, rubber, and soap are just a few familiar substances that contain these minerals. If they are not mined and prepared by efficient methods the general public pays for the waste. Unfortunately the methods are not as efficient as they ought to be. Small enterprises have grown up by themselves; many have prospered only because of the inefficiency of competitors, or the lack of competitors. Frequently companies engaged in producing the same material concealed everything they knew from each other; there was little team work. A few years ago the Bureau of Mines undertook the task of assisting these industries by collecting and compiling and distributing technical and statistical data that would help them to operate more economically and effectively. Now that the requested appropriations are refused by Congress the producers are protesting. They declare, and they are right, that they need help more than those engaged in highly developed and thoroughly organized industries. Probably if they had been able to apply concerted effort in presenting their case they could have averted the reduction of the appropriation. These protests, though unavailing, indicate that, as individuals, they recognize the value of the work the Bureau has been doing. We are glad to note the fact. The success of the efforts of the Bureau engineers will be proportional to the co-operation displayed by the executives of the industries they try to serve.

### Rand Metallurgical Practice

DETAILS of the design of the New State Areas milling plant in the Far East Rand were published in our issue of June 17. The primary breaking to 2½-in. cubes will be done in jaw crushers; then comes secondary reduction to 1 in., in disk-crushers—machines that are used to advantage in the great bulk-ore leaching plants of Chuquicamata and Ajo; also in a large number of stone-dressing plants, where the production of a minimum of unsalable undersize is desirable. Ore dressers will be inclined to inquire as to the advantage of selecting for the New State Areas plant a closed type of machine for secondary crushing. The ore is to be all-slimed, so that no advantage can be taken of the characteristic feature of the product from the disk-crusher. Further, it matters not whether much or little slime be formed during secondary crushing; a large proportion might be desirable if it could be produced cheaply. The second main advantage in the use of the disk-crusher is therefore lost.

The feed to the tube mills is to be 1 in. and under. This must be reduced to slime. Large tube mills are to be provided. The weak feature of the long axial-discharge, cylindrical tube mill is seen in the fact that all the pulp must travel the full length of the apparatus before it can be discharged. With outside mechanical classification it is obvious that a comparatively large tonnage of ore that is ground almost fine enough will be returned continuously to the mill. This may be reduced to the desired size within a short distance of the feed end, but it cannot escape there. In the New State Areas plant it must travel the full length of 20 ft., hindering the reduction of coarser particles, absorbing power and being ground to an unwanted fineness.

According to the account we published, "Ore will enter the water circuit in the crushers, and as soon as the pulp reaches the tube mills it will come into the cyanide circuit and will be crushed in a cyanide solution." This is inexplicable. Jaw crushers and disk crushers usually operate dry. Parts of the account from which we obtained our information may be in error, although both the consulting engineer and the consulting metallurgist to the Consolidated Investment Group are named as having supplied the information. The statement of responsibility for the data is followed by the remark that, "This plant marks the beginning of a new epoch in the metallurgy of gold, not only in South Africa but probably in the world generally." To this many metallurgists will demur; we are inclined to think that the newer Modderfontein plants in the Far East Rand are excellent examples of recent advance in the metallurgy of gold.

The engineers of the Witwatersrand have earned a position of well-merited eminence in the profession, largely because of the frank and scientific manner in which they have disseminated information dealing with research, as well as with the metallurgical results obtained on the greatest goldfield in the world. The New State Areas plant may mark an advance in local technical progress on a comparatively low-grade ore; we trust that it will. But if the information published during actual operation is no more complete than that which is available at the present time, many will be inclined to discount the claims being made as to the influence of the so-called "new metallurgy" on the treatment of gold ore throughout the world.

## A Four-Foot Shelf of Books\*

Thirty-six Volumes, Including Those of a Purely Cultural Value as Well as Those of a Technical Nature, Selected as a Working Library for a Mining Engineer

BY T. A. RICKARD

THE list of books selected by Dr. Charles W. Eliot, the former president of Harvard, won the interest of the general public because it suggested a limited library of maximum cultural value. Persons of various occupations and diverse interests have likings and needs sufficiently different to call for special selections of books adapted to their occupations and tastes; so I venture to suggest a list that may suit those engaged in mining engineering. I find, by measurement, that the so-called 'Five Feet' of Harvard classics occupies six feet, which is more space than we need. I believe that a collection suitable to our purpose can be restricted to four feet. As a veteran remarked to me a few days ago: "The mining engineer is an educated tramp; he can't afford a big library".

Four feet is 48 inches; the average book is 1½ inches thick, so that our shelf will give space for about 36 books. I have measured each of them. One can crowd a wonderful amount of mental tonic, spiritual comfort, and valuable information within the covers of three dozen volumes! It is my purpose to choose books that will serve as stimulating companions and trusty friends to those engaged professionally in the application of scientific knowledge to the art of mining.

First we must have the Bible and Shakespeare. Whether a man be religious or not, whether he be a sectarian or a pagan, he must read the Bible—the King James version preferred—for several reasons. In the first place it has been the book that a large part of mankind—the part to which we happen to belong—has been reading for three centuries; not to have read it is to miss the allusions made by the great writers in our language and to be out of touch with the moral development of our race. As Huxley said: "Take the Bible as a whole; make the severest deductions which fair criticism can dictate for shortcoming and positive errors . . . and there still remains in this old literature a vast residuum of moral beauty and grandeur". When a member of the London School Board, he insisted, although an agnostic, on the reading of the Bible in the public schools.

Next to the Bible comes Shakespeare, a keystone of English literature and a fundamental part of the Anglo-Saxon tradition. The sayings of Shakespeare are woven into the very warp of English speech; moreover, the founders of Virginia were the friends of Shakespeare and brought with them the philosophic ideas of Richard Hooker—from whom were derived the first principles of liberty as developed in America. I recommend an edition of Shakespeare's complete works in one volume, such as I happen to have received as a gift from a friend.

Even a mining engineer needs a dash of poetry, so I add an anthology of English verse, believing that an occasional dip therein will be a proper corrective for

the exaggerations of our material civilization. The anthology I mention is the one used by my son, a student in college.

Next comes a book of great cultural value. 'The Outline of History' co-ordinates all the scraps of history that any of us have ever learned; it brings the human record into grand perspective, and makes us realize

### THE FOUR-FOOT SHELF OF BOOKS

Name	Author or Editor	Publisher
The Bible.....		
Shakespeare.....	W. J. Craig.....	Oxford Press
English poetry.....	John M. Manly....	Ginn
The Outline of History.....	H. G. Wells.....	Macmillan
Abraham Lincoln.....	Charnwood.....	Holt
Benjamin Franklin.....	Autobiography....	Harper
Alexander Hamilton.....	F. S. Oliver.....	Putnam
Mountaineering in the Sierra Nevada.....	Clarence King.....	Scribner
Tent Life in Siberia.....	George Kennan....	Putnam
Lands Forlorn.....	George M. Douglas	Putnam
Geology.....	Pirsson and Schuchert.....	John Wiley & Son
Geology Applied to Mining.....	J. E. Spurr.....	McGraw-Hill
Mineral Deposits.....	Waldemar Lindgren	McGraw-Hill
Ore Deposits.....	J. F. Kemp.....	McGraw-Hill
Geology of Petroleum.....	W. H. Emmons....	McGraw-Hill
Political and Commercial Geology.....	J. E. Spurr.....	McGraw-Hill
Economic Aspects of Geology.....	C. K. Leith.....	Holt
Dana's Manual of Mineralogy.....	W. E. Ford.....	Wiley
Prospecting, Locating and Valuing Mines.....	R. H. Stretch.....	McGraw-Hill
Manual of Assaying.....	C. H. Fulton.....	McGraw-Hill
Mining Rights.....	R. S. Morrison....	Bender-Moss
Principles of Mining.....	H. C. Hoover.....	McGraw-Hill
The Cost of Mining.....	J. R. Finlay.....	McGraw-Hill
Principles of Copper Smelting.....	E. D. Peters.....	McGraw-Hill
Metallurgy of Gold.....	T. K. Rose.....	Lippincott
Lead Smelting and Refining.....	W. R. Ingalls.....	McGraw-Hill
The Cyanide Handbook.....	J. E. Clennell.....	McGraw-Hill
Concentration by Flotation.....	T. A. Rickard.....	Wiley
Textbook of Ore Dressing.....	R. H. Richards....	McGraw-Hill
Economics.....	Arthur T. Hadley	Putnam
Creative Chemistry.....	E. E. Slosson.....	Century
Mining Engineer's Handbook.....	Robert Peele.....	Wiley
Mines Handbook.....	W. H. Weed.....	Weed
Technical Writing.....	T. A. Rickard.....	Wiley
Roget's Thesaurus.....	Mawson.....	Crowell
Collegiate Dictionary or.....	Webster.....	Merriam
Oxford Concise Dictionary.....	Fowler.....	Oxford University

how long and difficult has been the trail over which mankind has toiled; an appreciation of the difficulties of that ascent is necessary as an approach to sociology and ethics. "The proper study of mankind is man", as Pope said. To understand the man of today we must study the men of yesterday, and of the day before. History is intensely educative. As Wells himself has

\*An address delivered before the New Mexico School of Mines, at Socorro, on May 16, 1922.

said: "A sense of history as the common adventure of all mankind is as necessary for peace within as it is for peace between the nations".

If history be a window to the understanding of mankind, then biography is a lamp of illumination thereto. Unfortunately no adequate biography of Lincoln exists, but not to be familiar with his life is to be ignorant indeed, so I suggest either Charnwood's or Herndon's 'Life' of the greatest of all Americans—one of the glories of our common humanity. Lord Charnwood is an Englishman, sympathetic to our political institutions, and his appreciation of Lincoln has features of special interest. Herndon was Lincoln's law partner and tells his story with less detachment but more intimacy. Another book that I do not hesitate to include is F. S. Oliver's 'Alexander Hamilton', a critical and scholarly account of the life of one of the founders of our republic. This extremely well-written book, by an Englishman, is a sympathetic account of the political conditions amid which the United States was born. It is surprising how little or how vague is the knowledge of early American history possessed by most of our people. Forgetfulness of our early history is suggested by the fact that most persons are in the habit of thinking that the War of Independence was fought by the early colonists. As much time elapsed between the colonization of New England and the Revolution as has elapsed between the Revolution and the Great War from which we have just emerged; the active life of such an American pioneer as John Winthrop is separated from the life of George Washington by an interval of time as long as that which separates our first President from our latest. I would like to add the 'Life and Letters of Huxley' to our shelf, if space permitted, because it deals with one of the founders of modern science, the exponent of veracity of thought, a splendidly courageous and nobly sincere man, whom to know in the pages of his son's biography is a privilege. Instead, however, I shall insert the autobiography of Benjamin Franklin, because Franklin is the exponent of the kind of plain sagacity we call 'horse sense', as Huxley was the exponent of organized common sense, namely, science. Franklin was a splendid old fellow, one of our first Americans, and his own story of his life is one of the authentic records of humanity.

The mining engineer is a traveler, and he is interested in books that tell him of countries to which his professional work may take him. Kennan's volume on Kamchatka and the Siberian hinterland is a delightful book, partly because it was written when Mr. Kennan had seen but little of the world, was unsophisticated, and described things with naivety and directness. It must not be confused with his account of the Siberian convict system; that is a much inferior work. Another book that has been re-printed in later years, and is worthy of a place in any library, is Clarence King's 'Mountaineering in the Sierra Nevada'. It describes a region that is classic in the history of American mining, and it is written with the charm and vividness characteristic of its author—he was a man of engaging personality and chromatic character—the founder of the U. S. Geological Survey. 'Lands Forlorn' describes an expedition to the Coppermine River district, in the Arctic portion of Canada; this book also is free from affectation; it is a true story, told simply and vividly. When you read it you will breathe the cold air of the North and feel the freedom of the wide places of the earth. To the three books of travel I would like to

add W. H. Hudson's 'Purple Land', which describes the country and people of Argentina; it is written by an author—one of the very few—whose style shows a knowledge of the technique of writing. It is worth reading for its good English alone.

Next we come to technical books. The mining engineer must have several books on geology. As a general and introductory textbook, I suggest either Pirsson & Schuchert's 'Geology' or the 'College Geology' of Professors Chamberlin and Salisbury, of the University of Chicago. Another excellent book, admirably written, is 'Geology of Today' by Professor Gregory, of the University of Glasgow. This is published by Seeley, Service & Co., of London. I give the name of the publisher of every book suggested for our shelf because this item of information is likely to be wanted. Next, the little book by J. E. Spurr—'Geology Applied to Mining'—can be recommended cordially; it is written in the form of questions and answers—an effective method of dealing with fundamental principles. After reading Mr. Spurr's book our young mining engineer will be in a position to appreciate the more elaborate treatises of Professors Kemp and Lindgren. 'Ore Deposits' and 'Mineral Deposits' are first-rate volumes, the products of scientific men of high academic rank, and with wide experience in field-work. They approach the subject from different angles, and therefore their books do not overlap. One should read both. The finding of oil and the winning of that liquid mineral is an important branch of mining, so a book on the subject must be included. The 'Geology of Petroleum' by Professor Emmons, of the University of Minnesota, is a good textbook on that phase of the subject. For exploitation, I suggest Dorsey Hager's 'Oil Field Practice'. The big 'Mineralogy' of Dana is too clumsy and too costly for a small library, so I recommend the smaller compilation made by Professor Ford, of Yale. Two more books belong to the geological department. 'Political and Commercial Geology' is a collection of articles by geologists and other scientific men all of whom were engaged in studying the distribution and supply of metals and minerals during the War. This book, assembled by the editor of the 'Engineering and Mining Journal-Press', deals with the political and commercial conditions that affect the world-wide trade in minerals; it is a most informing volume, and contains many data of a kind that the mining engineer will find useful. Another strictly modern book, covering new phases of the mining industry, is C. K. Leith's 'Economic Aspects of Geology'. Dr. Leith is Professor of Geology in the University of Wisconsin. This is a scholarly volume; it gives a comprehensive survey of the world's mineral resources and describes the exploration and development of ore deposits, as well as the taxation of minerals and the international aspects of the exploitation of them.

No mining library is complete without something on prospecting. Of the books available I have no hesitation in selecting the well-known volume by that veteran scientist Robert H. Stretch. It deals, among other matters, with the locating and valuing of mines, the last a subject that touches upon sampling. Two books on the sampling of mines may be mentioned: My own, published in 1906, and the later one by C. S. Herzig, published in 1914. Neither is a complete treatise on the subject, but a young engineer will find one or both of them useful. Of the textbooks on assaying, the best is the 'Manual of Fire Assaying' by Dr. Fulton, now

director of the Missouri School of Mines. A book on the regulations governing the locating of mining claims and the laws of mineral ownership ought to be on our shelf. The great book on the subject is 'Lindley on Mines', but this classic volume by the late Curtis H. Lindley is large and expensive. For our small shelf, 'Mining Rights', by Morrison, should suffice. Another excellent book on the subject is 'Mining, Mineral and Geological Law', by Charles H. Shamel, published by the McGraw-Hill Company.

On the economics of mining, we have two popular textbooks: The 'Principles of Mining' by Herbert C. Hoover and 'The Cost of Mining' by James R. Finlay. Both are what are called 'practical' books; their authors are engineers of wide experience, and they deal with realities in a workmanlike manner.

#### TEXTBOOKS ON METALLURGY NUMEROUS, BUT FEW POSSESS LITERARY CHARM

Of metallurgical textbooks there are many, and most of them lack literary charm. The 'Principles of Copper Smelting', however, by the late Dr. Peters, is excellent. It was written by a practitioner who became a professor—at Harvard—and who was eminently successful as a teacher because he had mastered the art of clear exposition. On lead, the choice lies between Mr. Ingalls' 'Lead Smelting and Refining' and Professor Hofman's 'Metallurgy of Lead' (McGraw-Hill). Neither is easy to read, but both are reliable textbooks. The 'Metallurgy of Gold' by Sir Thomas Rose is an old favorite, recently revised and brought up to date. On cyanidation, there is 'Cyaniding Gold and Silver Ores' (Lippincott), by Julian & Smart, but a more recent volume is Mr. Clennell's 'Handbook', which is better for our shelf. Flotation is a branch of metallurgy that is still in the making. No adequate book can be written on a process that is in its early stages of development, but 'Concentration by Flotation' is a useful compendium. The books on the same subject by Theodore J. Hoover and Arthur F. Taggart should be noted. On the general subject of ore-dressing, I suggest the textbook by Professor Richards, rather than his set of three volumes on the same subject, the choice being decided on grounds of economy, for the possessor of our shelf of books is not supposed to be extravagant either with his money or his space.

Mining engineers have to deal with economic problems, more particularly those of making a profit from industry and of adjusting the requirements of capital to the welfare of labor; therefore they ought to know something of the underlying principles of a science that used to be called 'dismal', but can today be described more accurately as 'insistent'. So I suggest 'Economics', by Dr. Hadley, the former president of Yale. This book, although first published in 1896, deals with the subject in an eminently readable style and is rich in common sense. Another subject that must not be overlooked is chemistry, so I include Edwin E. Slosson's recent volume on 'Creative Chemistry'. This is not a textbook, but an intensely interesting description of the dominant phases of industrial chemistry, such as the manufacture of paper, colors, perfumes, soap, sugar, alcohol, the fixation of nitrogen, and the making of fertilizers. It is a highly educative book, opening the mental eye to the wonders of industrial chemistry.

Next I come to several non-cultural but thoroughly useful books. The 'Mining Engineer's Handbook' by Professor Peele, of the Columbia School of Mines, is an

invaluable *vade mecum*. It contains information on a hundred and one matters that concern the mining engineer. Mr. Weed's annual compendium gives a list of mining companies, with details concerning their properties and their organization. It is useful as a book of reference in business affairs, for a mining engineer often needs data concerning the companies by whom he is or may be engaged professionally.

The mining engineer has to write frequently—letters, reports, technical articles. He will find it advisable to learn to write carefully, intelligibly, even attractively; so I venture to suggest a copy of a little book on 'Technical Writing' written by a mining engineer familiar with the work done by the profession; to this I add a standard thesaurus, or book of synonyms and antonyms, and, last of all, a dictionary of convenient size so that it can be picked up handily. I suggest either the Oxford Concise Dictionary or the Webster Collegiate Dictionary; of the two, the former is the cheaper and the better. The habit of using a dictionary is one that it is well to acquire, to check the misuse of words and to increase one's vocabulary. A small dictionary is more likely to be used frequently than a big one, because it is more convenient to handle in a hurry.

This ends the list of books on our shelf, which is two feet shorter than Dr. Eliot's. It is strange that one like myself, by no means blind to the cultural value of literature, should be able to compile a working library for a mining engineer and yet include so small a part of the selection made by a famous educator. From the Harvard classics I have borrowed Franklin's 'Autobiography' and I would like to take Dana's 'Two Years Before the Mast', which is an undying story, as well as Stevenson's 'Treasure Island', but we have no room for either of them on our small shelf.

#### 'HARVARD' CLASSICS ESSENTIALLY ACADEMIC AND FOREIGN TO LIFE AND THOUGHT OF AVERAGE ENGINEER

The so-called Harvard classics constitute a noble array of the best that has been written, from Plato to Plutarch and from Bacon to Berkeley, but is an essentially academic set of books, curiously foreign to the life and thought of the average man, more particularly of the engineering type. In a way it suggests how diverse are our ideas of culture, for Dr. Eliot includes no books of modern science, except Darwin's 'Origin of Species' and the 'Voyage of the Beagle', both of which are now chiefly of historic value. He devotes one volume to scientific papers by Faraday, Helmholtz, Kelvin, and Newcomb, but that does not fill the gap. Another group of scientific papers on his list includes writings by Harvey, Jenner, Lister, and Pasteur, a collection attractive to a physician, and of interest to anyone; but they and the other compilations fail to bring the reader in touch with the movement of scientific thought today or to put him in sympathy with the principles controlling the industrial progress of this generation. His list is rich in Greek poetry and Latin letters, together with English verse and essays. One item is American historical documents, which would correspond with the lives of Hamilton, Franklin, and Lincoln, as included in our list. Parts of the Bible are found in the two volumes devoted to 'Sacred Writings'. Yet, as I have ventured to say, the point of view of the college president would seem strangely different from that of a person much less scholarly but more closely in touch with industrial operations. "Man does not live by bread alone", nor can he live on angel-cake. The literature



that is divorced from the realities of every-day life has its function, to stimulate and to uplift the mind, but the understanding of man's relation to his fellow-men and the knowledge of the operations by which the material life of the community is sustained is more important than an acquaintance with poetry, whether ancient or modern. We live, as Tyndall said, in a flux of phenomena called life, and no man can live intelligently unless he possesses at least an elementary knowledge of the conditions governing life, of an individual, of a state, of a nation.

Reading enriches and develops the mind; so do travel and conversation; but it is not given to everyone to travel widely or to hold converse with the intellectual leaders of the race. The lack of such opportunities can be remedied in large part by reading books of travel and by making the mental acquaintance of the intellectual aristocracy—an aristocracy that even a democrat is glad to recognize—through their writings. For an educated or even half-educated man to forego the opportunity of such reading is pitiable. He should avail himself of it while his mind is maturing, soon after he has left college and before the cares of life absorb his mental energies too insistently. So I say to you: make the most of an opportunity for reading, such opportunity as comes during a period of enforced idleness, caused by illness or lack of employment. Unfortunately when a man has worked hard all day, he is not in a mood to read; he suffers from fatigue and repletion; he is inclined to let his mind rest. Our young technicians may be aware of the value of reading for sharpening their intelligence or improving their practice, but the laziness that follows upon weariness may prevent them from digging into books. That is one of the objections to hard manual work; if exacting, it stupefies the brain, and calls for physical rest and sustenance, not mental stimulation. The young man that has been shoveling underground or pushing a car all day will want food and sleep, rather than books. Therefore, as I have suggested, make the most of such intervals in your career as give you a chance for solid reading. The ten years between 25 and 35 constitute the choice period for stocking the memory and enriching the mind with the best that has been put into print; although I do not suggest that good reading should be like a college course, to be taken for a short spell and then set aside. As soon as a man ceases to learn, he grows old. The student's ideal is expressed by the epitaph that Greene desired: "He died learning". A proverb says that we live and learn; it is likewise true that we live to learn, and to make use of what we learn, for, among us of the technical and scientific professions, it is recognized that our learning is meant to be not a mere ornament of the mind, not an academic frill on our experience, but effective, for the purpose of making us more congenial as human beings and more useful as citizens. To be a good citizen is the ideal of our civilization.

### Nevada Lead Output Falls

The output of lead in Nevada decreased from 21,263,700 lb. in 1920 to 7,188,768 lb. in 1921. In the first half of 1922 the production of the lead mines has been unusually small, according to the U. S. Geological Survey. The mines of Goodsprings, Eureka, and Pioche have not recovered from the low metal prices and high freight rates of the last few years. The recent increase in the price of lead and the reduced freight may help.

## DISCUSSION

### Electrothermic Dry Distillation of Zinc Ores

THE EDITOR:

Sir—The article by Prof. Charles H. Fulton, on "Electrothermic Dry Distillation of Zinc Ores," in your issue of July 1, has been read by me with interest. For two decades past I have had the conviction that electrothermic methods would furnish the answer to the "zinc problem," for assuredly the zinc retort making on the average less than 20 lb. of zinc per day is an anachronism in modern metallurgy. The electric furnace puts the heat inside the furnace exactly where it is needed. The electrolytic process had a war-time vogue, but its production has of late decreased. The underlying points of superiority possessed by the electrothermic method over retorting have been exhaustively presented by Prof. Fulton, and I am fully in accord with his general views. It seems that electricity would finally effect in the zinc business a revolution similar to the ones being effected in the case of the brass crucible and which has been effected in the case of the steel crucible. All three of the operations cited have the logic of the situation, putting the heat through or near the charge by means of the electric current as against indirect heating through a fire-clay wall, with all the savings that the large, controlled units have over small, fragile units.

When Prof. Fulton comes to compare electric dry reduction of zinc ore with electric smelting, producing zinc, slag, copper matte and lead bullion, I believe that he errs, at least in the light of my fairly extensive experience. I have built several furnaces employing dry reduction, one making some 1,200 lb. of zinc with high condensation, and a number of slag-resistance electric zinc-smelting furnaces, the last of which made 34,133 lb. zinc, 9,797 lb. matte, 6,046 lb. of bullion.

What he says about a "buried-arc furnace" is perfectly true, for an electric furnace must be a short circuit under control. When zinc ores are smelted the control must be perfect, and a "buried arc" I have found does not give good control for zinc ores. A slag resistance does give a uniform heat and provided the zinc ores are well conditioned by a preliminary pre-heating and pre-reduction, it is not hard to get good reduction and perfect condensation. It is, of course, easy to smelt zinc ores poorly in an electric slag resistance furnace if one does not understand the conditions, or any ore in any furnace, for that matter.

For instance, it is quite easy to over-reduce in a slag resistance zinc furnace and make an accretion. It is easy to cut this accretion out. It is better to gage the reduction right, so that no accretion is formed. It is also easy to condition the ore so that condensation is good and smelting regular, and vice versa. But granted even fair work—and experience shows that it is possible to attain perfect smelting on a one-ton furnace—the fact that electric smelting is continuous and uses cheap slagging lead-zinc ores, making besides metallic zinc, lead bullion and copper-matte, gives it an innate superiority over dry reduction, which is intermittent and does not save the lead or other values. I have tried both types of furnaces on a scale larger than a laboratory one, treating in all 100 tons of ore

and I can say that electric zinc smelting is not only superior in its commercial prospects to dry electrothermic treatments but is metallurgically easy. For the electric current is a powerful, kindly agent when its use for a particular purpose is understood.

Hartford, Conn.

WOOLSEY MCA. JOHNSON.

#### THE EDITOR:

Sir—We have read with deep interest, in your issue of July 1, Prof. Fulton's article on "Electrothermic Dry Distillation of Zinc Ores." Especially our attention was caught by the statement that the "process is applicable to complex ores containing iron, lead, silver, and copper and is not limited to ores of any particular composition." This has raised one or two questions.

At the plant of the Bunker Hill & Sullivan company we have lately had occasion to treat a concentrate carrying 25 per cent of zinc and 30 per cent of lead. The power consumption by Prof. Fulton's process is given as 1,400 kw.-hr. per ton of green concentrate. At 94-per cent recovery this would appear to require about 6,000 kw.-hr. per ton of zinc produced from such a concentrate. It is also stated that the spent briquets carry about 75 per cent of carbon, being "practically a high-ash coke." (We take it that this is necessary to prevent slagging.) Since the residue from the above concentrate amounts to about 70 per cent of the original weight, it would seem that about 2.5 tons of coke (including that necessary for reduction) would be required for each ton of concentrate, or approximately 10 tons of coke for each ton of zinc produced.

It is stated that by close temperature control, 80 to 85 per cent of the lead can be left in the briquets, the remaining 15 to 20 per cent presumably passing over with the zinc. In the case above mentioned it would appear that the distilled zinc would carry over 18 to 24 per cent of its weight of lead.

The foregoing figures indicate that the electrothermic distillation process is hardly feasible for ores of this character and we would be glad to know whether such is the case or whether the data given are not intended to serve as a basis for calculation for the more complex ores such as those of this district.

Kellogg, Idaho.

W. G. WOOLF.

### A Standard Silver Nitrate Solution

#### THE EDITOR:

Sir—During the month of April, 1920, I suggested to Horace Freeman, of Vancouver, B. C. (the inventor of "Aero" brand cyanide), that a standard  $\text{AgNO}_3$  solution, containing 8.6745 g. salt per liter be used, when titrating plant solution; each cubic centimeter would then equal one pound of  $\text{NaCN}$  contained in each ton of solution. Using this standard  $\text{AgNO}_3$ , during the past two years at the plant of the Nugget Gold Mines, I have found the formation of flocculent precipitate a detriment during titration; the cause, of course, being the high strength of  $\text{AgNO}_3$  used as standard. Experimenting further, I find that a strength of 4.337 g.  $\text{AgNO}_3$  per liter, and reading 1c.c. = 0.5 lb.  $\text{NaCN}$ , to be excellent for plant practice. Excessive precipitation of flocculent silver cyanide is avoided; the endpoint is slower to arrive and is more distinct when obtained; errors of over-titration are mitigated 50-per cent, and the burette reading is to half pounds per ton

of milling solution. The number of grams of  $\text{AgNO}_3$  per liter I determined by substituting the Na for K, in Elsner's well-known equation.

Salmo, B. C.

GEORGE H. SHEPHERD.

### The Birth of Mercury Ores

#### THE EDITOR:

Sir—Your editorial of July 8, 1922, entitled "The Birth of Mercury Ores," mentions the frequent association of cinnabar and bituminous matter. You consider the two possible origins of the organic matter and conclude: "the rather characteristic coupling of mercury and bitumen would indeed suggest a magmatic origin for the latter in such cases, in spite of the fact that most bituminous material can be shown to be of organic origin."

I beg to differ with you on this point and base my conclusion on personal observations made during the last ten years in many quicksilver mines in California, Nevada and Texas.

G. F. Becker,<sup>1</sup> in his quicksilver classic, mentions the occurrence of bitumen in six quicksilver mines and in the Miocene schists generally. Since then text-book writers, following time-honored traditions, have faithfully copied and broadcasted this fact, making it a very shibboleth of quicksilver deposits.

Meantime another, even more general, characteristic of quicksilver deposits has failed of recognition. It is that most of them are found in brecciated or porous rocks *just under an impervious cap rock*. J. A. Udden recognized a special case of this general theory in the Texas deposits and has published his observations under the title<sup>2</sup> "The Anticlinical Theory as Applied to Some Quicksilver Deposits."

Becker recognized the importance of the clay hanging wall at New Almaden. He writes: "These layers of clay usually occur on the hanging side of the deposits and are known to the miners as *altas* . . . The clays are impermeable to solutions and the ore usually forms on their lower side, as if the cinnabar had ascended and been arrested by the *altas*." He also mapped the outline of the clay walls on the different levels. He seems not, however, to have recognized how general the existence of an impervious layer on the hanging wall of quicksilver deposits was, even though the term "alta" was used throughout the quicksilver mines of California to denote this hanging-wall gouge. This oversight was probably due to the tendency at that time to place quicksilver deposits in the class of veins or "stock-works," although they can perhaps more nearly be defined as a modified type of disseminated deposit.

We have then in quicksilver deposits two factors to which I have called attention in a previous article,<sup>3</sup> namely, a porous or brecciated rock overlain by an impervious cap rock limiting or directing the upward flow of the mineralizing solutions. It will be seen at once that these are the same conditions necessary to the accumulation of oil.

If, then, the ascension of quicksilver from the parent magma was carried on under conditions of even moderate heat, and this is probable, organic material in the

<sup>1</sup>G. F. Becker, *Geology of the Quicksilver Deposits on the Pacific Slope*. U. S. G. S. Monograph 13, 1888.

<sup>2</sup>J. A. Udden, *University of Texas Bulletin No. 1822, 1918*. (Also in the *E. & M. J.* of May, 1919.)

<sup>3</sup>C. N. Schuette, *The Sampling and Estimation of Quicksilver Ore*. M. & S. P. Feb. 26, 1921.

overlying sedimentary rocks would be distilled, ascend with the quicksilver through the same fissures and be deposited with the quicksilver under the impervious cap rock. Thus the presence of bitumen in quicksilver deposits (it is not, by the way, universal or even very marked except in isolated cases) is not a primary factor, but is merely an attendant occurrence due to the geological structure of the deposit and the temperature during deposition.

The cause, not the effect, "deserves special consideration and more study than has been given it" and I may add that in at least four cases under my personal observation, intelligent search based on the theory of a pervious rock capped by an impervious one, has resulted in finding orebodies.

There are a number of localities where cinnabar is found over a wide area in small patches or in mere colors. Search for a favorable structure in one of these localities in central Nevada showed a flat-dipping stratum of porous sandstone overlain by a dense silicified limestone. A little digging disclosed ore on this contact grading off into the sandstone. Bitumen was absent but search for the structure resulted in the finding of ore.

C. N. SCHUETTE.

San Francisco, Cal.

### Booms That Hurt

#### THE EDITOR:

Sir—What has Oatman done that it should be singled out for the thunderbolts of the Olympian Jove of mining trade papers? I refer to the editorial in your issue of July 1, 1922, entitled "Booms That Hurt."

Is it because Oatman has advertised its opportunities? Surely advertising one's wares is not a crime. If we are not mistaken, the *Engineering and Mining Journal-Press* is not averse to advertising itself and does not by any means hide its light under a bushel. And in advertising its opportunities, is Oatman, in the opinion of the *Journal-Press*, trying to create a faith in the minds of those outside the camp which is not shared by those living in the camp regarding its possibilities as well as its present importance as a gold mining center? If so, the answer is to be found in the fact that a very large part, if not the greater part, of the money which has been raised in recent years for local development has been supplied by the men working in the mines of the camp. That is a fact which can be easily verified.

From the last four lines of the *Journal-Press* editorial the reader might reasonably be led to believe that Oatman is "making it difficult for the honest promoter to finance his project and for the holder of promising claims to interest the capitalist in them."

Let us be frank. Let the *Journal-Press*, if it has such information, name the dishonest promoters in Oatman. Does the *Journal-Press* believe that the pitifully inadequate money that has been raised is going into the pockets of promoters and not into actual development? If the *Journal* has any information tending to prove this we should be glad to hear it. We know nothing of the kind here.

Do not honest promoters advertise their wares? Is it dishonest to advertise? Does the *Journal-Press* object to the method of calling the public's attention to the opportunities in Oatman? If so, that is a mere matter of opinion and not even the *Journal*, we believe, will contend that there is anything ethically wrong in

advertising so long as vital facts are kept within the bounds of truth.

It is true that Los Angeles and San Francisco newspaper men have visited the Oatman district in the search for "local color" and "human interest stories." Newspapermen have done the same in every gold camp. Mark Twain and Bret Harte found Virginia City and Sacramento a fertile field and Cripple Creek, Goldfield, Tonopah and South Africa have not been overlooked by enterprising journalists.

The *Journal-Press* makes another statement to which some objection might be taken. It says: "There have been other instances in Mohave County's history of booms that have come to naught which doubtless have cost the public something to the detriment of mining."

We object to the *Journal-Press*' use of the word "boom." It is true that there have been several periods of activity which have been followed by periods of comparative inactivity in the Oatman district. In 1900, for example, there was an active period here caused by the discovery of the Gold Roads mine. That mine has produced more than \$10,000,000. Does the *Journal-Press* therefore call the 1900 "boom" fruitless?

Oatman had another "boom" in 1906 when the Tom Reed began its period of greatest activity. The Tom Reed has produced more than \$12,000,000. If it resulted in nothing more than the bringing in of the Tom Reed was not the 1906 "boom" worth while?

Again in 1914-16 Oatman had still another so-called "boom." When that period of activity was over the famous United Eastern had begun producing and to date it has produced more than \$9,000,000. Was the 1914-16 boom, therefore, barren of results?

Has not Oatman proved in the mines already developed that it is justified in the attempt to develop other mines in the same locality?

If the above three discoveries had been made at the same time, then, we concede the *Journal-Press*, Oatman undoubtedly would have had a "boom." Nor would it have been exposed to the unfair charge made by the *Journal-Press* of fabricating a boom. Oatman's discoveries, however, have been made over a period of years. The Oatman district, as every gold miner knows, has been characterized by periods of great activity, followed by unsensational but none the less steady development.

Upon what then does the *Journal-Press* rest for justification of its unfavorable comment?

Is it because of a sudden solicitude for the public, the investor and the "honest promoter?" And does the *Journal-Press* honestly believe that in a speculative industry like mining that somebody is not going to lose money?

It is a matter of common knowledge in the gold mining industry that the speculative losses incurred at Goldfield and Tonopah were tremendous. The same was true at Cripple Creek.

Permit me to recall a little "ancient history." In 1878 Jack Bradley reported a discovery of gold in the vicinity of Mount Pisgah in what is now the Cripple Creek district. This resulted in a great rush to the locality with disappointing results. The boom faded. The camp lay undeveloped for thirteen years. Then Robert Womack in 1891 again reported a discovery of gold on what is known as Womack Hill which again directed attention to the district and resulted in the Cripple Creek "boom" of the '90s.

It must be remembered that the Cripple Creek gold

deposits were not discovered until thirty years after Russell Gulch, the Gregory lode and other mines in Clear Creek and Gilpin counties had begun to give their millions to the world. The same thing has happened in Oatman where gold was first discovered sixty years ago.

It was reliably computed that for every ounce of gold produced at Cripple Creek an expenditure of \$150 was made elsewhere in the camp. That meant that somebody lost. The same was true at Goldfield and Tonopah.

But Cripple Creek, which produced such mines as the Portland, the Vindicator, Raven, El Paso, Mary McKinney, Independence and many others, was not condemned. Why then condemn Oatman?

Why should a publication of the standing of the *Journal-Press*, which is generally believed to be a supporter of the mining industry, hold up the dark side of the picture? Why should a trade paper which is supposed to represent the mining industry call particular attention to a fact which is well known to all of us; namely, that speculation is a conceded concomitant of mining and that without it mining will cease to exist?

Oatman, which has had three producers like Gold Roads, Tom Reed and United Eastern with a total production record of more than \$30,000,000, certainly has a right to call public attention to the promising prospects lying near them and to plan for the legitimate development of these prospects.

Just why Oatman has been singled out for the *Journal-Press'* wrath we frankly cannot imagine. However, we cannot help but believe that in taking such an attitude toward Oatman the *Journal-Press* has been decidedly unfair.

We are inclined to believe that the *Journal-Press* in the present instance has not been well informed. Certainly its reference to the "one diamond drill hole on Oatman United" would lead one to believe so when it is taken into consideration that eighteen holes were drilled.

CHARLES F. PUGH,

Oatman, Ariz. President Oatman Mining and  
Business Men's Association.

#### THE EDITOR:

Sir—Your editorial "Booms That Hurt" in the July 1 issue, as applied to the Katherine and Oatman sections of the San Francisco mining district of Mohave County, Ariz., apparently needs some modification, notwithstanding the justice of its bluntness.

Booms, manufactured or otherwise, are always to be deplored because they retard an otherwise healthy growth. Unfortunately the mining industry has its full quota of the get-rich-quick element, some of whom are boomers. Others await an opportunity to take advantage of the situation when the boom becomes top-heavy, in order to make the crash the greater; these are bulls and bears of the vicious variety. Such has been and still continues to be the prime detrimental factor to an otherwise steady and normal growth of the mining industry of Mohave County, the leading gold producer of Arizona.

Notwithstanding the bursting of this embryo-boom bubble, the reserves of ore have increased in the Katherine mine. The development of such properties as the Adams, the Gold Chain and the Big Four is encouraging. Meanwhile the Oatman section is showing renewed activity chiefly because of its ability to

continue development after a large production of gold through the lean years of the war. In recent months the Oatman United in continuance of such development is said to have drilled eighteen holes laterally along about 1,800 linear feet of dike from the workings of its 600-ft. level, which disclosed payable ore. This is being confirmed by development, the one down-hole, which your editorial mentions, being now drilled for air connection only.

The core drilling from the surface of veins in the Oatman section, which was brought on by the widely heralded underground drilling of the Oatman United, has also been successful, and an extended use of this unusual method of primary development may be expected in the future, more especially in the southeastern extension of the entire Tom Reed-Gold Road zone, where it is covered by a flow of basalt.

Naturally, underground core drilling is keeping pace with development; one of the larger companies recently crosscut 1,000 ft. on the hanging-wall side of their principal vein, which is to be utilized to core-drill the principal vein to a depth of 3,000 ft., where the granite base may be expected, upon which is superimposed the andesite flows of the upper horizons. If these drill holes prove satisfactory it will mean much for the longevity of the mines of the district.

When we consider the lack of deep development of the mines that have been exploited in Mohave County, its splendid record of production is marvelous. It still offers a field for the operator that desires to mine a mine instead of the public, notwithstanding numerous failures, due chiefly, however, either to mismanagement or inability to finance properly

Kingman, Ariz.

W. W. WISHON.

#### THE EDITOR:

Sir—Not long ago there appeared in the *Journal-Press* an editorial entitled "Booms That Hurt." Rather a knock at the mining industry in this section of the country. Several of the miners dropping in at the office glanced over this article and were infuriated. "Booms that hurt be damned; they got this thing all wrong. One diamond-drill hole they say on the Oatman United when there were eighteen, and I panned the sludges myself. It's these here editorials that hurt a darn sight more than the booms. Why don't you stop your subscription to such a damnable paper?"

The boys, of course, meant well, but they do not understand the power of the press. I am reminded of an incident in Cripple Creek about ten years ago.

Julian Street, the eminent writer, was in town gathering material for a story which appeared in *Collier's Weekly*. Here, presumably, was where Cripple Creek was going to get some good advertising; a word about its wonderful mines, the millionaires who had made their fortunes here, and of the opportunities still to be found in the camp. Somehow or other he got sidetracked. His article told of a walk down Myer's Avenue, with its saloons and painted women, and dealt in detail with a conversation with one "French Kate." Not a word about the wonderful gold mines.

The people of Cripple Creek were furious. Practically all subscriptions to *Collier's* in the city were cancelled. But still the magazine seemed to thrive. But this deed must not go by unnoticed. At a special meeting of the Town Council the name Myers Avenue was officially changed to Julian Street and so remains.

Oatman, Ariz.

WILLIAM G. ZULCH.

## Mining Engineers of Note

K. C. LI

**I**F ONE was asked to describe the outstanding characteristic of K. C. Li—or, to address him according to the custom of his country, Li Kuo Ching—the president of the Wah Chang Trading Corporation, it might be sufficient to say that he possessed charm.

We say "might" advisedly because there remains a feeling that this designation does not cover the complete impression received upon meeting Mr. Li, and particularly when one appreciates his accomplishments as mining engineer, mathematician and business executive which, to say the least, are remarkable for one of his years. Mr. Li was born Sept. 24, 1892, at Changsha, in the province of Hunan, China. After receiving his earlier education in the local schools, he entered the Hunan Technical Institute where he took up the study of mining. Upon the completion of his course there he entered the Royal School of Mines, London, and graduated with the degree of Mining Engineer. It may be remarked in passing that Mr. Li is a firm champion of technical education of business men, for he says that the background provided by engineering training is essential to the analytical mind, so necessary in business today.

Returning to China Mr. Li became actively associated with the mining industries in Hunan, first accepting the position of secretary of the Hunan Mining Board. Later he was president of the Kiangwah Government Tin Mines, president of the Hsiao Ku San Government Mines, and co-director of the Hunan Mining Board.

In 1915 Mr. Li was appointed vice-president and New York manager of the Wah Chang Mining & Smelting Co., Ltd., when this company decided to open a branch office in America for the direct sale of its products. The business which began in a small way with the handling of antimony metal and tungsten ore only, developed rapidly and in 1916 the Wah Chang Trading Corporation was formed. This corporation did not become operative until early in 1918, when the capital was increased and the entire business of the Wah Chang Mining & Smelting Co., Ltd., branch office was taken over. Under the direction of Mr. Li, who is now

president and managing director, the scope of the business has been greatly extended and now includes antimony metal, tungsten and other ores, tin, silk and other commodities as imports, also machinery, pig iron, railway equipment, soda ash and other chemicals, aluminum,

brass and sporting equipment. For meritorious service rendered to the Republic of China, Mr. Li has received the fourth class Chia Ho decoration from the president. During the war he was active for both the United States and the Canadian government in obtaining war materials from China and South America and has received letters of appreciation and congratulations from the authorities of the various allied governments. He makes frequent trips to China and other countries of the world in the interest of his company's business. Mr. Li has considerable reputation as a mathematician and has written books on algebra, trigonometry and calculus in Chinese which are widely used in the native schools as text books. He received four honors during his college career and is recognized as a student of music and literature.



K. C. LI

Among his associates Mr. Li is known as an enthusiastic and hard worker, and he permits himself little leisure, unless it be considered that he obtains his relaxation from the study of some difficult problem that differs from his routine work.

Mr. Li is a noteworthy example of the successful type of the younger business man of the Orient who is pointing the way to a new era of commercial and industrial development for those countries. That he received his initiation into business by way of mining, and that he still retains an active professional interest in that industry is worthy of the attention of mining engineers who are inclined to question the advisability of continuing their work in their profession.

He makes his home at Glen Cove, Long Island; he is married and has four children. He is a member of the Lawyer's Club of New York, the American Institute of Mining and Metallurgical Engineers and the Institution of Mining and Metallurgy of London. He is also a director of the Wah Foong Cotton Mill.

## Ammonia Leaching of Zinc Ores

Preliminary Roasting Must Be Done With Care to Prevent Formation of Acid—Excess of Alkalinity in the Solvent Not Harmful—Distillation of Pregnant Solution Best Done in Two Stages

By J. F. CULLEN AND T. E. HARPER

THAT ZINC OXIDE is soluble in ammoniacal solutions is well understood, and the use of the ammonia-carbon dioxide leach for the production of pure zinc oxide from complex ores and other zincky materials has been proposed many times in the last forty years. As usually described,<sup>1</sup> the treatment consists in roasting the sulphide ore, leaching the calcine with a solution of ammonia and carbon dioxide, purifying the ammoniacal zinc solution and distilling it for the precipitation of a basic zinc carbonate which will yield zinc oxide by calcination. Except for small losses, the ammonia and carbon dioxide would be recovered in the distilling and calcining operations. In view of the recent successful application of the identical leach to the extraction of native and carbonate copper ores and tailings,<sup>2</sup> the following brief examination of ammonia zinc leaching may be of new interest and value.

The several steps in the production of a pure zinc oxide from a sulphide ore have been examined by the writers of this paper on only a small scale, although they are here interpreted on a working scale in the light of related operating experiences, so far as such interpretation is warranted.

### LOW-TEMPERATURE ROASTING

Zinc silicate is almost unaffected by ammoniacal solutions, and silicate formation during the roasting of the ore must be avoided by maintenance of the lowest practical roast temperature. Ores containing an appreciable amount of lead show a marked inclination for silicate formation at temperatures above 650 deg. C., whereas ores that are free from lead form practically no silicate at 800 deg. This observation suggests that the important insoluble zinc compound, with reference to ammonia leaching, is a lead-zinc silicate. A high pyrite content also promotes silicate formation, but in much lesser degree than lead. The effect of lead and high roast temperature on zinc extraction by the ammonia-carbon dioxide leach is indicated in Table I. The difference between extraction in excess of dilute sulphuric acid and in the ammoniacal solution is a fair measure of the silicate formation. The ore and concentrates were minus 100 mesh before roasting, and the calcines were leached without grinding.

It is evident that roasting in a Wedge or similar furnace for ammonia leaching would demand more care than roasting for the sulphuric-acid leach. The calcine made by the low-temperature roasting contains 6 to 10 per cent sulphate sulphur, and frequently as much as one-fifth of the total zinc is water soluble. This unavoidable production of sulphuric acid in the roast is a detriment in ammonia leaching, as the acid must

eventually be removed from the solution by means of lime.

TABLE I

Material	Assay before Roasting				Temp. deg. C.	Percentage of Total Zinc Extraction	
	Pb, Per Cent	Zn, Per Cent	Fe, Per Cent	"Insol." Per Cent		By Dilute (a) Sulphuric Acid	By NH <sub>3</sub> CO <sub>2</sub> Solution (b)
Special blende concentrate.....	0.10	45.0	8.4	5.0	800	96	95.5
U. S. blende concentrate.....	4.0	47.0	7.0	10.5	650	94	91
U. S. blende concentrate.....	4.0	47.0	7.0	10.5	800	95	65
C. M. ore.....	9.0	20.2	15.0	28.5	650	87	72
C. M. ore.....	10.3	46.8	3.5	1.6	800	73	36
S. S. L. G. concentrate.....	16.4	36.4	10.0	5.8	650	94	88
C. M. concentrate.....	19.8	35.0	3.6	3.0	650	95	8
Special S. S. middling.....	25.5	30.0	7.8	7.0	650	94	82.5
S. S. middling.....	.....	.....	.....	.....	800	91	41
S. S. lead concentrate.....	50.0	17.1	.....	2.0	650	96	77
S. S. lead concentrate.....	.....	.....	.....	.....	800	89	54.5

(a) 20 grams H<sub>2</sub>SO<sub>4</sub> per liter.

(b) 100 grams NH<sub>3</sub> and 70 grams CO<sub>2</sub> per liter.

The strength of the ammonia solution used for leaching would be determined largely by the character and efficiency of the ammonia distilling and condensing equipment. A solution containing 100 grams of NH<sub>3</sub> and 70 grams of CO<sub>2</sub> readily dissolves 100 grams of zinc oxide per liter, and a 140:100 solution will dissolve 150 grams of oxide per liter with equal ease. Unlike acid zinc leaching, where the leach is brought to the neutral state in order to precipitate important impurities before filtering, precise leach adjustments are not necessary in the ammonia leach and an excess of solvent is not harmful.

Table II gives leach results for several zinc concentrates.

TABLE II

	Weight Per Cent	Ag	Cu	Pb	"Insol."	Fe	Zn	CaO	As	Total	CO <sub>2</sub>
U. S. Blende											
Calcine.....	100	2.3	0.75	3.3	10.3	6.5	47.0	1.0	0.04	6.6	.....
Leach residue.....	35	7.1	0.60	10.4	33.2	18.5	14.2	3.3	Tr.	0.8	2.0
Per cent extracted.....	.....	.....	.....	.....	.....	.....	89.5	.....	.....	.....	.....
S. S. Middling											
Calcine.....	100	18.6	2.2	22.4	6.1	5.7	26.4	1.1	0.05	10.4	.....
Leach residue.....	50	29.6	1.7	44.4	10.8	9.9	9.3	2.3	0.04	1.0	4.6
Per cent extracted.....	.....	.....	.....	.....	.....	.....	82.4	.....	.....	.....	.....
C. M. Concentrate											
Calcine.....	100	13.7	.....	16.0	5.7	9.8	35.6	.....	.....	7.4	.....
Leach residue.....	46	23.2	.....	34.5	12.4	21.6	9.7	.....	.....	0.6	2.2
Per cent extracted.....	.....	.....	.....	.....	.....	.....	87.5	.....	.....	.....	.....

Note: These concentrates were roasted in a small reverberatory furnace with careful temperature control (450-650 deg. C.)

Practically all of the sulphate sulphur of the calcine appears in the solution as ammonium sulphate. A small loss of carbon dioxide in the leach residue is due to carbonation of lead and calcium sulphates contained in the calcine. Any lead that is present in the calcine as lead oxide apparently escapes carbonation. Considerable of the copper and cadmium, and minor amounts of iron, manganese, and arsenic, are dissolved. Copper and cadmium and a portion of the arsenic are readily precipitated as a metallic slime by agitating the solution with scrap zinc. Hydrogen gas is slowly liberated by reaction of ammonia with the scrap zinc:

<sup>1</sup>"Handbook of Metallurgy." Dr. Carl Schnabel, 2d ed. Vol. 1, pp. 679-686. "The Treatment of Complex Ores by the Ammonia-Carbon Dioxide Process." S. E. Bretherton. *Trans. A. I. M. E.*, Vol. 49, 802-808 (1914). U. S. patents 585,355, 611,917, 623,154, 654,804, 735,512, 780,293, 1,204,843.

<sup>2</sup>"Ammonia Leaching of Calumet Tailings." C. H. Benedict. *Eng. and Min. Journ.*, 104, 43-8 (1917). "Ammonia Leaching of Copper-Bearing Ores." L. Eddy. *Eng. and Min. Journ.*, 107, 1162, (1919) *Chem. & Met. Eng.*, 20, 328-34, (1919). U. S. patents 1,131,986, 1,238,954, 1,335,474.

during this purification; also, a minute quantity of arsine.

Continuous leaching can be done in covered steel tanks of the familiar pachuca design, wherein agitation is accomplished by cast-iron centrifugal pumps instead of by compressed air. The pulp would be filtered, the residue washed in the press with weak ammonia solution, and the cake blown dry and free of ammonia by steam. Continuous solution purification can be done in a series of covered steel tanks provided with revolving arms and a grid support for the scrap.

#### DISTILLATION OF PREGNANT SOLUTION

The distillation is best done in two stages. The first or roughing still expels volatile ammonia and carbon dioxide and precipitates about 90 per cent of the zinc as a basic zinc carbonate contaminated by basic sulphate. The approximate composition of this basic carbonate is  $5ZnO \cdot 2CO_2 \cdot 4H_2O$ . Prolonged boiling or distillation at elevated pressures would produce a more basic carbonate, but nothing would be gained thereby. Complete precipitation of the zinc is not obtained at this stage because of the solubility of zinc oxide in ammonium sulphate solutions. The amount of ammonium sulphate in the pregnant solution, and consequently the amount of zinc that escapes precipitation in the roughing still, varies with the sulphate sulphur content of the calcine. In general, about 10 per cent of the zinc may escape precipitation in the roughing still.

A continuous column still, with a scraper in each compartment, such as was developed in the copper leaching plant of the Calumet & Hecla Mining Co., would be suitable for the roughing distillation. The effluent of the roughing still would be filtered to remove the basic carbonate and then lime would be added to the hot solution to decompose the ammonium sulphate. The ammonia that is freed by the lime is enough to hold the remaining zinc in solution and to permit the filtering and thorough washing of the precipitated calcium sulphate.

The solution would now pass to a finishing still of the ordinary type for recovery of the ammonia, and precipitation of the remaining zinc as hydrate. No lime need be fed to this still, as a liberal excess of lime can be used for the decomposition of the ammonium sulphate without danger of precipitating zinc. The finishing still effluent contains about 0.3 gram  $NH_3$  and 0.1 gram ZnO per liter, and goes to the sewer.

Indicated ammonia and carbon dioxide losses, in the conduct of the process as here described, are 20 to 40 lb. of  $CO_2$  and 6 to 9 lb. of  $NH_3$  per ton of average complex 35 per cent Zn concentrates.

#### CALCINING BASIC CARBONATE AND REFINING ZINC OXIDE

The basic zinc carbonate and hydrate filter cakes would be combined and calcined at 300 to 400 deg. C. in a muffled Brunton or other small muffled furnace. About one-fifth of the carbon dioxide used in the leach is contained in the basic carbonate. This carbon dioxide, and any ammonia retained in the cakes, can be recovered by cooling the muffle gases and absorbing in sodium carbonate or ammonia solution. The crude zinc oxide obtained by this calcination has the following approximate percentage composition:

ZnO	SO <sub>3</sub>	Cu	Pb	Cd	"Insol."	FeO <sub>3</sub>	Mn <sub>2</sub> O <sub>3</sub>	As <sub>2</sub> O <sub>3</sub>	CO <sub>2</sub>
96.4	2.7	None	None	0.005	0.10	0.35	0.04	0.10	

This crude oxide is of poor color and low covering power. By mixing it with about one-third of its weight of coke and refining in a small reverberatory furnace, an oxide of excellent color and covering power is obtained which contains approximately 99.7 per cent ZnO and 0.1 per cent SO<sub>3</sub>.

### Gold Mining in South Dakota Increasing

Two lode mines in the Black Hills in South Dakota, the Homestake and the Trojan, and several small placers produced \$6,605,167 in gold and 112,464 oz. of silver in 1921. The quantity of bullion produced by these mines during the first six months of 1922 indicates, according to C. W. Henderson, of the U. S. Geological Survey, that the production of gold and silver in South Dakota in 1922 will be slightly larger than in 1921, and if the new South mill of the Homestake company, the machinery for which is now being installed, is in operation by September, the production may be materially increased.

### Some Amador County Mines Being Reopened

In Amador County, California, the old Moore mine, near Jackson, is being reopened after an idleness of thirty-five years and a new 20-stamp mill and electric hoist are being built, according to the U. S. Geological Survey. The Argonaut mine, at Jackson, is dropping sixty stamps and the Kennedy eighty. The Kennedy company has brought suit against the Argonaut for damages due to underground fire and the flooding of the mine. In the Oroville field, Butte County, only three dredges are not in operation and two of these will work out their ground this year. Ten years ago forty dredges were at work. At Las Plumas the Surcease mine is being reopened and a mill and other machinery are to be installed. The Golden Mary, near Merrimac, is to have a new mill. In Calaveras County the Carson Hill Gold Mines, Inc., has purchased the mine and plant of the Melones company, thus putting under one management these two valuable properties, both using the Melones tunnel. The Easy Bird mine, Mokelumne Hill, is being reopened. New machinery for the Triple Lode mine, at Angels, is being installed, and at the same place the California Exploration Co., of San Francisco, has purchased the Angels Deep mine.

The Calaveras Copper and Penn Mining companies remain closed in 1922 as in 1921, but some cement copper is being made from the mine waters of the Penn. A number of small quartz and placer claims have been started up in Eldorado County this year. In Inyo County the Lucky Jim mine of the Darwin Silver Co., at Darwin, is being worked under lease by A. G. Kirby after a period of idleness. Silver-lead concentrates are being shipped to the smelter in Utah. When the aerial tramway now under construction is completed, the Defiance mine will be worked. The Tecopa Consolidated, at Tecopa, continues to ship 1,500 to 2,000 tons of \$30 carbonate lead-silver ore a month. The Slate Range Consolidated Mining Co., working both the Slate Range and Marble Hall mines, has been installing new machinery, including air compressor and drill, hoist, and mill equipment. The shaft is being sunk 500 ft. deeper. The Estelle Mining Co., at Keller, is shipping such ore as is taken out in prospecting and development work.

## Variable Voltage Installation at the Missouri School of Mines

New Equipment for Controlling Power Conditions in Electro-thermic Work Allows Full Capacity at Voltages from 18.5 to 506, and Down to Zero at Lower Capacities—Some Features Are Unique

BY T. M. BAINS, JR.

Associate Professor of Metallurgy, Rolla, Mo.

**A** RECENT INSTALLATION at the School of Mines and Metallurgy at Rolla, Missouri, for the electro-thermic work, is unique in certain features. Whenever electric-furnace problems are to be worked out, there are always a number of variable factors which have to be determined, and flexible voltage control is necessary. The voltage control here obtainable covers a range of voltage from 0 to 506 v. Full capacity

cable to the Metallurgy building. A branch line is also run to the Electrical Engineering building. The above equipment of the school has hitherto been used for the electrical engineering laboratories only.

Upon entering the Metallurgy building, the current passes through three disconnecting switches, to the oil circuit-breakers, Fig. 1, thence to the single-phase induction regulators and to the primary of the three

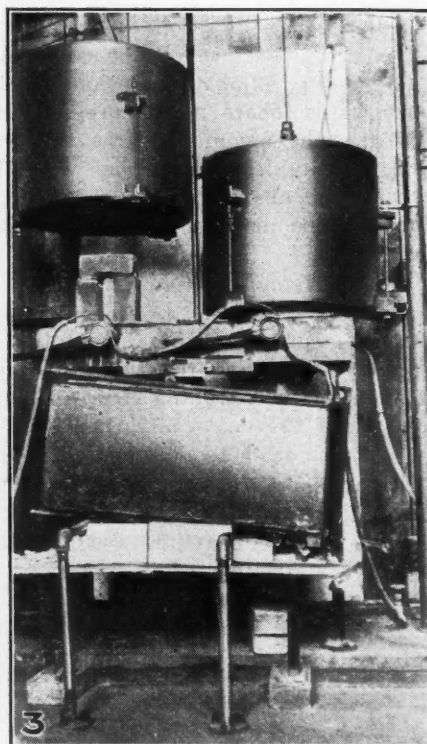
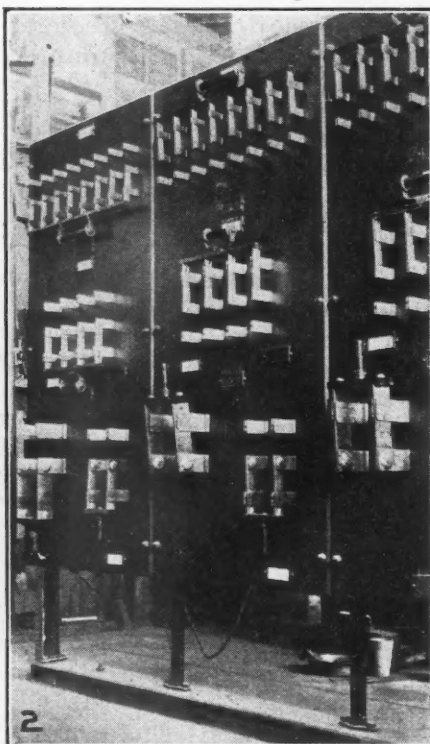
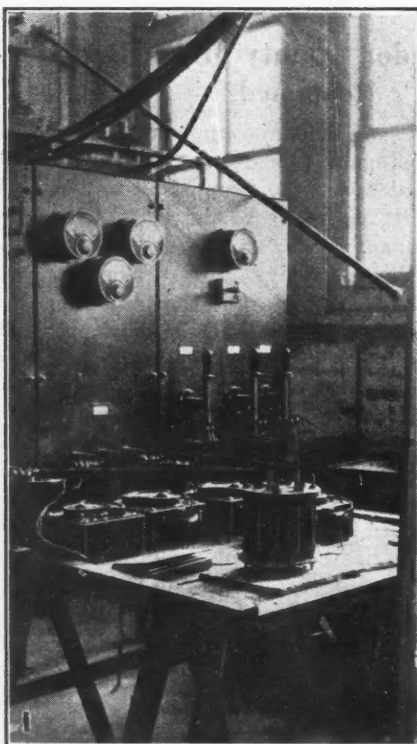


Fig. 1. High-voltage panels. Fig. 2. Secondary, or low-voltage panels. Fig. 3. Two-column zinc furnaces.

of the generating unit at the power house can be utilized at voltages from  $18\frac{1}{2}$  up to 506 v. Below  $18\frac{1}{2}$  v. a reduced capacity is necessary on account of the limiting feature of the current-carrying capacities of the transformers, regulators, and switchboard.

This equipment was furnished by the General Electric Co. It has been operating for four months, giving perfect satisfaction.

The generating unit is a 60-cycle, 40-kw., 220-v. generator driven by a vertical type of steam engine. The current from the generator goes to a switchboard with ammeters, wattmeter, and necessary protective devices, then to three single-phase, 60-cycle, 20-kva., 2,220—220-v. transformers. These transformers are delta-connected on both primary and secondary sides. The current then goes from the secondary of the transformers at 2,200-v. through a three-phase lead-covered

single-phase transformers. Switching devices on the high-tension side of the equipment allow the primaries of the single-phase transformers to be connected either in delta or "Y." The secondaries of the three transformers each have eight coils with sixteen leads coming out of the transformer case. By means of switching devices on the switchboard these coils can be thrown in series, series-multiple, multiple-series, and multiple, thus obtaining respectively 220, 110, 55, and  $27\frac{1}{2}$  v. on the single-phase busses. By means of a three-pole double-throw switch, the single-phase busses can either be connected delta or "Y."

By throwing the primary into "Y" and the secondaries into delta, 128, 64, 32, or 16 v. is impressed on the secondary busses. By throwing the primaries into delta and the secondaries into "Y," 382, 191,  $95\frac{1}{2}$ , and 48 v. can be obtained.



The induction regulators are designed so that a boost or buck of 730 v. may be obtained. As the secondary windings of the regulators are in series with the primary windings of the transformers, this means that with 2,200 v. impressed on the line, the voltage at the terminals of the transformers can be varied from 1,462 to 2,925 v. The transformers are therefore designed for 2,925 v. primary, so that the iron in the transformers will not be too highly saturated when the regulators are in the maximum "boost" position. By means of these regulators, therefore, any voltage from 18½ to 506 v. can be obtained at a capacity of 45 kva., three-phase. When the regulators are "boosting," a greater transformer capacity, up to 60 kw. for maximum boost, may be obtained. Below 18½ volts, reduced capacity may only be utilized on account of the carrying capacity of the copper.

If voltage below 10 v. is desired at reduced capacity, it may be obtained, down to 0, by means of a transformer rated 60-cycle, 12 kva., 220—12 v., single-phase. The primary of this transformer may be connected to the 220-v. a. c. supply circuit, which is also brought into the Metallurgy building from the generator switchboard. The secondary of this transformer is placed in series with the secondary circuit from any one of the single-phase panels. The connections are made so that the secondary of the 12-kva. transformer will "buck" the secondary of the transformer connected with the regulator. As it is possible to secure 12 v. on this second transformer, zero voltage can thus be obtained. If one volt is desired, a voltage of 13 v. is held on the induc-

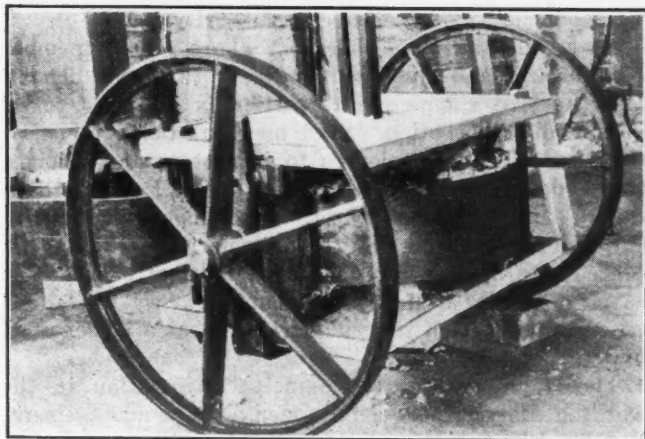


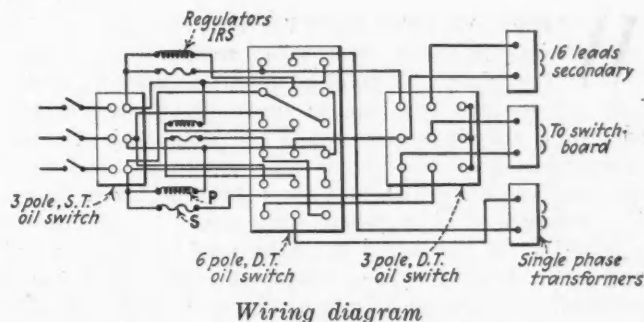
Fig. 4. Induction furnace for drill steel

tion regulator-transformer unit and the 12-v. "buck" of the 12-kva. transformer will give the desired voltage. By this means any voltage from 0 to 10 v. single-phase can be secured, at a capacity depending on the maximum current-carrying capacity of the equipment.

At present, the equipment is so connected that one single-phase panel is used entirely for laboratory purposes by the Bureau of Mines and Metallurgy Department. The feeder wires from this panel are carried up to the different laboratories in the building and a system of remote control allows the regulator controlling this single-phase system to be operated from the laboratories.

The second and third single-phase panels are used for electrothermic work in the basement, where the equipment is installed. (Fig. 2). It is, therefore, possible to furnish the laboratories with a variable

voltage, single-phase, from 18½ to 292 v. at a maximum capacity of 15 kva. At the same time two single-phase electric furnaces near the switchboard can be operated at different voltages from the other two panels with a full-load capacity of 15 kva. each. Or else a three-phase "open delta" connection can be made so that a three-phase furnace can be operated at voltages from 18½ to 292 v., with a full-load capacity of 25 kva., three-phase.



So far there has been no demand for a two-phase circuit, but should such be desired, a Scott transformer can be secured so that instead of three-phase, two-phase can be secured for furnace work. However, there is very little use for two-phase furnaces as the transmission lines are generally three-phase.

It will be noted that with the arrangement of circuits as described in the above paragraph, and, as shown in the wiring diagram, only the delta connections on both the primary and secondary can be used. The "Y" can be used only for three-phase work when the three transformers and three regulators are being operated as a unit, or for single phase, on one or more phases, if the voltages used on different phases are approximately the same.

At present, the following electrothermic furnaces are in use:

- 2 Single-phase zinc briquet furnaces of the intermittent type, 15 kva. each, with condenser, heated by carborundum brick. Fig. 3.
- 1 Three-phase briquet furnace of the continuous type, 15 kva.
- 1 Crucible furnace, granular resistor, 10 kva.
- 1 Bake oven, granular resistor, 10 kva.
- 2 Hot plates, granular resistor, 10 kva.
- 4 Granular furnaces, 5 kva.
- 1 Induction furnace, 5 kva., 12-v. primary for heating drill steel. Fig. 4.
- 2 Drill steel furnaces of the carborundum type, 5 kva.

Students in electrometallurgy build various types of electric furnaces, which are tested and replaced by other types. Portable General Electric P-3 voltmeters, ammeters, wattmeters, and power-factor meters are used for readings on the low-voltage side of the equipment.

#### Good Bricks From Dolomite

At the ceramic experiment station, Columbus, Ohio, the U. S. Bureau of Mines has made standard sized bricks from calcined dolomite and from raw dolomite using 10 per cent of the flux  $Fe_2O_3$ ,  $Al_2O_3$ ,  $SiO_2$ . Calcined dolomite was found undesirable for making bricks; the mud slakes rapidly, and on account of enormous shrinkage during drying and burning, samples crack badly. Raw dolomite, together with 10 per cent flux, gives excellent promise. The bricks so burned to 1,450 deg. C. were sound, of high density and have not yet shown signs of slaking when subjected to the boiling test.

## Mine Labor

An Analysis—Unit Costs Important as Means of Controlling Operations—Measurement of All Work Desirable—Contract Or Bonus System Advisable To Reward Additional Effort

BY H. J. C. MACDONALD

WHEN AN INQUISITIVE VISITOR asks a mine superintendent just what amounts were spent for labor and supplies upon an outgoing train-load of ore the question is unusually pertinent and searching, for the superintendent is entrusted with the economic use of mine labor and supplies. Therefore, the range within which he knows these things will be a just measure of his personal efficiency.

Standing at the last turn in the road between capital and labor, upon the superintendent rests the ultimate responsibility for all details of the mine work. Funds are provided him for the upkeep and operation of a plant whose chief function is the economic conversion of labor and supplies into shipped ore. His duties include the selection, safety, and placing of all employees so as to provide them with increasingly productive work, as well as their discipline, recompense, promotion, and cooperation, besides, at the same time, watchfulness over the choice, distribution, and consumption of mine supplies. Through the staff he has to combine and coordinate all this routine along the course of greatest advantage to the operating company and to the mine. This entails not only low-cost production, but the expert exploration and development of all ore possibilities throughout the company's mineral area, and especially the safe-keeping and protection of the known ore reserves and resources through well-planned and careful extraction.

The mine foreman is so insistently looked to for the daily delivery of the rated tonnage output that the volume of the work, not the costs, holds first place with him. Eager to accomplish the work forced upon him, he may retain too many men in the mine. But too great a feeling of security often moderates the vigilance of supervision, resulting in high labor costs through not gaining the maximum output from each workman. A well-sustained tonnage output and low costs should go hand in hand.

### FOREMAN ACCOUNTABLE FOR MINE WORK

As the majority of mine employees are under the direct command of the mine foreman, upon him devolves the intelligent direction of the greater part of the mine work. Seconded by his shift bosses, he selects and places all workmen at the tasks they are best fitted for, and provides them with the needed tools and supplies and with a definite program for the day. As needed, he instructs them in the proper performance of their tasks. The responsibility for the safety of the men falls directly upon him. At the right hand of the superintendent, to whom he reports all unusual occurrences that interfere with the orderly progress of the routine work, the foreman is accountable for all mining activities.

Technical direction depends upon the evidence collected by the mine engineer. Throughout, the theoretical must be evenly balanced with the commercial. The engineer compiles in the mine balance sheet the estimate of ore reserves, the residual tonnage of extractable ore. His special duty is to compel adherence to

the development plans and stoping campaign through the survey control of mine openings.

The unbroken record of the cost of mine work is the duty of the accountant. In addition, at regular intervals he prepares reports as to the financial condition of the company, also showing how labor and supplies have been absorbed.

The superintendent and his three aids, the foreman, the engineer, and the accountant, share in the direction and insure the smooth running of the plant. In the smaller mines, these four may actually exercise all directive functions, and in the larger they become the leaders of the general, operating, technical, and accounting staffs.

### TENDENCY TOWARD TOO SMALL STAFFS

With due regard for the scope of the mine work, comparison of the size of the staff with the total numbers of employees is always of interest and importance. As numerous petty bosses on the staff are often paid by the day, this factor is inadequately indicated on the usual wage and salary lists. So all existing lines of authority have to be traced to their ends to compute a total inclusive of everyone in authority.

A small staff is effective where each member systematizes and standardizes the work of his department so that complete information is imparted to all in control of operation. Staff members being the most conspicuous mine employees to inspectors and officials, the tendency is toward too small staffs. For it is difficult to explain and justify duties that involve past, present, and future time. So the diplomatic operator often concedes to an officious opposition; for, after all, it is easier to under-staff a mine than to array the added expense and hidden supernumeraries that a larger staff underground creates.

The wage scale is the principal stipulation in the working contract between the men and the management. Besides being mutually understood and agreed upon, any alteration in this scale has to be made with thoughtful consideration of the probable outcome. In looking over a schedule of mine-labor costs, the average of all daily wages paid invites comparison with the wage paid to the predominant class, the miners, as both are reliable index figures to which to refer when a series of months or years of operation is being examined.

### GROUPING EMPLOYEES

A numerical listing of employees by nationality is valuable where well-balanced crews are preferred. This list shows the relative strength of groups that are bound together by all that race means to them, and warns of an undesirable preponderance of any one of these. Further, in times of labor unrest, knowing the leaders in each group, an unofficial channel of communication is open for the casual interchange of harmonizing ideas.

A shipping mine, with little hiring and firing, can steadily employ a crew that remains nearly constant in

numerical strength. Mining at many working faces, a company stopes ore for present shipment and develops ore for future shipment. Where a variable output is demanded by the mill or smelter, these two fields, stopping and development, can be used to equalize the mine work. Also, where warranted, future work can be encroached upon, ore stoped for shipment at a later date, and development carried out far in advance of the demand.

#### MAINTAINING EFFICIENT CREWS AN ENDLESS PROCESS

Undoubtedly, strict discipline must be maintained. But far the greater amount of discharging and hiring aims to replace the most inefficient with the more efficient; that is, it is an endless and artificial selection of the fittest. Wholesale discharge and the continual prospect for new employees is the habit of operators who are impatient with all restive and refractory labor material. Efficient management, however, requires that when a workman becomes negligent in the regular pursuit of his duties, every endeavor should be made to discover the underlying cause and to determine if this be reasonable and removable. The question then is, would further instruction in the task or transference to a more befitting place and occupation be a saving for the company?

The boss of the old school is fast disappearing before awakened and up-to-date management and before the strength of organized labor itself. And so resistless is modern impulse in its elimination of the more abusive types, that anyone will hold a brief reign, even if he be an exceptionally efficient engineer, who attempts to place himself upon this ancient and arrogant throne. Also, the best miners are cosmopolitan enough to counteract undue coercion on the part of the management by discrimination between plants. Such conditions, in the long run, should reward those companies that select leaders with the moral ballast to deal most squarely with labor.

#### RIVALRY SOMETIMES MISTAKEN FOR FRICTION

A paternal interest in their tasks arouses continual rivalry among the employees which often breaks out in strife and friction between those in equal authority. Thus, human instinct brings into relief the more imperfect points of contact in the daily procedure. This is sometimes termed by the superficial observer lack of co-operation. It seldom is. And all unrest is not harmful, whereas placid accord might be deceptive. A watchful operator can easily recognize the lack of harmony that is destructive, and thus readily eliminate those interactions that sap the vitality from an organization.

Innovations will always encounter a certain opposition; for all workmen possess an inertia of habit and training, coupled with a creative interest in their work. These traits are often strongest in the most skillful. But these same mental attitudes incite ideas that test and weigh any proposed innovation, and uncover the weaker points of departure from the customary practice. So by making proper use of the workers' intelligence, the countercurrent that is set up will assist the reasonable operator.

In the matter of promoting men, the whole fiber of an organization is weakened through the hit-or-miss selection that promotes the less able or the ever-present kinsman. Such action is resented by all. On this account alone, the concepts of a supervisor who oversees many

tasks should be confirmed by actual measurement of work accomplished.

The argument for checking measurements is that constant scrutiny over mine workmen is not possible in practice. Underground workers are so split up into small groups that the boss completes only a few "rounds" a shift. So to maintain a uniform high standard, all rigid measurements possible should be put into practice.

#### TONNAGE BROKEN AN INDEX OF RESULTS

The result of mine labor can be read in the tonnage figures and in the unit operating costs. Mine work is rock broken or moved in the course of stoping or developments. At each stage in the chain of operations the actual weight of rock, always inclusive of the waste rock, gives an exact measure of expended effort.

In practice there are several machines in each stope, so that their output is inadvertently mixed. Moreover, stope storage usually is the practice in the mine as a buffer that puts breakage in stopes out of tune with the remainder of mine work. Yet sometimes stopes can be readily emptied, or perhaps surveyed, to allow frequent measure of the rock broken in a stated number of miner's shifts. More often breakage is averaged over considerable periods from the ore shipments. This records the average miner-shift or machine-shift tonnage, a universal measuring rod, yet is often inaccurate in mine comparisons when it includes and conceals the waste rock drilled and broken at the same time.

The rock broken in development has little storage space at the headings and appears almost at once in the haulage records. So here the work of breakage is readily measured by the tonnage, only to be set aside for other simple measures applicable to a set and restricted opening.

#### ORE HANDLING MORE READILY MEASURED

The second cardinal division of mine effort, handling, is more responsive to accurate tonnage measure. Such figures seldom reflect the work of a single man, although this is often approached, but rather show the combined result of a crew engaged upon the same kind of work.

However, the attempt continuously should be made to measure so far as practicable the accomplishment of each employee. In this manner many standards come into use. As intrinsic value of work is hard to compute, such standards catalog the workmen in an imperfect listing.

#### WORK CONTROLLED THROUGH UNIT COSTS

In good practice the unit costs afford an accurate comparison between the task and its expense. Through the unit costs all branches of mine work can be controlled and co-ordinated. Where the costs are utilized completely by the proper authority, economies will be made. The retention of the normal interrelation of operations in the cost accounts, furthermore, registers the place and the consequences of all delay in the mine work.

#### EXTRA EFFORT OF WORKMAN SHOULD BE REWARDED

Between the output a workman turns out for others and the larger one that, if he wants to, he can produce for himself there exists a margin that is a dominant factor in all industry. Practically, under present conditions, this reserved toil is an inalienable right of the

employee. To make him give it up there must be a payment that entices beyond the daily wage—a contract, bonus or piece rate based upon reward for extra effort and personal exertion; or in the workman there must be created, in some way, a feeling of personal interest in an increased output. Commonly, employers become freebooters of the whole margin, finally defeating their own ends through cutting the contract rates to the vanishing point for incentive. These dubious and grasping methods have aroused an ill-advised but protective and organized resistance to all comparative productiveness methods of wage payment. Still, where the cost of standard performance has been well established, a fair employer can reap great benefit through equitable contracts that share this margin, to the mutual advantage of both employer and employee.

#### CONTRACT SYSTEM MOST ADAPTABLE TO DEVELOPMENT

Mine development, with its easily measured work and its widely separated working faces, is a fertile field for the contract system. This is especially true where all past work is clearly mapped before the operator by well-kept records. Then an equitable contract figure can be settled upon by the methodical use of repeated experiments in past development. A system of payment in development that is remunerative in proportion to actual accomplishment also gives a chance to attract, retain and recompense a large number of capable employees for whom there may exist no promotion places, or who are energetic and industrious without having the qualities for successful leadership.

#### CONTRACT WORK MUST BE SUPERVISED

Contracting stoping is hampered because the real proceeds from stoping crews must be measured while maintaining an advantageous confluence of mine tonnages, and, above all, because the mine ore reserves must be protected. Where this can be done, stoping also becomes a fruitful contract field. But supervision cannot relax, for having their own business to promote, contractors may neglect safety, be destructive of commodities, implements or machines, and, moreover, retard the other mine work.

Stope contracts lead into leasing systems, usually as the mine is approaching exhaustion, where there is a lack of working capital, where there is, or has been, a breakdown in the technical extraction of ore, or where exceptional natural conditions are encountered. In all such systems, loss of company control over mine workmen must be replaced by a strong mutual understanding; for essentially this makes a series of contracts for similar work most successful because of the experience of years where the rates have been equitable and have been established by a management having the confidence of the employees.

#### SLIDING SCALE OF PAYMENT OBJECTIONABLE

The integral of mine achievement is the mining and shipping of a ton of ore. Its mineral contents may reflect the skill of mine direction, but they cannot measure the effort expended by the workman. In this fact lies an ingrained objection to the sliding scale of wage payment that advances pay with a rise in the selling price of metals, that part of the profits which are a direct saving from low operating expenses being entirely ignored. As the marketing and speculative sides of mining are not earned increments of the mine workmen, this widespread system fails to maintain

high efficiency at those times when the highest wages are being paid. Though the sharing of abnormal profits undoubtedly buys some good will in so far as it creates an impression of liberal management, it is certain that any form of profit sharing should be safeguarded by measures that enforce an unslackened standard of mine efficiency at all times.

In dealing with its chief problem, labor, the mining industry has proceeded along a little-altered course during the recent strenuous years. While other industries have resorted to various labor legerdemains, and, in the modern manner, have sometimes rushed to extremes, the costly disasters and successes in the restless and undulatory labor world remain in greater part an open door to the mine operator of today. He can deliberate upon the rapid swing of the pendulum from the opposite extremes of "efficiency" and "social democracy," and now, restrained by the practiced hands of plant operators, watch it swing back to a sane mid-point.

The one way to combat labor unrest in the coming years is to build from within upon the incentive that finds satisfaction in work well done. Progressive employers have already made rapid strides in the accomplishment of this object, and the further they advance the more successful and consistent the method suggested appears to be.

### Standardization of Structural Slate Products Effects Economy

Standardization of products should greatly reduce the cost of manufacture and eliminate much waste. According to Oliver Bowles, mineral technologist of the U. S. Bureau of Mines, the necessity for the elimination of superfluous varieties and the better standardization of essential products is now recognized. For example, it has been customary for manufacturers of structural slate to prepare it in sizes specified by builders and architects. Thus, the material could not be manufactured in advance. The result has been irregular activity of mills and delays in filling orders, and in some instances the forcing of manufacturers to use raw materials that might be better adapted for products other than those called for in the orders. To improve this condition, one of the slate-producing companies of Pennsylvania has issued a series of pamphlets giving complete specifications of structural slate for various purposes. Architects find it so much easier to order slate from these sheets that, in preparing plans for new structures, standard sizes are specified. Slate producers will probably be enabled to build up a reserve stock of standard sizes, which will be advantageous both in marketing and in manufacturing.

Slate switchboards are also usually manufactured after the order has been received. The most serious objection to the filling of orders directly from the quarry is that freshly quarried slabs have only about half the resistance in ohms of the same slabs after drying out for three months. One Chicago manufacturer claims that 80 per cent of all switchboards are of standard sizes, and he keeps such sizes in stock. The facility with which orders may be filled from stock, and the improved quality of seasoned switchboards, will undoubtedly influence electrical companies toward a more uniform standardization in size. Simplicity could be attained to a greater degree by the elimination of minor irregularities in style, as for example in the beveled edges.

# The Principal Mines of Japan

Location, Geology, Mineralogy and Production in 1917 of Properties of Importance in the Islands—Ore Deposits and Related Rocks Classified According to Geological Period

BY H. NISHIHARA

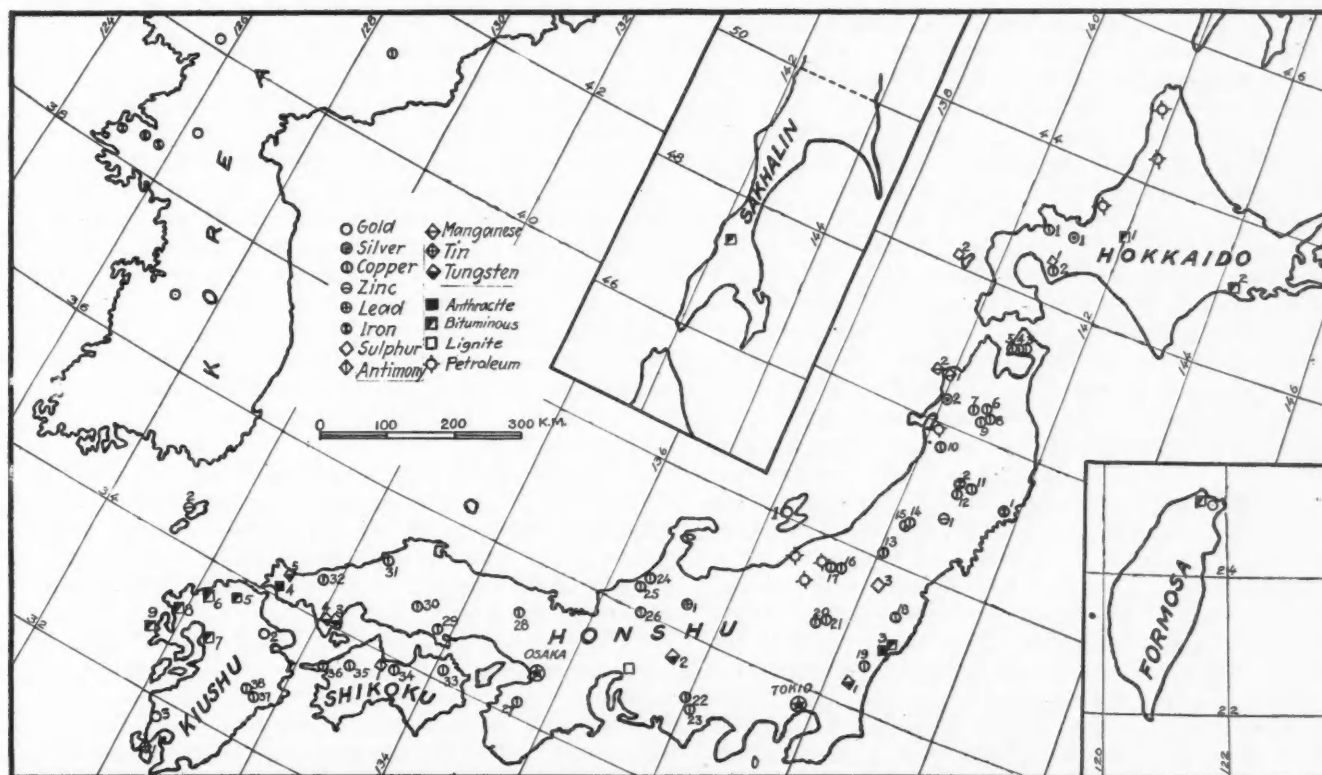
**I**N THIS ARTICLE the author tersely describes the principal features of the geology and mineralogy of the more important mines of the Japanese islands. He has grouped the deposits according to the principal metal produced rather than according to the geographic location. The figures given in parenthesis refer to the accompanying map.—EDITOR.

### GOLD AND SILVER DEPOSITS

*Sado mine (gold, 1).* The Sado mine is situated on Sado Island, near Aikawa. The formations are Tertiary tuff and shale cut by pyroxene andesite. There are three principal veins running almost east

ft. The main vein strikes east and west and dips north. The other veins strike northwest and southeast. The width of the veins varies from 2 to 30 ft. The ore minerals are proustite, pyrargyrite, stephanite and at many places the veins contain silver as high as 10 per cent and gold as much as 0.1 per cent. In the upper part of the orebody below the oxidation zone a great quantity of secondarily enriched native gold has been extracted. In 1917, 10,518 tons of ore was mined which contained 0.8 oz. gold and 11.2 oz. silver per ton.

*Kushikino mine (gold, 3).* The Kushikino gold mine is in southwestern Kiushu. The rocks are Tertiary sandstone and tuff intruded by pyroxene-andesite in



Map showing location of principal mineral deposits in islands of Japan

and west. The length of veins is from 2,500 to 4,000 ft. and the width varies from 1 to 100 ft. The veins consist of quartz and calcite and contain native gold and silver together with argentite, chalcopyrite, pyrite, zinc blende, and galena. Stephanite, pyrargyrite, marcasite, and arsenopyrite are also reported. In 1917 the output was 16,347 oz. of gold and 174,500 oz. of silver.

*Bajo mine (gold, 2).* This is in northeastern Kiushu. The district is almost covered with andesite and its agglomerate. A small area of Tertiary sediments, granite, gneiss, and crystalline schist is exposed. The ore bringer is a propylite andesite, which is widely distributed in other gold producing districts in Kiushu. There are six rich veins in the sericitized granite. The length is 2,000 ft. and the width varies from 2 to 8

ft. which gold-bearing quartz veins are found. The veins strike east and west and dip south at an angle between 30 and 70 deg. The longest is 7,000 ft. and the width varies from 10 to 150 ft. The average tenor of the ore is 0.384 oz. gold and 3.52 oz. silver per ton. In 1917, 82,425 tons of ore was mined yielding 30,744 oz. of gold and 267,970 oz. of silver.

*Toyoha mine (silver, 1).* This is in the mid-western part of Hokkaido. The deposit is in fissure veins in pyroxene-andesite. The ore minerals are silver-bearing pyrite, galena and zinc blende. The oxidized orebody is from 50 to 100 ft. deep and the richest ore is found in a mixture of red clay and quartz. In 1917, the mine produced 110,000 tons of rich silver ore carrying 2 oz. in gold per ton.

*Kunitomi mine (copper, 1).* The Kunitomi mine is in the western part of Hokkaido. The orebody is a replacement deposit between Tertiary shale and liparite, which is closely related to the deposition of ore. The ore is disseminated, bedded or massive, and the bodies are of various sizes. The average tenor of the ore is 2.6 per cent copper, 0.022 oz. gold, and 1.568 oz. silver per ton. In 1920, the mine produced 1,200 oz. of gold, 81,000 oz. of silver and about 1,400,000 lb. of copper.

*Horobetsu mine (copper, 2).* Here there is a pyrite-chalcopyrite-quartz vein in tuff breccia. Another orebody at the contact between rhyolite and tuff is a network of veins. The grade of the ore is 2.25 per cent copper, 0.06 oz. gold, and 0.41 oz. silver per ton. In 1917, the mine produced 17,337 tons of ore.

*Abeshiro mine (copper, 3).* This is located in the northern end of Honshu. The rocks in the district are liparite and andesite flow. A small patch of Tertiary sedimentary rocks is exposed near the deposit. The liparite, which is closely connected with the ore deposit, intrudes the Tertiary rocks as a mass or sheet or as dikes. The orebody is an irregular mass in the intensely brecciated liparite, which is replaced by the ore. First brecciated of the liparite has taken place, followed by silicification and replacement by and deposition of pyrite and chalcopyrite, followed by dissemination of zinc blende, galena and barite. The average tenor of the ore is 0.019 oz. gold, 1.2 oz. silver, and 1.45 per cent copper. In 1917 the company mined 72,700 tons of ore and produced 6,810,700 lb. of copper.

*Taisho mine (copper, 4).* The Taisho mine is west of the Abeshiro mine. The rocks are Tertiary tuff, shale and intrusive liparite. The deposit is a replacement in the Tertiary rocks and in the liparite. The roof is either decomposed shale or clay, and the floor is mainly liparite and at some places conglomerate. The thickness of the orebody is between 35 and 100 ft. The ore minerals are, in the order of importance, chalcopyrite, zinc blende, galena, pyrite, and the gangue minerals are quartz and barite. The ore runs 3 per cent copper. The mine, in 1917, produced 1,190,683 lb. of 95.33-per cent copper containing 1.12 oz. gold and 39.04 oz. silver per ton.

*Nishimata mine (copper, 5).* This is west of the Taisho mine. The rocks in the district are dacite, liparite and Tertiary tuffs. The ore deposit is an irregular mass in the contact zone between tuff and liparite. The ore consists of pyrite, chalcopyrite, zinc blende and galena, with a gangue of quartz and barite. In 1917, the mine produced 67,274 tons of ore carrying 3.132 per cent copper, 0.03 oz. gold and 3.2 oz. silver per ton.

*Hachimori mine (silver, 2).* The Hachimori mine is in Akita. Tertiary shale is intruded by pyroxene-andesite and cut through by innumerable fissure networks. Two massive orebodies are found in the brecciated shale. The ore is rich in silver and in some places 0.1 per cent is reported. The ore is a intimate mixture of galena, zinc blende, barite, witherite, quartz, and chalcopyrite. The tenor of the ore is 84.8 oz. of silver and 3.8 per cent copper. In 1917, 2,116,400 lb. of copper was produced.

*Kosaka mine (copper, 6).* The Kosaka mine is in the northern part of Honshu. The rocks are liparite, dacite, pyroxene-andesite, and Tertiary shale. A massive orebody is in brecciated tuff and also in the decomposed liparite. The roof is somewhat propylitized andesite and the floor is liparite. The irregular orebody forks

in depth. The ore minerals, in the order of importance, are pyrite, chalcopyrite, galena, zinc blende, and bismuthinite, with gangue minerals of barite and quartz. In 1917 the mine produced 215,385 tons of ore carrying 1.665 per cent copper, 0.012 oz. gold, and 1.115 oz. silver per ton.

*Hanaoka mine (copper, 7).* This mine is in the province of Akita, west of the Kosaka mine. Tertiary tuff is intruded by liparite and covered by pyroxene-andesite. The irregular and massive orebodies are surrounded by clayey material and decomposed tuff, which are cut through by innumerable veins of gypsum. The ore consists of pyrite, chalcopyrite, galena, zinc blende, quartz and gypsum. In 1917 the mine produced 113,732 tons of concentrate carrying 2.543 per cent copper, and 0.024 oz. in gold and 1.088 oz. in silver per ton.

*Furokura mine (copper, 8).* The Furokura mine is in Akita. The rocks are of Tertiary tuff and andesite. The veins are found in the decomposed andesite. They strike northeast and southwest and dip southeast or north-west 50 to 80 deg. The width is 2 to 6 ft. The ore minerals in the order of importance are chalcopyrite and pyrite with minor quantity of zinc blende. The gangue minerals are quartz and calcite. The tenor of the ore is 2.61 per cent copper. In 1917 80,961 tons of ore was mined.

*Osarusawa mine (copper, 9).* The Osarusawa mine is in Iwate province. Tertiary tuffs and shales are intruded by liparite and andesite. About seventy parallel veins in the sedimentary as well as in the igneous rocks are reported. The width of the veins varies from a few inches to 2 ft. The ore consists of chalcopyrite, pyrite, and bornite with a minor quantity of galena, zinc blende, hematite, native copper and chalcocite. The gangue minerals are quartz and barite. The tenor of the ore is 2.45 per cent copper. In 1917, the mine produced 5,932,587 lb. of copper containing 562 oz. of gold and 47,843 oz. of silver.

*Arakawa mine (copper, 10).* This is situated in Akita province. Tertiary sandstone and tuff breccia are intruded by liparite and sheets of andesite. There are quartz veins in the Tertiary rocks and pyroxene-andesite. The chief ore mineral is silver-bearing chalcopyrite. In 1917, 64,673 tons of ore carrying 2.329 per cent copper was mined.

*Tsunatori mine (copper, 11).* The Tsunatori mine is in Iwate province. The formations are Tertiary tuffs, shale and sandstone and liparite tuff breccia. There are two kinds of orebodies. The one is represented by the veins in the tuff and there are about twenty in number. The veins are from a few inches to 3 ft. in width and consist of pyrite and chalcopyrite. The other is ore represented by a chain of lenticular orebodies in the silicified tuff consisting of chalcopyrite and quartz carrying gold and silver. There are also galena and zinc blende together with barite and gypsum. The grade of the ore averages 3.06 per cent copper, 0.275 oz. gold, and 0.735 oz. silver. In 1917 14,471 tons of ore was mined.

*Oarasawa mine (copper, 12).* This is in Iwate province. The bed rock is hornblende granite upon which Tertiary tuff was deposited and in turn was intruded and cut by liparite dikes. The orebody lies in the tuff and also in the granite and liparite. There are ten nearly parallel veins carrying chalcopyrite, pyrite with some bornite and oxide of copper. In 1917 the mine produced 28,491 tons of ore carrying 2.52 per cent copper.

*Yoshino mine (copper, 13).* The Yoshino mine is in Yamagata province. Tertiary sedimentary rocks are intruded by liparite and andesite and at the contact between sedimentary and igneous rocks irregular orebodies replace either igneous or sedimentary rocks. In general, the top of the orebody is covered by clay to a thickness of 3 to 20 ft. Near the orebody the fissures in the brecciated tuff are filled (or the ore is disseminated) by the siliceous ore containing pyrite, bornite, and chalcopyrite. The ore is a mixture of pyrite, zinc blende, chalcopyrite, barite and bornite. The tenor is 0.021 oz. gold, 1.92 oz. silver, 1.65 per cent copper, and 7.32 per cent zinc. In 1917, the mine produced 40,518 tons of ore.

*Okura mine (copper, 14).* This is in Yamagata province. Tertiary tuff is intruded by liparite. It is a fissure vein deposit in the liparite. The vein strikes east and west and dips north. The width of the vein varies from 1 to 8 ft. The quartz vein contains chalcopyrite and bornite with a minor quantity of pyrite, galena, and zinc blende. In 1917, the output of the mine was 26,509 tons carrying 1.98 per cent of copper.

*Nagamatsu mine (copper, 15).* This is also in Yamagata province. Tertiary tuff and shale are intruded by liparite. There are some andesite dikes, but they have no connection with the ore deposition. The veins are numerous. Their strike is northeast and the dip is either northwest or southeast. The chief ore minerals are pyrite, chalcopyrite, and zinc blende, with silica as gangue. The tenor of the ore is 2.92 per cent copper. In 1917, the mine produced 1,817,813 lb. of copper.

*Shikase mine (copper, 16).* The Shikase mine is situated in Niigata province. The rocks in the district are Tertiary tuff and sandstone and intrusive liparite. It is a regular vein deposit in the sandstone, tuff, and liparite. The strike of the veins is northwest and southeast and the dip is 60 deg. northeast. The ore consists mainly of pyrite and chalcopyrite and carries 5.85 per cent copper. The output in 1917 was 1,808 tons.

*Mochikura mine (copper, 17).* This is located in Niigata province. Palaeozoic slate, sandstone, hornstone and limestone are intruded by granite and form a wide contact zone. The orebody is an irregular mass or is somewhat lenticular. The deposit consists of chalcopyrite, zinc blende, pyrrhotite, magnetite, pyrite, galena, hedenbergite, garnet, calcite and quartz. In 1917, the mine output was 28,562 tons of 2.65-per cent copper ore.

*Yakuki mine (copper, 18).* This mine is in Fukushima province. Palaeozoic slate, sandstone, hornstone, and limestone are intruded by granite. A lenticular orebody is in the metamorphosed limestone. The minerals are chalcopyrite, pyrite, pyrrhotite, arsenopyrite, zinc blende and galena with garnet and hedenbergite. The thickest part of the orebody is 300 ft. through. The copper content is 1.16 per cent. In 1917, 79,190 tons was mined.

*Hitachi mine (copper, 19).* The Hitachi mine is situated in Ibaragi province. Palaeozoic hornblendite, phyllite, sericite-schist, biotite-schist and limestone occur. The later intrusive rocks are granite and diorite. The deposition of the ore is related to the intrusion of the granite. The bedded orebody is in the hornblende-schist and the ore mineral is fine-grained pyrite. Cordierite, garnet, vesuvianite and

biotite are found at the contact with the granite. Below the oxidized zone a secondary enrichment zone from a few inches to 2 ft. thick occurs. The mineralized zone is 5,000 ft. long, 500 ft. wide and is worked to the depth of 1,500 ft. The pyritic ore contains 2.08 per cent copper and gold and silver in various quantities. In 1917, 553,319 tons of ore was mined yielding 18,420,121 lb. of copper, 11,514 oz. of gold and 119,580 oz. of silver.

*Ashio mine (copper, 20).* This is in Tochigi province. Palaeozoic clay slate, sandstone and hornstone are intruded by liparite. It is a fissure vein deposit in the liparite. There are over 200 veins which strike in all directions with high dip angles. The longest lode is a mile. The vein consists of quartz and calcite; the ore minerals, chalcopyrite, pyrite, galena, zinc blende and arsenopyrite. Intense sericitization is noted. Below the oxidized zone are found bornite, chalcocite, cuprite, malachite, azurite and native copper. The tenor of the ore is 2.34 per cent copper. In 1917, the production of copper was 27,027,490 lb.

*Kidogasawa mine (copper, 21).* This mine is also in Tochigi province. It is a fissure vein deposit in liparite and Tertiary tuff. The chief ore minerals are chalcopyrite and pyrite. The gangue minerals are quartz and calcite. The width of the vein varies from 3 to 15 ft. The tenor of the ore is 3.18 per cent copper. In 1917, the output of the mine was 41,042 tons.

*Kune mine (copper, 22).* The Kune mine is situated in Shizuoka province. It is a bedded replacement deposit in Archaean graphite- and chlorite-schist. The strike of the orebody is northeast to southwest and the dip 50 deg. northwest. The ore consists mainly of chalcopyrite mixed with pyrite containing 6 to 7 per cent of copper. The main orebodies are parallel lenses terminating at both ends in silicified orebodies or disseminating into the country rocks. The length is 850 ft. and the thickest part is 100 ft. It is worked to the depth of 1,300 ft. The output of the mine in 1917 was 198,400 tons of ore running 3.59 per cent copper.

*Minenosawa mine (copper, 23).* The mine is in Shizuoka province. Like Kune it is a bedded deposit in Archaean chlorite-schist. The ore is banded and very siliceous. The length of the orebody along the outcrop is 6,000 ft. The width varies from 20 to 30 ft. The strike is from northeast to southwest, dipping 65 deg. northwest. The chief ore mineral is copper-bearing pyrite and the average tenor of the ore is 2.11 per cent copper. In 1917 the mine produced 69,549 tons of ore.

*Yuzenji mine (copper, 24).* The Yuzenji mine is in Ishikawa province. The ore is in a fissure in the Tertiary tuff. First silicification, then deposition of sulphides and again silicification was the genesis. There are six important veins. Some strike northeast, dipping 60 to 80 deg. southeast, and others dip northwest. The width of the vein varies from 2 to 3 ft. The ore minerals are chalcopyrite and pyrite, the ore running 1.29 per cent copper. In 1917, the mine output was 42,243 tons.

*Ogoya mine (copper, 25).* This mine is located in Ishikawa province. Tertiary tuff is intruded by liparite and veins are found in the tuff. There are three important veins which run almost parallel, striking northwest and dipping toward the southwest or northeast at an angle of 70 or 80 deg. The width of the veins is 4 ft. on an average, the longest known being 2,000 ft. The veinstone consists of quartz and the ore minerals are chalcopyrite, tenorite, bornite, azurite, native copper, and pyrite. Secondary minerals are found near the

surface. They are bornite, azurite, chalcocite, and cuprite. The gangue minerals are quartz, calcite and a subordinate quantity of barite.

*Omotani mine (copper, 26).* This is in Fukui province. Mesozoic sandstone is intruded by liparite. There are numerous veins in the liparite. Their strike is northeast and the dip 60 deg. northwest. There are thirteen important veins in all, the width being on an average 4 ft. The veinstone consists of quartz, calcite and fluorite. The ore minerals are argentiferous chalcopyrite, bornite, argentiferous galena and zinc blende. At many places native silver has been found. The tenor of the ore is 0.009 oz. gold, 2.72 oz. silver, 1.17 per cent copper, and 1.07 per cent lead. In 1917, 53,430 tons of ore was mined.

*Imori mine (copper, 27).* The mine is in Wakayama province. The rocks are Archaean chlorite-, sericite-graphite-, and piedomontite-schists. The ore is a bedded pyrite deposit in the chlorite schist. The ore mineral is copper-bearing pyrite. The thickness of the orebody is 6 ft. The orebody strikes east and west, dipping south at an angle of 45 deg. The enriched part of the orebody is 2.5 ft. thick all the way through from east to west. The copper content is 1.2 per cent. In 1917 the mine produced 121,968 tons of ore.

*Ikuno mines (copper, 28).* This property is in Hiogo province. It includes three mines, Kanagase, Tasei, and Kasei, of which the first is the most productive. The Kanagase is an area of Mesozoic slate and sandstone, Tertiary tuff breccia and shale, which are intruded by liparite. All six veins are in the fissured liparite. They strike north and south and dip 60 deg. east. The principal vein is 7 ft. wide and the longest is 10,000 ft. long. The ore minerals are chalcopyrite, bornite, pyrite, argentite, galena, stibnite, pyrargyrite, zinc blende, bismuthinite, tetrahedrite and native silver and copper.

The Tasei mine is in Tertiary tuff, intruded by liparite. The principal lode is in the liparite and is 5,000 ft. long and 15 ft. wide. It strikes east and west, dipping 50 deg. north. The ore minerals are argentite, native gold and silver, chalcopyrite, pyrite, galena, zinc blende, and malachite.

The Kasei mine is in diorite traversed by liparite and propylite dikes. The veins are found in the diorite. The principal vein is 5,000 ft. long and is 50 ft. through at its greatest width. It strikes north and south and dips 50 deg. east. The chief ore minerals are argentite, native silver, chalcopyrite, pyrite, pyrargyrite, stibnite, galena, and zinc blende. The mines produced 115,628 tons of 1.84-per cent copper ore and 1,171 tons of silver ore in 1917.

*Obiye mine (copper, 29).* The Obiye mine is in Okayama province. Palaeozoic clay slate is cut by quartz-porphry. A granite is exposed in the district. The veins are found in the clay slate and their width is variable, but on an average is 2 ft. The ore minerals are chalcopyrite, pyrite, and argentiferous galena. The chief gangue is quartz. The tenor of the ore is 1.36 per cent copper. In 1917, the mine produced 5,933,571 lb. of copper containing 1.44 oz. gold and 8.96 oz. silver per ton.

*Yoshioka mine (copper, 30).* This is in Okayama province. Palaeozoic clay slate, sandstone and schalstein are cut by porphyry dikes and porphyrite. There are innumerable veins in the Palaeozoic rocks which strike northeast, dipping northwest. The width of the main vein is on an average only 1 ft., but its length is

nearly 3,000 ft. One vein lies in the porphyry and contact minerals are found. The ore minerals are, in the order of their abundance, chalcopyrite, pyrrhotite, pyrite, zinc blende, and arsenopyrite with gangue of quartz. The ore contains 1.1 per cent copper with 0.8 oz. of silver. In 1917, 71,209 tons of ore was mined.

*Omori mine (copper, 31).* The Omori property is in Shimane province. Hypersthene-quartz-andesite intrudes the Tertiary formation. The andesite is propylitized at some places. The veins, which are found in the andesite, consist of quartz and barite with pyrite and chalcopyrite as ore minerals. The sulphides carry gold and silver. The width of the vein varies from 1 to 2 ft. The strike of the veins is east and west and the dip is 60 deg. north. Other veins in the agglomeratic hypersthene-quartz-andesite carry native silver, argentite, siderite and malachite. The ore carries 1.76 per cent copper, 0.12 oz. gold, and 4.80 oz. silver per ton. The output of the mine in 1917 was 33,825 tons.

*Sasagatani mine (copper, 32).* This mine is likewise in Shimane province. Palaeozoic sandstone, hornstone, slate, and limestone are cut by liparite dikes. Contact metamorphic deposits are formed in the limestone. The ore minerals are chalcopyrite, arsenopyrite, zinc blende, pyrite, galena, and pyrrhotite, with gangue minerals of quartz, calcite, garnet, epidote, and wollastonite. The orebody strikes almost east and west and dips north at 50 deg. The grade of the ore is 1.65 per cent copper. The mine produced 21,516 tons in 1917.

*Higashiyama mine (copper, 33).* This property is in Tokushima province. It is a bedded deposit in the Archaean chlorite schist. The orebody strikes east and west, dipping 60 deg. south. The thickness is from 2 to 3 ft. The chief ore minerals are chalcopyrite and pyrite with siliceous gangue. The ore contains 1.09 per cent copper. About 69,000 tons of ore was mined in 1917.

*Besshi mine (copper, 34).* The Besshi mine is situated in Ehime province. The country rocks are Archaean chlorite-, graphite-, and quartz-schists in which a bedded deposit of pyrite and chalcopyrite is found. The orebody strikes northwest and dips 45 deg. northeast. The length is over 5,000 ft. and the thickness varies from 4 to 30 ft. The average content of copper in the ore is 2.748 per cent. In 1917 the mine produced 19,854,988 lb. of copper.

*Ose mine (copper, 35).* This is also in Ehime province. The rocks here are Archaean chlorite-schist, sericite-schist, and graphite-schist. The ore is a bedded deposit in the chlorite schist like that of the Besshi. There are two beds in the deposit. The main orebody strikes east and west and dips 10 to 20 deg. south. It is over 1,000 ft. long and the thickest part is 30 ft. The smaller deposit lies above the main orebody and its thickness is from 3 to 4 ft. The ore minerals are pyrite and chalcopyrite. The average content of the ore is 3.64 per cent copper and 44.22 per cent sulphur. In 1917 the output of the mine was 49,520 tons.

*Omine mine (copper, 36).* The Omine mine is also in Ehime province. It, too, is a bedded deposit in Archaean chlorite-schist. The orebody strikes northeast, dipping 30 deg. northwest. Five important beds in the orebody have been discovered. The chief ore minerals are chalcopyrite and pyrite carrying on an average 2.0 per cent copper. In 1917 the mine output was 27,463 tons.

*Hibira mine (copper, 37).* This property is in Miyasaki province. The country rocks are Paleozoic slate



and quartzite. There is a granite-porphry intrusive about a mile and a half north of the mine. The ore is a lenticular deposit in the slate. There are four main orebodies. They strike northwest, dipping northeast. Each orebody is from 230 to 600 ft. long and assumes a lenticular shape. The entire mineralized zone is 1,200 ft. There is a bluish phylite-forming foot wall of the orebody, which is found to be originally saussurite gabbro. This basic rock is supposed to be the ore bringer. The present schistose structure may be attributed to the later dynamo-metamorphism. In 1917, the mine produced 15,365 tons of ore carrying 4 per cent copper. In the same year the production of refined copper was 1,386,277 lb.

*Makimine mine (copper, 38).* The Makimine property is in Miyasaki province. The rocks are Palaeozoic phylites, quartzite and chlorite schists. The orebody follows the strike of the chlorite schist in an east-west direction, dipping north. The orebodies are lenticular. The chief ore mineral is copper-bearing pyrite carrying on an average 2.7 per cent copper. In 1917, the mine output was 31,625 tons of ore and production was 1,434,524 lb. of 98.76-per cent copper.

*Takata mine (zinc, 1).* The Takata mine is situated in Miyagi province. Tertiary sandstone, shale and tuff are intruded by andesite. There are over twenty veins in the andesite and Tertiary sedimentary rocks. The chief ore minerals are silver-bearing galena and zinc blende with subordinate quantity of chalcopryrite and pyrite and fluorite. As secondary minerals, smithsonite, siderite, marcasite, and jamesonite occur. The ore contains 4.82 per cent lead and 8.81 per cent zinc. In 1917, the output of the mine was 79,684 tons of ore.

*Yasuda mine (zinc, 2).* This mine is on Tsushima Island. Mesozoic slate and sandstone are intruded by quartz-porphry. There is a replacement deposit in the slate. The vein strikes north and dips east at 35 deg. The length of the orebody is 2,280 ft., and it continues in the claim to the south. The width varies from 1 to 15 ft. The orebody is made lenticular by later dynamo-metamorphism. The vein consists mainly of zinc blende and pyrrhotite occurring in alternate bands, although the pyrrhotite at most places is found near the walls. The ore is disseminated in the roof and the line of demarkation between the vein and the country rock is indistinct, whereas the foot wall is sharply defined and separated from the vein by gangue. The grade of the ore is 40 per cent zinc and 14.5 per cent iron, which is intimately combined with zinc, the two being mechanically inseparable. The ore reserve in 1916 was estimated to be 250,000 tons.

*Kamioka mine (lead 1).* This is in Gifu province. Archaean amphibole-gneiss and limestone are intruded by quartz-porphry. One vein strikes north and dips steeply to the east. The other vein strikes east and dips steeply to the south. The width of the veins varies from 1 to 50 ft. The veinstone consists of actinolite, epidote, calcite, and quartz. The ore minerals are argentiferous galena, chalcopryrite and zinc blende with minor quantities of chrysocolla, malachite, pyrite, arsenopyrite, cerrusite, and scheelite. The grade of the ore is 4.3 per cent lead, 13.3 per cent zinc, 0.005 per cent tungsten, 0.006 oz. gold and 3.072 oz. silver per ton. The output in 1917 was 127,300 tons of ore.

*Kamaishi mine (iron 1).* This mine is in Iwate province. It is a contact magnetite deposit at the contact between Paleozoic limestone and a granite instru-

sive. In the contact zone, garnet, diopside and epidote occur. The high-grade ore contains 65 per cent iron, 0.053 per cent phosphorus, 0.096 per cent sulphur, 2.66 per cent silica, and a trace of copper. In 1917 the mine produced ore containing 59,016 tons of iron.

*Sennin mine (iron, 2).* This deposit is in Iwate province. Paleozoic slate, sandstone, and limestone are intruded by granite. The orebody is at the contact between the granite and the limestone or in the limestone and forms an irregular mass. The ore is specular hematite with garnet, hedenbergite, epidote and some pyrite and chalcopryrite. The ore runs 50.2 per cent iron and 2.79 per cent copper. In 1917, the mine produced 6,192 tons of iron ore and 695 tons of copper ore.

#### DEPOSITS OF SULPHUR, ANTIMONY AND MANGANESE

*Horobetsu mine (sulphur, 1).* This mine is in Iburi, Hokkaido. The rock in this district is andesite and sulphur is found as a disseminated deposit in the brecciated andesite. The average grade of the ore is 43.26 per cent sulphur. In 1917, the mine output was 61,342 tons of ore, yielding 19,670 tons of 97-per cent sulphur.

*Okujiri mine (sulphur, 2).* The Okujiri mine is on Okujiri Island, Hokkaido. It is a bedded deposit in between propylite andesite and its tuffaceous agglomerate. The thickness of the deposit is between 10 and 40 ft. The average content of sulphur is 35 per cent. In 1917, 69,571 tons of ore was mined, yielding 16,899 tons of 99.78-per cent sulphur.

*Numajiri mine (sulphur, 3).* The Numajiri mine is in Fukushima province. The district is covered with andesite tuff and volcanic ashes. It is a Tertiary or post-Tertiary deposit around a fumarole. The deposit is 1,000 ft. long in a north-and-south direction, 500 ft. wide in an east-and-west direction and on an average 50 ft. thick. In 1917, the mine produced 218 tons of ore containing 45 per cent sulphur.

*Ichinokawa mine (antimony, 1).* This property is in Ehime province. The rocks are Archaean graphite-schist and Cretaceous conglomerate. The antimony occurs in veins cutting through these rocks. The veins strike east. Two of them are prominent. One is in the conglomerate and is 6 ft. wide. Large and splendid crystals of stibnite were formerly extracted from this vein. Another vein, which dips vertically, is in the crystalline schist and is also 6 ft. wide. The ore minerals are stibnite with some quartz and calcite. In 1917, the output was 8,442 tons of 2.72-per cent ore.

*Iwasaki mine (manganese, 1).* The Iwasaki mine is in Aomori province. The deposit is in Tertiary tuffaceous sandstone and strikes north, dipping west at an angle of 5 to 15 deg. The width of the vein varies from 1 to 8 ft. In 1917, the mine produced 5,325 tons of ore carrying 18 per cent manganese.

*Yunosawa mine (manganese, 2).* This is also in Aomori province. The deposit occurs in Tertiary tuffaceous sandstone and in pyroxene-andesite and is bedded or massive. In 1917, the mine produced 18,972 tons of ore containing 16 per cent manganese.

*Taniyama mine (tin, 1).* This property is in Kagoshima province. Mesozoic clay slate and sandstone are cut by dikes of augite andesite. There is a granite intrusive protruding in the middle of the district, which appears to be closely related to the deposition of the ore. The veins are found in the fissured clay slate and are from 1 to 5 in. wide. They run parallel from east to west, dipping south at an angle of 60 deg. Pyrite

and pyrrhotite are found besides cassiterite. Siderite, chlorite and quartz are predominant gangue minerals. In 1917, the output was 6,099 tons of 0.8-per cent ore.

*Takatori mine (tungsten, 1).* The Takatori mine is situated in Ibaragi province. Paleozoic sandstone, quartzite and slate are penetrated by seven parallel veins. The veinstone is quartz and the ore minerals are wolframite, silver-bearing chalcopyrite, and pyrite. In 1917, the mine produced 10,276 tons of ore carrying 1.3 per cent tungsten.

*Ebisu mine (tungsten, 2).* The mine is in Gifu province. The deposit fills a fissure in the quartz-porphry. There are about twenty veins which run from east to west and are vertical. Their known length is 900 ft. and they have been worked to a depth of 450 ft. Wolframite and bismuthinite are disseminated in the quartz. In 1917, the output was 6,241 tons of 1.32-per cent ore.

*Kiwada mine (tungsten, 3).* The Kiwada property is in Yamaguchi province. Paleozoic slate, quartzite, limestone and hornstone strike northwest and dip southwest at an angle varying from 10 to 70 deg. These rocks are cut by granite and dikes of lamprophyre. The orebodies are regular veins and contact metamorphic deposits. The vein contains pyrite and scheelite and is from 1 to 3 ft. wide. The contact deposit is found in the slate and hornstone and assumes an irregular shape. The associated minerals are quartz, chalcopyrite, pyrrhotite, arsenopyrite, pyrite, cassiterite and scheelite. In 1917, the output was 12,420 tons of 2.18-per cent ore.

*Kuga mine (tungsten, 4).* This is in Yamaguchi province. Alternate beds of Palaeozoic slate and quartzite strike north, dipping west at an angle of 25 to 40 deg. The ore is a replacement deposit in the limestone and forms a lenticular mass. Predominant minerals are pyrrhotite and garnet, and associated with them are scheelite and chalcopyrite. In 1917, the output of the mine was 20,019 tons of 1.346-per cent ore.

*Jutoku mine (tungsten, 5).* The Jutoku mine is in Yamaguchi province. Granite and granite-porphry are intruded by andesite dikes. The deposit is a fissure filling in the granite and locally pegmatitic. The veinstone is quartz and the ore minerals are chalcopyrite, arsenopyrite, and pyrrhotite with a subordinate quantity of scheelite and molybdenite. There are several veins, but only one is workable. It is 2,000 ft. long and 1 ft. wide. It strikes northeast. In 1917, the output of the mine was 3,060 tons of 3-per cent tungsten ore.

#### ORE DEPOSITS CLASSIFIED

The important ore deposits and related rocks, either sedimentary, metamorphic, or igneous, of different geologic periods in Japan may be tabulated as follows:

Rocks in Which Deposit Is Found	Igneous Rocks	Typical Forms of Deposit	Representative Ore Minerals
Archaean Graphite-schists Sericitic-schists Piedmontite-schists Chlorite-schists	Not found near by	Bedded lodes	Chalcopyrite-copper bearing pyrite
Paleozoic Slate Sandstone Quartzite Hornstone Limestone	Granite Diorite Porphyrite Quartz-porphry Liparite	Contact Replacement	Gold and silver ore Iron ore
Mesozoic Sandstone Slate	Diorite Porphyrite Granite Quartz-porphry Liparite	Replacement Fissure veins	Gold, copper, zinc blende, tin, silver
Tertiary Tuff Breccia Shale Sandstone	Liparite Andesite	Replacement Fissure veins	Kuromono(a) gold, copper, zinc, sulphur, manganese

(a) Gold- and silver-bearing mixed sulphide ore.

### Mining in Colorado Improving

Mining in Colorado showed some general signs of improvement during the first six months of 1922, according to Charles W. Henderson, of the Geological Survey. Cripple Creek, which produced \$4,300,000 in 1921, continued production at exactly the same rate in 1922. At Leadville the Down Town Mines Co. continued production as did the Ibez mine and the Yak mines. The Graham Park and Carbonate Hills mines remained idle. The A. V. smelter continued in operation and the zinc oxide plant increased the number of furnaces in use. Telluride maintained steady production and increase the shipments of concentrates from the new Smuggler Union and Tomboy mills. The new dredge at Fairplay began to ship bullion in June. The London mine, above Alma, has continued to make regular shipments of gold ore. Northern Gilpin County, in the vicinity of Rollinsville, is showing more activity in development than it has shown for many years. The East Butte Copper Co.'s new mill on the Dives-Pelican dump at Silver Plume began shipping silver concentrates in May. The Mollie Gibson mine, at Aspen, is being unwatered. Iron sulphide ore carrying silver has been shipped regularly from Gilman.

With the exception of Cripple Creek and certain parts of Gilpin County, future mining in Colorado is intimately dependent on the metallurgical treatment of zinc and the market for the metal, as the mining of zinc ores usually leads to the development of other ores. Certain mines that produce ore capable of separation into zinc concentrate and lead concentrate cannot operate unless there is a market for the zinc concentrate. If commercial zinc can be obtained from certain ores and concentrates in other mines the metallurgical troubles at lead smelters will be lessened and the penalty charges on such ores will be removed.

### Mines in New Mexico Resuming Operations

During the first six months of 1922, several large companies in New Mexico resumed mining, according to C. W. Henderson, of the U. S. Geological Survey. On April 1 the Chino Copper Co.'s 12,000-ton concentration-flotation mill at Hurley, which was closed April 12, 1921, was started at 30 per cent of its capacity. The Eighty-Five mine, at Lordsburg, began shipments of siliceous ore carrying copper, gold, and silver in February, shipping several hundred tons; increased them in March to 2,500 tons, and in April, May, and June shipped more than 7,000 tons monthly. The Graphic-Waldo mine and mill, at Magdalena, idle since March, 1921, was reopened in January and made regular shipments of lead-zinc sulphide ores each month. With the reopening of the Colorado Fuel & Iron Co.'s steel plant at Pueblo, in April, iron-manganese ore from Silver City and iron ore from Fierro began to move in large quantities to Pueblo. At the same time, shipments of iron-fluxing ores carrying silver began from Silver City to El Paso. The Mogollon Mines Co.'s mill, at Mogollon, continued to produce silver-gold bullion. Several bars of gold bullion were shipped from the Helen Rae mill in the Nogal district, Lincoln County.

In 1921 the mines in New Mexico produced \$196,822 in gold, 571,899 oz. of silver, 14,267,338 lb. of copper, 678,601 lb. of lead, and 228,000 lb. of zinc, all having a total value of \$2,651,146.

## THE PETROLEUM INDUSTRY

### Core Drilling in California Oil Wells

Sampling With Fish-Tail Bit Not Trustworthy—Single-Barrel Cores Most Commonly Used  
—Advantages and Disadvantages as Disclosed by Extensive Tests

**M**ETHODS of sampling oil formations by core drills were described by F. C. Merritt, of Los Angeles, at a meeting of the San Francisco Section of the Institute on July 11. After defining coring as a method of sampling in critical formations, Mr. Merritt described the use of the fish-tail bit at the end of a column of heavy drill pipe, which was rotated, the sand being removed by a mud "flush" that was pumped down. The recording of sampling results obtained by such a method was found to be exceedingly difficult and the data obtained were invariably unreliable. At the Huntington Beach field, three wells in near proximity were sampled in this manner, but the resultant logs showed no resemblance. Indifferent results such as these are caused to a large extent by carelessness and by the difficulty of maintaining the proper pressure during drilling. The driller judges the requirement in this respect by the feel of the column; he relies mostly on inspiration and imagination. Further, the hydrostatic head of a column of mud tends to drive the light oil into the formation. The heavy oil, being viscous, is retained and makes a disproportionate showing.

#### SHELL COMPANY PIONEER IN CORE-DRILL EXPLORATION IN CALIFORNIA

The core drill was first used in California oil fields by the Shell company during prospecting work at Downey, Los Angeles County, in 1920. There are now two principal styles. In one of these a length of drill pipe, varying from 2½ to 6 in. in diameter, has three, four, or six teeth, of fairly soft metal. These are used to cut the core in the usual manner. The drill pipe is then weighted and the teeth are thereupon crimped inward, thus holding the core so that it can be brought to the surface. A modification of the drill has a blank tool joint inserted in the column about 4 ft. above the teeth. Above and below this there are three or four holes, which provide for the escape of the flush. For the bottom 4 or 6 ft. of the hole there is no circulation.

Double-barrel core drills are designed with various modifications. It is usual to use a 4-in. drill pipe with a 2-in. galvanized-iron pipe inside. This latter is screwed into a shoe with four cutting teeth. The flush passes between the pipes and goes to the bottom of the hole. The cuttings are "circulated out" before the core is taken. There are a number of different types of double-barrel drills in operation, but it is probable that nine-tenths of all the cores taken at the present time are obtained by the single-barrel drill, which is easily built and easily manipulated. The core is also extracted without difficulty. In spite of these advantages, how-

ever, several companies are experimenting with the double-barrel drill.

In taking a core it is important that the driller be in sympathy with the work, otherwise the burning of the "business end" of the drill is inevitable. With a core drill of any type the procedure is generally as follows: The barrel is first lowered to within 1 ft. of the bottom of the hole, rotated and the mud circulated out. It is then raised and lowered three or four times to dislodge the mud. It is then lowered to the bottom of the well and rotated at from 12 to 16 r.p.m. Speed and weight applied are important factors; the former is under easy control, once a desirable rate has been established. The use of a weight indicator is a necessary refinement, however, and this phase of the question should receive more consideration, according to Mr. Merritt. After the barrel has been rotated and advanced for a certain distance the teeth become dull and it is impossible to progress further. Adequate weight is then applied, whereby the teeth are bent inward so that the core cannot drop out. With the double-barrel drill the extra weight tends to plug the opening. The drill is then withdrawn and the core is available after the pipe has been cut with an oxy-acetylene flame.

The single-barrel drill, although easily made and easily controlled, operates under the disadvantage that the lowest point of circulation is at some distance from the bottom of the hole. In some cases the heat generated during drilling is sufficient to cause the end of the drill to fuse into a solid mass of metal. In any case the heating effect is such that the danger is always present that oil may be volatilized and the sampling results spoilt. A small amount of volatilization is inevitable when the pipe is cut by the oxy-acetylene flame, but usually the center of the core is unaffected.

#### GEOLOGISTS EXPERIMENTING TO DETERMINE KEY HORIZON

Speaking of the uses of core drilling, Mr. Merritt mentioned the value of a method whereby it would be possible to determine the proper position to place cement. Geologists are experimenting extensively with cores in an endeavor to correlate the geology of the various oil fields; if found practicable, this should aid considerably in wild-cat drilling. A large number of tests have been made in regard to the solubility of core material in dilute acid, in order to obtain data with which it may be possible to identify soft-water sand. Graphs of wells are now being plotted, whereby it is hoped that a key horizon may be determined for the oil fields of Southern California.

## SOCIETIES, ADDRESSES, AND REPORTS

### Seeking Closer Co-operation Between Engineering Schools

Committee of Society for Promotion of Engineering Education Makes Report

A report has been submitted to the council of the Society for the Promotion of Engineering Education by a special committee, which, if approved by the society and accepted by the colleges of the country, will tend to modify greatly present engineering courses and methods of instruction. The committee investigating this subject has recently been in session in New York City and Pittsburgh, and its report is the outcome of an intensive study of the apparent needs of the situation. The committee is made up of C. F. Scott, chairman, professor of electrical engineering at Yale and president of the Society for the Promotion of Engineering Education; M. E. Cooley, dean of engineering at the University of Michigan; F. W. McNair, president of the Michigan College of Mines, Houghton, Mich.; and F. L. Bishop, dean of engineering at Pittsburgh and secretary of the society.

The general aim of the committee's deliberations has been in the direction of closer co-operation between the engineering schools, standardization, and greater efficiency, to the end that the entire range of engineering practice may be placed on the highest possible plane and more young men attracted to the engineering professions.

### Canadian Government Studying Mineral Resources

The Canadian Department of Mines is showing great activity this season in endeavoring to extend the amount of information available with regard to the mineral resources of the country. There are thirty-nine parties of the Geological Survey in the field, the work being carried on in eight provinces, the Northwest Territories and the Yukon. Ten of these parties are engaged on topographical mapping, with a view of assisting prospectors and others in the investigation of mineral deposits. A scheme of geological mapping is being developed whereby the isolated piece of geological work in southern British Columbia will be correlated in one general geological map of that area. The policy of the government is to confine investigation work mainly to territory readily accessible to transportation routes, rather than to send parties to remote districts where discoveries could be developed only after the construction of costly and uneconomical lines of railway.

### Federal Problem of Coal Control Differs from That of War

Traffic Difficulties Now Mainly Involved—Fuel Handling to Be Decentralized

That control of coal distribution must continue for the remainder of the calendar year and possibly for the remainder of the coal year is becoming more and more apparent. A large corps of workers will be required. It is probable that a deficiency appropriation of \$200,000 will be asked for the purpose.

The problem before the Government differs considerably from that with which the Fuel Administration had to deal during the war. The situation now is a traffic problem. It is somewhat similar to the situation very successfully handled by the Central Coal Committee in 1919 and 1920. As a result of the very successful work done by that committee, it is probable that the new organization will be formed along the line of that committee. It may be stated, however, that the methods used by the Central Coal Committee in regard to paying for coal will not be followed. Since the situation is being controlled through the powers vested in the Interstate Commerce Commission, the execution of any plan must be carried out by the railroads. For that reason, Henry B. Spencer, a former member of the Central Coal Committee, has been chosen as the fifth member of the President's committee.

In addition to the need for an appropriation, it is very apparent that the administration soon will request legislation giving out-and-out power to fix prices and to seize coal. There is a possibility that a revolving fund will be asked, so that the administrative committee can buy and sell coal when the occasion demands.

Even if arbitration negotiations were begun at once, it is realized that some time necessarily must elapse before the union fields actually would be producing coal. By that time, the country will be so far behind in coal production that supplies will be insufficient for all purposes. For that reason, for many months, there is certain to be a very trying situation in the attempt to see that the more essential activities receive their necessary fuel requirements. Control of distribution has not begun, as yet, and it will be several days before the necessary machinery can be put into shape for its inauguration. The fact that the job is a railroad traffic problem is probably the reason why Dr. Harry A. Garfield was not requested to take over the actual administration of the work. The desire

was voiced in official circles that he be made the administrative member of the President's committee as recognition of the work he did during the war and to prevent what would seem to be a further mark of ingratitude for the very valuable public service that Dr. Garfield rendered as fuel administrator. So far as can be learned, no invitation was extended him. The reason, doubtless, was that he already had announced that he would not accept such an appointment, although the very apparent fact that the actual administrator in this situation must be a traffic man probably may have been the compelling one.

Reports reaching Washington during the last three days as to the improvement in the railroad strike situation have been very encouraging. Apparently, the railroad executives were not thoroughly aroused to the seriousness of the situation before the shop-craft strike. As a result, there was hesitancy in taking drastic action to operate with new men. The seriousness of the situation soon became apparent, however, and the results of the delayed effort are only now becoming apparent, it is believed. Traffic is moving better through all the vital junction points and there have been very encouraging responses to the railroad's invitations for outside shopmen. The situation will be relieved further, it is believed, as industry is slowed down by lack of coal, thereby making available more men from whom the railroads can draw workers. The coal operators report much better prospects of securing men for the mines in the union fields.

Secretary Hoover announced that every effort is going to be made to decentralize the handling of the coal situation. Great reliance is being placed upon the state governors, the state public utilities commissions and upon the railroad administrative officers and coal operators in the different districts. Mr. Hoover stated that there would be no direct effort from Washington to prevent retail profiteering. This he is leaving to the states, although every effort will be made to co-operate closely in any action they may take.

Very evidently Senator Borah has learned since introducing his resolution that the work he prescribes for three commissioners at \$8,000 a year is an undertaking which will require a large organization to carry through and will cost hundreds of thousands of dollars. The task is even more complicated than the valuation of the railroads and many years would be required to gather accurately the information which he proposes should be collected in nine months.

## MEN YOU SHOULD KNOW ABOUT

George Carnahan is in California.

P. A. Robbins has returned to Chicago from Canada.

Hoyt S. Gale was in Washington, D. C., last week on a business visit.

S. H. Dolbear has returned to New York from Thetford Mines, Quebec.

Courtenay DeKalb is developing the Roadside mine near Tucson, Ariz.

H. R. Norsworthy has returned to New York from Andagoya, Colombia.

A. J. Bone has returned to New York from a trip to northern Manitoba and Ontario.

W. O. Hotchkiss, Wisconsin State Geologist, is doing some work on the Gogebic Range.

Newton Booth Knox has left London for Bohemia to examine gold mines in Czechoslovakia.

C. H. Dane and L. G. Westgate are making an examination of the Pioche mining district in Nevada.

Byron L. Eastman has been appointed manager of the Paymaster mine, at Porcupine, Ontario.

William A. Burr, mining and metallurgical engineer of Monterey, Mexico, is in New York on business.

Alex Wise, mining engineer of Virginia City, and one of the owners of the Middle Mines, is in San Francisco.

J. H. Wade, of Cleveland, president of the Montreal Mining Co., has returned from a visit to the Gogebic Range.

Charles W. Goodale, who has been visiting in the East for the last several weeks, has returned to Butte, Mont.

Wilbur Judson has returned from Europe, where he has been visiting for several months, and has gone to Texas.

Seeley W. Mudd recently visited the Mesabi Iron Co.'s plant at Babbitt, Minn., and other points on the Mesabi Range.

Charles E. Locke, of the faculty of the Massachusetts Institute of Technology, is on a mine examination trip in Mexico.

Captain J. G. Ross has been appointed consulting engineer to the Asbestos Corporation of Canada, at Thetford Mines, Quebec.

J. R. Van Evera, of Marquette, Mich., has been appointed a member of the Board of Control of the Michigan College of Mines.

L. E. Meyers, of Chicago, president of the Lake Superior District Power Co., has returned from an inspection of the company's operations.

Alan M. Bateman, after visiting the Utah Copper Co. at Bingham, Utah, has returned to Ely, Nev., to carry on some mining geological work.

W. H. Landers, who recently completed a feldspar wet-grinding and purification plant at Erwin, Tenn., for

the Clinchfield Products Corporation, is back in New York at 4 West 43rd St.

R. W. Stone, geologist, and John F. Reese, mining engineer of the Pennsylvania Topographic and Geological Survey, are spending the month of August examining quarries in the eastern part of the state.

Byron C. Riblet, of the Riblet Tramway Co., Spokane, returned to his home recently after a visit to Peru, in connection with estimates to be made for tramway construction for A. S. & R. operations there.

It was erroneously stated in the July 22 issue of the *Journal-Press* that Dr. G. A. Young was professor of geology at McGill University. Dr. Young has been a member of the staff of the Geological Survey Branch of the Department of Mines of Canada since 1904.

D. A. Lyon, general supervisor of field stations of the U. S. Bureau of Mines, and O. C. Ralston, assistant supervisor and superintendent of the Berkeley experiment station, are in Reno, Nev., from Berkeley, Cal.

W. Clayton Miller, of the Coeur d'Alene district, was elected president of the Cassiar Crown Copper Mining Co., at the annual meeting held in Spokane the latter part of July. The Cassiar company's holdings are in central British Columbia.

A group of officials of the Mahoning Ore and Steel Co. including Hugh Kennedy, B. Goodyear, W. A. Rogers, and C. Clement, of Buffalo, N. Y., and G. Alexander, of Chicago, Ill., accompanied by W. C. Agnew, of Duluth, Minn., general superintendent, made a tour of inspection of the company's properties on the Mesabi iron range.

Frederick Gleason Corning, consulting mining engineer of New York, in acknowledgment of his services on behalf of the Freiberg School of Mines, was appointed an honorary freeman of that institution on July 1. Mr. Corning, one of the older graduates of the school, was a directing official of the "Gesellschaft der Freunde der Bergakademie Freiberg." His recent book, "A Student Reverie," is considered a memorable tribute to his alma mater.

Sidney Norman, of Spokane, was elected to represent the State of Washington on the Board of Governors of the western branch of the American Mining Congress, at a joint meeting of delegates from the mining bureau of the Spokane Chamber of Commerce, the Northwest Mining Association, the Washington Metal Miners Association and the mining section of the Seattle Chamber of Commerce, held in Spokane on July 24. Mr. Norman is editor and manager of *Northwest Mining Truth*, a local publication of the Northwest, and has been prominent in mining circles.

Mining and metallurgical engineers visiting New York City last week included: H. L. Mead, of Brewster, Fla.; James A. Barr, of Mount Pleasant, Tenn.; F. L. MacKenzie, of Brookline, Mass., and Campbell M. Hunter, of London, England.

## SOCIETY MEETINGS ANNOUNCED

The first meeting of the newly-formed Association of Maine Geologists will be held on Aug. 11 in Auburn and Lewiston. Professor Frank D. Tubbs, of Bates College; N. B. Tracy, of Auburn; L. C. Bateman, of the *Lewiston Journal*, and other members of the local committee have arranged a program that will take in all the points of geological interest in the vicinity. These include Mount Apatite, the source of much of the feldspar, and of many of the Maine gems and a large variety of rare and beautiful minerals; the Lewiston Falls, which present features of particular interest to geologists; and a number of other localities. The first purpose of the association is, naturally, the promotion of scientific investigation of the rocks and minerals of Maine. The headquarters of the association will be at the Auburn Chamber of Commerce. The secretary will be on hand early on the morning of Aug. 11, and all who attend are asked to register with him, whether members of the association or not, in order that an account of the meeting may be as full and accurate as possible. The exact time of meeting, and the details of the program, will be published later. Communications should be addressed to Freeman F. Burr, secretary, Augusta, Maine, or to one of the above-named members of the local committee.

## OBITUARY

John Gace, superintendent of the Mizpah mine, near Wickenburg, Ariz., was accidentally killed recently while dismantling the mine.

William H. Mack, pioneer miner in Arizona, died recently at Prescott, aged seventy-six. The Billy Mack mine, in northern Yuma County, was one of the most notable of early properties. In later years Mr. Mack owned and operated the Ruth mine, near Parker.

Evan W. Jones, of Salt Lake City, died at his home on July 13. For a period of about thirty-two years Mr. Jones was engaged in mining in Utah. He was superintendent of the Sacramento mine, at Mercur, and later superintendent of the Conger mine, in Bingham.

Frank G. Peck, president of the Portland Gold Mining Co., died at his home in Colorado Springs, July 26. Coming to Colorado at the age of ten, for fifty years Mr. Peck was a resident of the state. He was one of the first to become interested in Cripple Creek and one of the original organizers of the Portland company. He was also interested in mining and industrial enterprises at Guanajuato, Mexico.

## THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

### Leading Events

**A** SHOOT of extremely rich lead-silver ore has been opened in the Florence mine, near Ainsworth, B. C.

The Johns-Manville Company proposes to erect a million-dollar plant for fabricating asbestos near the mines in Quebec.

Copper output from the Lake Superior region increased slightly in July. No ill effects of the coal and rail strikes are yet apparent.

The Secretary of the Interior has authorized construction of a branch railroad to the Healey coal fields in Alaska. This will stimulate development of industry in regions tributary to Fairbanks.

The Walker mine, in the Plumas copper region of

California, is shipping 100 tons of flotation concentrate daily to the Tooele smelter, in Utah.

Colorado coal mines are helping to supply eastern markets.

"Lean" iron ores are being successfully washed in a new plant on the Cuyuna Range in Minnesota.

The United Verde Copper Company has started heap leaching at Jerome, Ariz.

Shipments from the Pioche district in Nevada have doubled recently.

The Greene-Cananea Copper Co. will resume production soon after Aug. 1, at its property in northern Sonora.

#### Rich Shoot Opened at Florence Mine, in British Columbia

**New Lead-Silver Orebody Found Above the Fifth Level—Believed To Be the Old "Bonanza" Shoot**

Intense excitement prevails in the Ainsworth district of British Columbia over a strike made a few days ago in the Florence Silver mine. In a raise from the No. 5 level an orebody has been encountered that is believed to be the old bonanza shoot which produced \$500,000 above No. 2 level, and was 400 ft. long, averaging 15 ft. wide, and was mined to the surface.

The face of the upraise is all in ore about half of which is clean shipping lead-silver. If this proves to be the Bonanza shoot, its downward trend will be picked up by an extension of the No. 5 level at approximately 400 ft. below the No. 2 level.

The Florence mill recently resumed operations and regular shipments have been started to the Consolidated Mining and Smelting Co. at Trail. If the orebody opens up as expected the company will be enabled to double or triple its output. The property is one of the most important lead-silver mines in the province.

#### Hollinger Pays \$300,000 on Schumacher Purchase

The Hollinger Consolidated Gold Mines, of the Porcupine district in Ontario, has made a second payment of \$300,000 on the Schumacher property which it acquired recently. The balance of the total purchase price of \$1,650,000 will be paid in four quarterly payments. A dividend of 20c. per share was paid to Schumacher shareholders from the proceeds of the sale.

#### Greene-Cananea Resumes Operation on Curtailed Scale

The Greene-Cananea Copper company resumed operations Aug. 1. The rate of production will be gaged by the requirements of the copper market. It is not expected that output will assume any substantial proportions before the middle of September. The company on several occasions has produced 5,000,000 lb. of copper and about 100,000 oz. of silver per month. Improvements to the mills have been completed. These included a new ore flotation plant. The smelter is expected to start operations on Aug. 16.

#### United States Smelting Co. Insures Employees at Midvale Smelter

The United States Smelting Co. has insured free of charge its employees at the Midvale (Utah) plant. Insurance starts when a man has been in the employ of the company one year, and increases in amount according to length of service. The system is being inaugurated with a view to rewarding continued service. The schedule provides that married men who have been with the company for five years or more receive a policy for \$1,000, and single men of like tenure of employment, \$700. Married men in the employment four years and less than five receive a policy for \$900 and single men, \$600. The scale decreases until married men in the service of the company for one year and less than two years receive policies for \$600 and unmarried men policies for \$300. This insurance does not conflict with workmen's compensation or any other insurance, which the men may have.

#### Government Railroad in Alaska Runs Prospectors' Special

**Volume of Traffic Exceeding Expectations—Two Trains Weekly Now Scheduled**

Prospecting by pullman is reported from Alaska where gold was discovered recently on one of the creeks crossed by the Alaska Railroad. When the discovery was reported, the management of the railroad ran a special train from Anchorage to the scene of the stampede. Instead of mushing across the hills, a large number of prospectors were enabled to visit the scene of discovery, step off the train, stake out their claims and return to the railroad dining car for luncheon. A lawyer accompanied the special train and looked after the necessary legal matters connected with the new operations. Regret was expressed that an extra baggage car had not been attached, so as to permit the opening of a mining exchange in the evening, according to a humorous correspondent.

Traffic on the Alaska Railroad is exceeding expectations. It is much heavier than was the initial traffic on the Great Northern. During 1921, the total number of passengers handled by the line was greater than the entire white population of the territory. This year, with two through trains weekly, the passenger traffic is exceeding the seating capacity of the equipment. Like all other pioneer railroads built in advance of development, a deficit in operating costs is certain to continue for some years, but it is believed a much better showing in this regard will be made by the Alaska Railroad than by the first transcontinental lines in the United States.

**Lawrie Estimates Fifteen More Months of "Dollar Silver" Draws Attention to Complications That Will Arise When the Purchases Approach the Total That Is To Be Taken at Guaranteed Price**

Apropos of the probable duration of the period of silver purchases under the terms of the Pittman Act, H. N. Lawrie, managing director of the American Gold and Silver Institute, has called attention to the fact that while the Pittman Act was approved April 23, 1918, the market price remained above \$1 per ounce until May 14, 1920. Silver was actually presented for sale to the Mint during the last days of May, 1920, when the first purchases were made by the San Francisco Mint. The record of monthly purchases of silver by the Mint under the terms of the Pittman Act in fine ounces is as follows:

1920		1921		1922	
May.....	332,088	January.....	4,677,188	January.....	2,532,000
June.....	6,168,505	February.....	4,615,842	February.....	3,444,740
July.....	3,288,856	March.....	5,912,065	March.....	5,370,980
August.....	3,429,277	April.....	4,334,741	April.....	8,117,748
September.....	3,815,733	May.....	6,836,500	May.....	4,122,400
October.....	4,634,860	June.....	4,442,000	June.....	5,204,750
November.....	3,638,870	July.....	4,670,119		
December.....	4,599,172	August.....	4,913,614	Total 1922.....	28,792,618
		September.....	3,471,436		
Total 1920.....	29,907,361	October.....	5,917,997	Total 1920-1922...	117,362,506
		November.....	3,447,000		
		December.....	5,424,025		
		Total 1921.....	58,662,527		

The monthly average of purchases in 1920 is 3,738,420 oz., in 1921, 4,888,544 oz., and in 1922, 4,798,770 oz. The total silver purchased to July 25, 1922, was 119,960,506 oz., leaving a total of approximately 87,000,000 yet to be purchased. The monthly average for the twenty-six months is 4,513,943 oz. At that rate the 87,000,000 oz. would be purchased in a period of 19.3 months. At the monthly rate of purchases for 1922, however, the period of purchase would be shortened to 18.2 months. With the increasing production of copper and lead, the production of silver will increase this year, it is estimated, by about 6,000,000 oz.

If the estimated increase in production for 1922 is maintained during 1923 it will decrease the duration of the Pittman Act by about three months, indicating a total remaining period of 15.2 months. It will be noted that the monthly average of purchases during 1922 is slightly less than that of 1921, which does not reflect any increase in production for 1922. When allowance is made for the time of smelter treatment, the increase in ore production now taking place will not become evident in the silver returns of the Mint until the last months of this year and the first months of 1923.

A marked increase in the cost of production, a curtailment in the production of copper and lead, and an increase in the international market price of silver above the Pittman price are among the conditions which would

be necessary in order to extend the life of the Pittman Act. Careful analysis of the current economic evidence and the trend of conditions does not indicate that any of these conditions will occur. To protect their interests silver producers should be guided in their operations and plans for the future marketing of silver by the minimum estimated life of the Pittman Act of 15 months from July 25, 1922, or to about November 1, 1923, according to Mr. Lawrie.

Silver contained in ores, concentrates, matte, slag, sweeps, etc., which had been produced previously but was not in marketable condition on May 14, 1920, under the regulations, was admitted to purchase when refined. The amount involved was relatively small, as producers and smelters had hastened operations that they might obtain the higher prices prevailing prior to May 14, 1920.

The precautions taken by the Mint

to exclude from the silver presented for purchase any silver produced outside of the United States are well known. The detailed statements submitted to the Mint by producers and smelters with every presentation of silver have been most carefully scrutinized by the authorities and the interests of the domestic producer well protected.

While the formulation of regulations under which the Pittman Act could commence purchasing silver was difficult in many respects, the formulation of regulations to terminate purchases under the Act presents a more complicated problem.

The difficulty will be to allocate equitably the last purchases to all producers of silver. It is not too early for the producers and the Mint to develop specific regulations governing the presentation of the last purchases. It seems inevitable that a period will exist when payment cannot be made by the Mint until the amount of silver which the Mint can purchase from any single producer is determined. There will probably exist a surplus of silver presented in excess of the amount the Mint can purchase. This will involve a scaling down of the amount presented by each producer. It seems essential that the Mint notify the producers at least six months in advance of the anticipated date of terminating purchases, stating the conditions under which the final purchases will be made and the procedure necessary to assure an equitable result.

**Mount Morgan in Queensland Is Operating at a Loss**

**Increased Production Necessary to Reduce Costs—Competent Miners Are Scarce**

A summary of the report of Mount Morgan Gold Mining Co., of Queensland, Australia, for year ended May 28, 1922, cabled to Reuters on July 18, states: Revenue from all sources, £276,199; expenditure charged, £301,301; deficit £25,102; balance forward £187,248. Included in total revenue referred to above is the valuation of 929 tons of copper on hand at the close of the year, which, as usual, has been taken at £55 per ton. The deficit would have been greater but for the realization during the year on the balance of copper on hand as of April 17, 1921, when operations ceased. Revenue also includes £145,111 belonging to previous periods made up of gold premiums, £62,496, and final adjustments in respect of 2,694 tons of copper, £82,614. The amount paid in taxation during the year was £26,353. Reserves, insurance, contingent funds and undivided profits amount to £579,854, and liquid assets total £480,956.

The negotiations in progress at the date of the last previous report for resumption of work ultimately resulted in a proposal by Queensland Government being accepted. This provided a 20-per cent reduction in wages covered by the award of the Queensland Arbitration Court, Feb. 17, 1922, the reduction being met in part by a rebate during a period of six months on government rail freights up to a maximum of £1,100 weekly, the effect on the employees being a reduction of from 5 to 10 per cent according to classification. Operations were resumed underground on March 13.

Unfortunately, the company is experiencing difficulty in securing competent machine miners, and the output of ore and blister copper consequently is below normal. In resuming on the basis of current prices for metals, it was recognized that a loss would be made, but the decision was arrived at from desire to try out economies and prove whether operations could be profitably carried on in future. Overhead expenses have been cut in every direction, but loss is still resulting. The necessity for increased output to correct this position is obvious.

**Burma Mines, Ltd., Mined 500 Tons Per Day During June**

Cable reports from Burma summarize the production by the Burma Corporation from its Bawdwin mine as follows: During the month of June, 15,055 tons of ore was milled in the treatment plant, producing 9,600 tons of lead concentrate; 10,224 tons of lead-bearing material was smelted in the blast furnaces, producing 3,491 tons hard lead for treatment in the refinery. Refinery products were 3,281 tons of refined lead and 379,683 oz. of refined silver.

### New Shippers Send Ore to Smelter at Trail, B. C.

A number of new names appear in the latest list of shippers to the Trail smelter of the Consolidated Mining and Smelting Co., of Canada. While some of the consignments are small, the list is indicative of productive activity. During the two-week period ending July 21, receipts were as follows:

Name of Mine	Locality	Tons
Black Bear	Zwicky B. C.	5
Black Rock	Northport Wn.	44
Etheopia	Greenwood B. C.	7
Emerald	Salmo B. C.	31
Monarch	Field B. C.	40
Quilp	Republic Wn.	322
Republic	Republic Wn.	39
Rosebery Surprise	New Denver B. C.	139
Standard	Silverton B. C.	187
Surprise	Republic Wn.	263
Gold Hill	Taghum B. C.	8
Northport S. & R. Co.	Northport Wn.	40
Sally	Beaverdell B. C.	34
Silversmith	Sandon B. C.	437
Van Roi	Silverton B. C.	58
White Elephant	Ewings Ldg. B. C.	30
Company mines		11,085

### United Verde Settles Smelter Smoke Suit at Jerome

A smoke-damage case involving injury to bees has been settled at Jerome, Arizona. W. E. Woodward sued the United Verde Copper Co., alleging that smelter fumes had caused the death of many bees in his large apiary. The company is said to have purchased a number of hives in Phoenix and to have given the bees a thorough "smoke test." As a result, there has been a settlement outside of court. The company soon will have its smoke filtered in a new Cottrell plant.

### Small Increase in July Output of Lake Copper Mines

**Calumet & Hecla Benefits by Contracting Mining and Trammings—Other Companies Are Short Handed**

Copper output, refined, in the Lake district in July is estimated at 9,750,000 lb., or 250,000 lb. more than in June. Calumet & Hecla and Ahmeek produced more than in the preceding month, while Copper Range, Quincy and Mohawk show a loss. Isle Royale and Wolverine held their own. Properties falling off in production have lost a considerable number of underground men. The Calumet & Hecla mines have been more fortunate in their labor supply in their respective districts and tonnage underground has increased through the adoption of the contract system of mining and trammings. It is estimated Calumet & Hecla produced 4,000,000 lb. in July; Ahmeek, 1,350,000; Copper Range, 2,000,000; Quincy, 800,000; Mohawk, 800,000; Isle Royale, 500,000; and Wolverine, 300,000.

Approximately 5,500 men are employed in the mines, mills, and smelters of the district, or one-third the number on the payrolls in the "good" years when 15,000 to 17,000 were employed. The Calumet & Hecla group has 3,200. On its present curtailed production basis, Calumet & Hecla has about as many men as it needs.

### Colorado Coal Mines Help Supply Eastern Markets

**Measures Are Being Taken to Prevent Profiteering by Producers**

Colorado coal mines are being worked to capacity with production greatly in excess of that of the same period last year. With the opening on July 28, of the Moffat road to the Routt County fields, where production has ceased for several months on account of a blockaded tunnel, the coal output was increased by about 100,000 tons monthly. The output from this field is a high-grade bituminous coal, most of which is being shipped to Eastern markets.

A "fair price coal commission" has been appointed by Governor Shoup to set a reasonable price on coal at the mine, especially that produced in the northern Colorado fields. The appointment of the commission followed an announcement that profiteering by operators would not be tolerated, and that state protection for the mines would be withdrawn if operators attempted to fix unreasonable prices for their product.

### Rich Strike on Big Missouri in British Columbia Reported

Rich silver ore has been opened by Harry Howison and A. B. Trites, who recently bonded the Big Missouri property in the Salmon River district of British Columbia. Heretofore numerous operators have prospected the property without great success.

### Where Is the Ten-Day Miner?

Statistics collected in Bisbee by the Copper Queen branch of the Phelps Dodge Corporation show that 40 per cent of its employees have been with the company more than ten years, that 76.2 per cent are married and that more than 80 per cent are citizens of the United States. Over 80 per cent had been with the company for three or more years. A large number of the men own their homes, some of them secured through the assistance of the company. These figures are the more striking in view of the fact that Mexicans form a large part of the surface forces around the mines. For the present at least the ten-day miner seems to be avoiding Arizona.

## News from Washington

By PAUL WOOTON  
Special Correspondent

### New Coal Mines Will Stimulate Metal Mining

**Alaskan Railroad Will Construct Branch to Healey Coal Deposits—Reasonable Fuel Prices Will Help Industry in Territory Tributary to Fairbanks**

THE Secretary of the Interior has authorized the immediate construction of track connections between the Alaska Railroad and the coal mines recently developed on the Healey River. By constructing a spur four miles long, cheap fuel will be made available to Fairbanks and the mining region tributary to it.

The successful development of coal on the Healey River promises to stimulate mining in the Fairbanks region more than any other event in recent years. Even at present, without track-connection, with all the expense entailed by having to haul the coal four miles to the railroad, unload it at the Nenana river, ferry it across and re-load it on cars on the other side of the river, this coal is being laid down in Fairbanks at \$8 per ton. With the completion of the Nenana River bridge this winter, and with the establishment of through traffic, Fairbanks will have all the advantages of cheap fuel.

Until the Healey River coal became available, the Fairbanks district was dependent largely upon wood for its fuel. Prices last winter were as high as \$24 a cord. Even the largest consumers paid \$12 a cord on contracts. At such prices, no serious efforts were made to thaw ground or even to operate the dredges on a large scale. The

cost-of-power factor has kept out of development large areas of promising placer ground of moderate value.

The coming of the railroad already has cut down the cost of miscellaneous supplies at Fairbanks by one-third. Now, with the assurance of a dependable supply of satisfactory fuel it will be possible to undertake both lode and placer mining on a scale which costs have made impossible in the past.

What is true of the Fairbanks district will apply in different degree to all points along the inland rivers, since coal can be delivered by barge from Nenana at prices much below what has been paid previously. This year, there is no boat service on the Tanana River, because the White Pass line has withdrawn its steamers. Protests have been made to officials at Washington and the War Department is working out a plan to furnish temporary service with Army steamers now in Alaskan waters. It is expected that by next year some river service can be established which, by making connection with the Alaskan Railroad, will give Alaskan miners on the inland waters joint rail and water freight rates from the States, such as are now enjoyed by points along the railroad itself.

Contracts have been let by the Healey River Coal Corporation for driving a 1,200-ft. main adit which will open a



series of coal beds which vary from 7 to 46 ft. in thickness. The coal is a fair grade of sub-bituminous and already is being used extensively for railroad, industrial, and domestic use.

Steam-boiler tests have been made at Anchorage by John A. Davis, of the Bureau of Mines staff, which show an efficiency equal to 90 per cent of the bituminous coal produced in the Matanuska field. The corporation engaged in the mining enterprise is being financed and conducted by local men familiar with conditions in Alaska. It only has been appreciated within the last year that this coal, which occurs near the lignite deposits in the Nenana fields, is not itself a lignite, but is of a distinctly better grade. The failure to recognize its quality explains the long period that elapsed before development was started.

### Federal Income From Mineral Leases Half Million Monthly

Royalties received from the production of minerals on leased public lands are becoming an important item of Federal revenue, according to the U. S. Bureau of Mines, which reports receipts totaling \$5,766,507 to June 30 from the production of oil, gas and gasoline in the states of Wyoming, Montana, and California. Oil and gas royalties are now being reported in excess of half a million dollars per month, receipts for June amounting to \$565,199. Of this amount, \$295,147 is credited to Wyoming, \$250,297 is credited to California, and \$19,755 to Montana. Royalties from the production of oil, amounting to \$550,708, constitute the bulk of the June receipts.

To the end of June, 7,889 oil and gas prospecting permits and 297 leases had been received by the Bureau of Mines from the General Land Office. There were 311 producing oil wells on Government leased land, and seventy-two wells were being drilled. Coal is now being produced from Government land in eight states: Washington, Montana, Wyoming, North Dakota, South Dakota, Utah, Colorado and New Mexico. Phosphate is being produced from government lands in Idaho, and a potash lease has been issued in California.

### Mining Companies Seek Reduced Freight Rates for Arizona Copper

Unreasonable rates on copper bullion from Clarkdale, Ariz., to New York via rail, and also between Clarkdale and Los Angeles, San Pedro and East San Pedro, Cal., are alleged in a complaint filed with the Interstate Commerce Commission by the United Verde Extension Mining Co. of Jerome, Ariz. The company requests the establishment of a rate of \$5 per ton for domestic shipments and \$4 per ton for export shipments from Clarkdale to the California points from which the metal will be shipped through the Panama Canal.

### Production of Both Gold and Silver Decreased in 1921

Despite falling production costs, and the Pittman price, production of silver in 1921 was 2,309,132 ounces less than in 1920, the final figures show. A statement giving the final figures of refinery production of gold and silver in the United States during the calendar year of 1921 has just been issued by the Bureau of the Mint. The figures are compiled in co-operation with the U. S. Geological Survey. The value of gold production in 1921 decreased \$1,119,600 as compared with 1920. The country's record production of both gold and silver occurred in 1915. In that year, gold to the value of \$101,035,700 and silver to the extent of 74,961,075 fine oz. were produced from American mines. The detailed figures of the 1921 production are as follows:

State or Territory	Gold		Silver (a) Ounces and Value
	Ounces	Value	
Alaska.....	386,927	\$7,998,500	750,999
Alabama.....	4	100	4
Arizona.....	160,498	3,317,800	2,509,200
California.....	728,590	15,061,300	3,606,708
Colorado.....	355,459	7,347,800	6,310,694
Georgia.....	53	1,100	3
Idaho.....	26,229	542,200	7,200,319
Illinois.....			1,616
Maine.....	9	200	
Michigan.....			316,551
Missouri.....			63,470
Montana.....	83,476	1,725,600	9,677,020
Nevada.....	155,791	3,220,500	6,998,774
New Mexico.....	9,824	203,100	579,374
North Carolina.....	82	1,700	13
Oregon.....	39,454	815,600	53,118
Pennsylvania.....	24	500	1,707
South Dakota.....	315,550	6,523,000	111,670
Tennessee.....	241	5,000	106,664
Texas.....	116	2,400	548,827
Utah.....	91,636	1,894,300	14,028,661
Virginia.....	29	600	8
Washington.....	7,309	151,100	147,584
Wyoming.....			65
Philippines.....	60,705	1,254,900	26,392
	2,422,006	\$50,067,300	53,052,441

(a) Valued at \$1 per ounce, provided by the Pittman Act of April 23, 1918, for domestic product

### Washington Headquarters Discontinued by A. F. of L.

The American Federation of Labor has discontinued its mining department, which has been maintained at the Washington headquarters for special consideration of mining matters. James Lord, who has been president of the department, has taken the field as a labor organizer and will work in the Pacific Coast region. It is said the abolition of the department was due to a large extent to differences which have arisen between President Gompers of the American Federation of Labor and John L. Lewis, president of the United Mine Workers.

### Cut in Iron Ore Rates Rejected by I. C. C.

Proposals of Eastern trunk line railroads to reduce by about 20 per cent the rates on iron ore coming from the Great Lakes water-line to steel plants in various localities were rejected recently by the Interstate Commerce Commission. The commission held that the reductions were out of harmony with the general rate situation, in that iron ore as a commodity

would have a rate level below that of other important raw materials. The commission, however, allows to go into effect reductions in local and import rates on iron ore shipments in Eastern trunk line territory. The schedules incorporating the lower local and import rates were filed to become effective April 1, but were suspended by the commission. The recent order withdrew the suspension and allowed the rates to become effective Aug. 28.

### Noble Electric Steel Co. Awarded \$41,256.33 by War Minerals Commissioner

Subject to the approval of the Secretary of the Interior the War Minerals Relief Commissioner has recommended an award of \$41,256.33 in favor of the Noble Electric Steel Co. and \$29,571.25 in favor of the Western Rock Properties Co. Each of these recommendations was influenced by the recent opinion of the Secretary of the Interior affecting the offset of profits from a non-stimulated mine as against the losses of a stimulated one in charge of the same owner.

The Ladd manganese mine was operated by the Western Rock Properties Co. prior to any request from Government sources for war minerals. The extent and scope of its operations were not increased after the appeal of the Government for manganese. For that reason, the profits of that operation are not being taken into consideration in computing the losses incurred on the stimulated activities.

### Arizona Mining Companies Oppose Boulder Dam Project

Arizona mining and agricultural interests are making protest against passage of the Swing bill, proposing a national appropriation of \$70,000,000 for construction of a storage and power dam at Boulder Canyon on the Colorado River, with definition of rights in which it is claimed that California is given far too much. Preference generally is expressed for the early construction of the Girand dam, at the mouth of Diamond Creek Canyon, a project that is backed by the Calumet & Arizona and other large mining interests that are large consumers of power for the operation of mines, smelters and mills.

The Girand project already has been given recognition by the National Power Board. It plans development of 140,000 hp. at a point only twenty-one miles north of the main line of the Santa Fe railway system. Funds are said to be available for immediate use and promise is made that work will be started within sixty days if Federal authority be given. Statement is made that the project is essential to the mining industry in that it will permit operation of mines and reduction works in which the mounting costs of power now are beginning to be a serious factor.

## News by Mining Districts

### London Letter

**Rhodesia Broken Hill Produced Lead for £17.46; Fair Profit—Cinderella May Reopen**

By W. A. DOMAN

London, July 21—Since the Central Mining & Investment Corporation took a hand in the affairs of the Rhodesia Broken Hill Development Co., and supplied it with funds for working capital, the company has certainly gone ahead, and has the distinction of paying dividends while many other lead companies experience difficulty in carrying on. For the past calendar year the shareholders receive 10 per cent. Working expenses are high, as is true, but when there is a distributable balance, this matter is overlooked. Last year 43,285 tons of ore were smelted, producing 18,122 tons of lead. The expenses amounted to £316,793, of which £124,432 went in shipping, etc., and £10,559 in royalty. The average cost per ton of lead was £17.46. Pumping was a heavy item, amounting to no less than £2.26 per ton of lead, or nearly 13 per cent of the aggregate expenditure. The "cementation" process was used freely, and at the end of the year the main shaft was down 190 ft., and No. 2 shaft 119½ ft. For the first half of the current year, the production of lead was 11,134 tons, so that on the average the output is considerably ahead of last year.

An agitation—mild, it is true—is proceeding in South Africa for the reopening of the Cinderella Consolidated Mines. This is one of the large properties on the East Rand, having something like 2,300 mining claims. Previous to the war, the property was closed down owing to exhaustion of funds, and subsequently negotiations took place between the company and the East Rand Proprietary Mines, with a view to coming to a working agreement. The East Rand Proprietary itself is none too flush of funds, and consequently nothing has been arranged. Early in 1916 George Denny, formerly the consulting engineer, who had been absent from the Rand for about ten years, returned and spent five months on the property, and gave it as his opinion that the main reef leader in the north section, the chief gold carrying orebody of the mine, had been left unexposed both in development work and in stopping operations. He further stated that as the result of his investigation, the gold content in the lower levels of the property is unequalled by anything in the upper levels. Recalculating the ore reserves, he gave what is, of course, the position today:

Fully developed payable ore—466,500 tons, averaging 7.1 dwt.

Partly developed payable ore—558,300 tons, averaging 6.47 dwt.

Ore in suspense, possibly 50 per cent payable—436,000 tons.

As working costs have been substantially reduced of late, and as the out-

look for mining on the Rand is regarded as distinctly more hopeful, the reopening of the mine is not an improbable event, though, naturally, working capital must be found, and it is not an easy task at the present time to induce the public to put up money, especially as the finances of the company are by no means strong.

### Johannesburg Letter

**Additional Links in Cape-to-Cairo Railway Are Projected—New Gold Discoveries Reported**

By JOHN WATSON

Johannesburg, June 27—During the past week the following dividends have been declared by gold-mining companies:

	Dividend No.	Rate of Dividend		Par Value
		Per Cent	Per Share	
Government G. M. Areas.	10	20	4s.	£1
Van Ryn Deep.	18	10	2s.	£1
Witwatersrand G. M.	36	5	1s.	£1
Johannesburg Consol. Invest. Co.		7½	1s. 6d.	£1
Rand Mines, Ltd.	38	20	1s.	5s.

Latest advices from Belgium confirm the intention of the colonial authorities, there, to push the construction of the two new projected Congo-Nile railroads with great energy in the near future. The recent important discoveries of richly mineralized areas on the Congo-Nile Divide will give increased interest to the projected railway extensions, as they will bridge one or two of the great breaks remaining in the Cape to Cairo railway route.

The location of a new gold reef near Lake Chrissie, Eastern Transvaal, is reported by an experienced prospector, named W. Hugo, who has traced the reef unbroken for 15 miles; from Lilieburn, through Spion Kop, Warburton and Lillysvlei to Ferniehaugh. He believes the reef extends further. Visible gold has been found and one sample from the outcrop assayed 17 dwt. per ton. It is proposed to form a syndicate and commence work immediately at Spion Kop. Lilieburn is 11 miles from Lake Chrissie, so this discovery may influence the route of the projected railway.

The reported discovery of a rich gold reef, about 80 miles from Keetmanshoop, Southwest Africa, has created a wide interest throughout the Union. The members of the local syndicate have been inundated with inquiries by letter and wire. The two principal holders are members of the local Criminal Investigation Department and are at present engaged on government business in connection with the shooting of certain Hottentots at Umias, near Raman's Drift.

Two receivers have been appointed in London for the Cape Copper Co., on the motion of Lloyds Bank City Offices Norminees, Ltd., which is a large holder of debentures in the copper company. Justice Romer, on June 21, granted the application for their appointment and gave liberty to borrow £500 immediately to pay the wages of employees.

### CANADA

#### British Columbia

**Nickel Plate Will Spend \$30,000 in Diamond Drilling—Fluorspar Mill Threatened by Fire**

Hedley—The mill of the Hedley Gold Mining Co. is now in regular operation, with mine output nearing normal. Prior to the shutdown, about two years ago, the property, known as the Nickel Plate mine, was one of the most regular producers and dividend payers of the province, the total profit distribution to date being approximately \$2,500,000. It is understood that this season's development campaign will involve the expenditure of \$30,000 in diamond drilling.

Grand Forks—Early in July, the mine and mill crew of the Rock Candy mine, the Consolidated M. & S. Co.'s fluorspar property on the north fork of Kettle River, were engaged for several days in a desperate fight to save the mine camps and mill from destruction by a forest fire.

Nelson—At a sheriff's sale of the mine and surface property of Gibson Mining Co., held here on July 21, the entire property was sold to a number of Portland, Ore., residents, some of whom had been heavy stockholders in the old mining company. The sale price was \$76,000. A short time after the sale was closed word was received to the effect that all the surface improvements had been wiped out by a forest fire. The Gibson mine is situated on Cariboo Creek, a tributary of the South Fork of Kaslo Creek, and is considered a valuable property, a limited amount of development having opened up considerable ore of a mixed character, with values in silver, lead and zinc. It is understood that the new owners will start operations soon.

#### Ontario

Coniston—Early in the morning of July 24 the cashiers of the Mond Nickel Co., when approaching the entrance to the plant here with the semi-monthly payroll amounting to about \$30,000 in two bags, were attacked by three armed bandits, who ordered the cashiers to hand over the money. This they refused to do and a struggle followed during which the hold-up men secured one of the bags with which they made off. The stolen bag contained about \$3,000 in small bills and change. The robbers escaped.

Renfrew—Joseph Legree reports the discovery of a large deposit of zinc on his property near here. A short cross-cut uncovered a good vein assaying 30 per cent zinc. Another opening has been made on the same vein 400 yd. east, which assays 15 per cent on surface. This property contains 100 acres and is situated 1½ miles from Opemgo Station on line of C. P. Ry. A transmission line runs across the property, and electric power is thus available.

## Quebec

**Johns-Manville Company Plans Million-Dollar Asbestos Plant**

Danville—The Canadian Johns-Manville Co. Ltd., will erect a large plant for the fabrication of asbestos products. Hitherto the raw asbestos has been shipped to the United States to be manufactured. Construction will be commenced immediately and the plant, the estimated cost of which is over \$1,000,000, is expected to be completed in about six months. About 300 men will be employed at the start. The Johns Manville Co. is now financing the Bennett Martin property at Thetford Mines, taking over the entire output on an option to purchase.

## MEXICO

**Moctezuma Copper Increases Operations**

Nacozari—The Phelps-Dodge Corporation will start a second unit of the Moctezuma concentrator. The plant has been under construction for two years. Concentrate is to be sent to Douglas.

## CALIFORNIA

**Walker Mine Is Shipping Concentrate to Tooele—Many Shafts Seek Ore in Randsburg Silver District**

*Special Correspondence*

San Francisco—The Walker Mining Co., a subsidiary of the Anaconda Copper Mining Co., through the International Smelting Co., is shipping 100 tons of copper concentrate per day from its plant near Portola, Plumas County, to the International smelter at Tooele, Utah. This is to be augmented almost immediately by daily shipment of crude copper ore containing gold.

The Engels Copper Mining Co. is also shipping copper concentrate to the Garfield smelter. The presence of the precious metals in the copper ores of Plumas County enables these companies to operate profitably, whereas most of the other Californian copper districts are dormant.

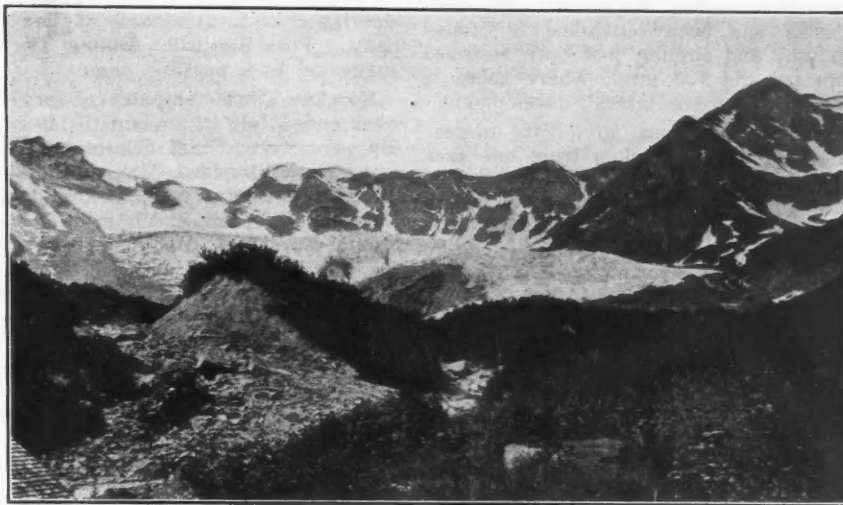
The Gold Leaf mine between Redding and Shasta, and the Plumbago mine near Downieville, Sierra County, are being reopened; underground work is being resumed at the City of Six mine.

The Newtown Mining Co., operating on the Mulcahy Ranch property near Grass Valley is shipping ore to the Selby smelter as an experiment to determine the economic practicability of this method of treatment.

The Randsburg Silver Mining Co., which purchased a group of claims to the northwest of the "reef" on the projection of the north-south veins in the California Rand Silver mine, is cross-cutting from a 450-ft. shaft to see if these continue through the reef. The same company also has a group of claims northeast of the California Rand, on which a number of lessees are working, two of whom have shafts down over 300 ft. If profitable ore is found in the new ground the discovery will assure to the California Rand company large ore reserves on the extension of its veins in ground still unprospected. Half a dozen companies are sinking shafts to

the northwest of the reef, one of whom, the Montana-Mizpah, went through 400 ft. of granite before entering the schist; they have cut, in the shaft, both in the granite and schist, north-south veins carrying small amounts of gold and silver.

Tuolumne—The Hoff Magnesite Co. has opened at Chinese Camp, a deposit of high-grade magnesite. It was supposed that the magnesite veins in the Sierra Nevada were small but develop-



*Along Copper River & North Western Ry. between Cordova and Kennecott, in Alaska*

ment opened a 15-ft. ledge of high-grade material a large tonnage of which is being shipped to Oakland. Analysis is said to show low silica, iron and lime, and 96 per cent magnesium carbonate.

## ALASKA

**Kennecott Copper Increases Output—Green Butte Being Developed**

Kennecott—With more ore in sight than at any time in the history of the property, and with plenty of promising ground left to explore, the Kennecott Copper Corporation is increasing its output as rapidly as the labor supply will permit. The properties have been put into the best possible condition to secure maximum of output, and one large stope is in almost solid chalcocite.

John Phillips, Jr., who has kept an exploratory force in Alaska for many years, apparently is about to be rewarded for his industry and persistence. He has opened the Green Butte property, near the Kennecott mines, and it is said to have all the signs of developing into a property similar to the Kennecott, the Jumbo, and the Mother Lode. The probability of early production from the Green Butte makes brighter the prospects of the Copper River and Northwestern Railroad. It will be recalled that at the time this road was under construction, the project was widely held to be a gigantic folly. Since its completion, the road has more than been paid for by the output of the mine, the development of which it made possible.

## ARIZONA

**United Verde Ready to Start Heap Leaching—United Eastern Is Milling \$15 Ore**

Jerome — The United Verde has started another reverberatory at Clarkdale and has added 150 men to its payroll. In the upper surface workings the shovels are approaching the oldest of the mine workings, where good smelting ore is expected. Mine water has been turned upon the first 5,000-

ton ore heap preparatory to leaching. The United Verde Extension is reported to have cut a new lens of oxide ore on its 1,300 and 1,400 levels.

The Verde Central is completing its 850 station, cut from coppershot schist, and will drift along the contact. The west-side tunnel, now 1,500 ft. long, will be carried 500 ft. farther.

The Dundee Arizona, under W. E. Defty, is continuing development of its upper carbonate zone, with expectation of installing a leaching plant this fall.

The Verde Jerome is now under management of William Gohring, formerly with the Copper Queen. A new surface plant is being installed, with power from the lines of the Arizona Power Co. A sinking pump has been ordered and the shaft is to be deepened.

Kingman—At Oatman, the United Eastern is milling about 10,000 tons of \$15 ore per month. The Tom Reed mill is receiving ore from the Telluride, which is averaging about \$50, and which, below the 500 level, is said to have a 4-ft. ledge that samples \$133 gold. The Gold Ore will ship to the Tom Reed from a 5-ft. vein on the 500 level, the ore averaging \$15. United Western is drilling toward the United Eastern vein extension. The Gold Dust is reported to have developed ore in eight drill holes from the 500 level and the Oatman Gold to have cut rich ore in a 500 level drift.

Gold ore is being taken from the Robinson-Sands property in Secret

pass, at 70 ft. depth. In the same section a small mill is being operated on ore from the Orphan mine.

On Silver Creek, west of Oatman, sluicing has been started on gravel brought up from bed rock, whereon much trouble has been experienced from water.

Following favorable report by A. A. Hassan, Ed. Olson and associates have located 2,240 acres of placer ground on the Colorado River, near the mouth of the Grand Canyon.

In the Katherine property, near the Colorado River, water in the lower levels has been controlled by added pumps and sinking has been resumed toward the 700 level, where there is to be extensive lateral development.

**Bisbee**—Siliceous ore, for smelter fluxing, is being taken from one face on Sacramento Hill, opened by the stripping. About 4,000 tons a month will be used. All material and timber on the Higgins property, lately bonded by the Phelps Dodge Corporation, has been taken over by the Copper Queen branch.

Water is impeding progress on the long 1,800-level drift that is to connect the Junction and Campbell shafts of the Calumet & Arizona. Pumping and hoisting ore for the Campbell section is to be done at the Junction.

Development has been resumed on the King Copper Co.'s mines in the Chiricahua, after favorable report by C. W. Botsford.

Shipments of silver bullion are going to the mint from several small mills at Tombstone, where good extraction is reported by the cyanide process.

#### NEVADA

##### United Comstock Construction Is Up to Schedule

**Virginia City**—Active development work is being carried on from the workings off the Hale and Norcross tunnel of the Middle Mines. In the Savage ground, nearly 900 ft. north of the tunnel, the east crosscut is said to have been in good ore for more than 70 ft. In the Chollar-Potosi ground, 750 ft. south of the tunnel, an east crosscut is said to be in good ore. No definite data are available regarding any new option involving the Middle Mines group, but rumors persist that a new deal is being made, and that it includes not only the Middle Mines group but several adjacent groups as well.

All construction work on the 2,500-ton plant of the United Comstock Mines Co. is up to schedule. The structural steel work on the cyanide building should be completed by August first. A good part of the machinery is in place and the mill will begin to operate in September.

**Tonopah**—In spite of a loss of two days on the fourth and fifth the district production for the first fifteen days of July was about normal. The Tonopah Belmont shipped \$96,200 in bullion, the Tonopah Extension \$81,000, West End \$79,500, and the Tonopah Mining \$60,000.

#### UTAH

##### Shipments From Both Tintic and Park City Districts Increase

**Park City**—Shipments for the week ended July 22 amount to 4,218 tons. Shippers were: Ontario, 1,654 tons; Park-Utah, 876; Silver King Coalition, 857; Judge, Daly, and Daly West, 831. The Bingham Galena Mining Co. is reported to be starting work on the Bone group of claims adjoining the Glen-Allen in the eastern part of the camp. A stockholders' meeting will be held Aug. 21 for the purpose of considering changing the name of the company. Park-Bingham Mining Co. is suggested as a possible name.

**Eureka**—Tintic shipments for the week ended July 22 amount to 149 cars. Shippers were: Chief Consolidated, 42 cars; Tintic Standard, 33; Iron Blossom, 21; Grand Central, 12; Colorado, 10; Eagle & Blue Bell, 8; Victoria, 5; Centennial-Eureka, 4; Mammoth, 4; Swansea, 3; Gemini, 2; Alaska, 1; Sunbeam, 1; Tintic Drain Tunnel, 1; Eureka Mines, 1; Yankee, 1. At the Iron Blossom a promising find of ore has been made in new ground.

#### NEW MEXICO

##### New High-Grade Ore Being Opened in Bonney Mine—Last Chance Rushes Mill Construction

**Lordsburg**—Lessees are making new strikes of high-grade ores in the Bonney mine. On the 250 level of No. 1 shaft, Sholly & Reynolds have opened a 4½-ft. vein of sulphide. A fifty-ton car of this ore was shipped to the El Paso smelter on July 25. It sampled 0.56 oz. gold, 7.96 oz. silver and 7.98 per cent copper. A body of red oxide ore is being opened on the 125 ft. level of the same shaft, which assays 1.67 oz. gold, 36.54 oz. silver, and 12.80 per cent copper. A carload will be ready for shipment in a week. The highest grade copper ore ever shipped from this district has come from this shaft.

Schauber & Kurtz, who have a lease on surface ground between Nos. 2 and 3 shaft, have encountered high-grade copper oxides carrying about \$20 in precious metals at a depth of 25 ft. The vein is 20 in. wide. A carload of this ore was shipped on July 24 to the Copper Queen smelter at Douglas, Ariz. These strikes are all in new ground and in no way effect the blocked out reserve in the mine of which there is reported to be 45,000 tons of a gross value of \$600,000.

The Last Chance mine is pushing work on the mill installation, preparatory to milling 30,000 tons of silver ores now blocked out. This averages 10 oz. silver; it was blocked out in less than a year by the late Jack White.

The 85 Mine branch of the Calumet & Arizona Mining Co. is shipping an average of 7,500 tons of ore monthly to the smelter at Douglas, Ariz.

The Anita Copper Co. expects to have its experimental concentrator in operation in about ten days. Ed. Daily, formerly assayer at the 85 Mine, has been retained to complete the job.

#### IDAHO

##### Good Ore Found Near Hailey—Ponderay Property Will Be Auctioned

**Adair**—More copper stringers have been cut by the long tunnel of the Montana-Idaho Copper Co., which work has been advanced steadily forward for more than two years. The bore is believed to be close to the vein.

**Hailey**—Assays of a streak of high-grade ore struck recently on the property of Colorado Mining & Milling Co., show 190 oz. silver, 52 per cent lead, and \$2 to \$4 in gold. The strike was made next to the hanging wall of a vein opened up by a crosscut tunnel only 50 ft. long. The property is three miles from Hailey; it is planned to commence production.

**Sandpoint**—Under order of the District Court of the Eighth Judicial District of Bonner County, Sheriff William Kirkpatrick will dispose of by auction the entire holdings of Ponderay Mining & Smelting Co., in the town of Ponderay, near here, together with a small steamer and a number of mining claims in the vicinity of Pend Oreille Lake. The sale is scheduled to be held at Sandpoint on August 10 next, and is to satisfy the claim of \$59,938, principal, and \$23,905.89 in interest and fees, held by the Union Trust Co., of Spokane. The company has not been active for several years past.

#### COLORADO

##### Two New Companies Start Operations at Leadville

**Cripple Creek**—The bonanza strike made at the junction of the No. 1 and the Lee No. 5 veins on the property of the Portland Gold Mining Co. in July, has been explored over 110 ft. and the high-grade ore continues to hold. At the intersection with the Strong vein, which was cut later in the month, extremely high-grade ore was encountered, proving a large area of ground. Shipments from the find the latter part of the month, were netting more than \$30,000 a week.

**Leadville**—The Starr Leasing Co. is the name of a newly organized and strongly financed organization which has taken over a large acreage in the Leadville Basin, including the Thompson, Gow, and Starr placers. The property will be operated from the California gulch shaft which was sunk to a depth of over 500 ft., but has been inactive for twenty years. W. J. Davis, who has been connected with the property since the early days, is in charge of operations. Other well known mining men back of the enterprise are J. W. Collins, and J. B. MacDonald, who are officials of the Western Zinc Oxide Co.

Another new enterprise, backed by Horton Pope, of Denver, M. A. Nicholson, John Cortellini, and E. L. Hartwell, of Leadville, and J. C. Wood, of Colorado Springs, has been organized to unwater the New Monarch property situated on the north slope of Big Evans Gulch.

## WISCONSIN

## Better Zinc Market Will Open Mines Unless Coal and Rail Strikes Interfere

Platteville—Prices for zinc ore during the month of July have steadily increased, one buyer the latter part of the month offering \$39 per ton for 60 per cent zinc concentrates. With the market showing a strong upward tendency, many of the operators who have been idle for about two years are considering unwatering their properties and getting ready for operations. Should the coal and rail strikes be satisfactorily settled in the near future, such operators as the Wisconsin Zinc Co., Kistler-Stephens Co., Frontier Mining Co., Rodham & McQuiety Co. and the Mineral Point Zinc Co., having known ore deposits ready to be worked, will be operating again at capacity. With these companies again producing, the district will be an important source in supplying the demand of the smelters.

The Zinc Hill Mining Co. operating the Big Dick mine near Cuba City, has opened a large deposit of lead, and expects to produce about forty tons of 80 per cent lead per week. This company also plans to start erecting mills and equipment on several bodies of ore drilled out in 1920. Drilling shows large deposits of low-grade zinc.

The Connecting Link mine at Cuba City is coming in strong, and at the present time is producing 100 tons of 35 per cent zinc concentrate per week.

The Nightingale mine at Leadmine continues to produce 150 tons per week of low-grade assaying about 22 per cent zinc.

The production of 60 per cent zinc concentrate for the month reached 1,500 tons. As this production was readily disposed of, the surplus in the district remains the same as of June 30, namely 4,000 tons. There is no surplus of lead in the district.

## MINNESOTA

## Lean Ores Are Successfully Washed at Maroco Mine

Ironton—Clement K. Quinn & Co., operators of the Mahnomen mine, have contracted for the use this season of the ore concentrating plant of the Pittsburgh Steel Ore Co., situated at the Rowe mine at Riverton, four miles west, and are now running the output of the Mahnomen open pit through this plant before shipment. The ore is treated by log washing and crushing, and it is stated that highly satisfactory results are being obtained. The Mahnomen ships a soft red non-besemer hematite and several grades of lumpy manganiferous ores. Operation of the Rowe mine plant was abandoned by the owners in 1918 when mining methods were changed from open pit to underground at this property. All mining ceased in 1920.

Trommald—Encouraging results are being obtained at the Maroco mine

washing plant, the first experimental plant for treating the lean wash ores near the base of the Cuyuna iron formation. It is reported that the grade of concentrate secured at this plant is better than anticipated and that an average of forty cars per day is being shipped from the plant. The plant output represents about two-thirds of the mine shipments, the remainder being direct shipping ore from the pit operation. The property is operated by the Marquette Ore Co. W. B. Pattison, of Negaunee, Mich., is general superintendent.

The Adbar Development Co. (Robt. Adams and associates) has taken under option several forties in Section 27, Township 47, Range 29, and is now exploring here with one diamond drill. The property lies north of the Clark mine, a manganiferous iron ore property opened up by Oneida Mines Co. in 1918, but subsequently abandoned.

## JOPLIN-MIAMI DISTRICT

## Royal Mine Will Be Reopened—Co-operation Planned to Combat Coal Shortage

Joplin—A new shaft is being started by F. W. Evans on the Southern Lead & Zinc Co.'s property, north of Picher, Okla., which he leased some months ago. The site is on the forty-acre tract east of the mill. Drilling has proved up an orebody.

J. R. Cole reports a drill strike on what is known as the Cemetery lease, immediately west of Baxter Springs, Kan., which adjoins one of the developed properties of the Chanute Spelter Co. The ore was found at a depth of about 210 ft. Full development is planned.

The United Zinc Smelting Corporation, in which Charles M. Schwab has the controlling interest, has completed unwatering its Royal mine, near Picher, and will place the property in operation immediately. The Manhattan mine, its other property in this field, has been in steady operation for some months and is a steady producer. H. W. Lohman, treasurer of the company, has been here from New York for several days overseeing the preparations for the starting of the Royal.

Another boost for the zinc-roofing campaign has been given in this field by announcement of the Empire District Electric Co. that it will replace a tile roof on one of its boiler houses at Riverton, Kan., with a corrugated sheet-zinc roof. The building is 180 by 90 ft. and the roof will take about 18,000 sq. ft. of zinc.

Several conferences have been held among operators looking toward all possible conservation of coal and electric power in the field, provided the coal and railroad workers' strikes are not settled at an early date. It is expected that a good many of the mines using electricity will operate their mills on night shift for a while at least to help cut down the peak load of the electric company.

## MICHIGAN

## The Copper Country

## Adequate Coal Supply for Winter Depends on Duration of Strikes

BY M. W. YOUNGS

Houghton—Current coal shipments are much below normal and most of the mines face a shortage next winter unless there is a change in the strike situation soon. It was believed during the early days of the strike that this district would not be seriously affected. Shipments in June, however, were comparatively small, and even less coal has been unloaded in July. The rail strike has complicated matters to such an extent that doubts now are entertained whether sufficient coal will be brought in to last the mines, mills, and smelters through the cold weather.

Even on the present basis of operations, 50 per cent of normal, the Calumet & Hecla plants are four or five months short on their supply, and other companies are similarly affected. Some of the mine managers are confident their coal needs will be supplied, while others are non-committal, declaring all depends on a settlement of the coal and rail strikes.

Calumet & Hecla's "subway" haulage level, 8,100 ft. underground, in the conglomerate department, is nearing completion, and a portion of it is being equipped preparatory to use. It will be but a short time before No. 12 shaft, its southern terminal, will be holed through, and only a small amount of drifting remains to be done. The level, which will be used entirely for haulage purposes, will be 7,800 ft. long. From it sub-shafts will be sunk to mine the lode at greater depth.

Only one shaft, the Red Jacket, will be used for hoisting, and that shaft is now being straightened and otherwise equipped for that duty. No. 12 shaft will be employed for supplies and the men. The intervening shafts above the eighty-first level will be abandoned so far as hoisting is concerned. The result will be a lowering of costs.

## Gogebic Range

## Oliver Company Has Five Months' Coal on Gogebic Range

Ironwood—As elsewhere, the coal and railroad strikes are now causing some concern. As to coal the larger mines have supplies to last them several months, the Steel & Tube Co. has enough for about eight weeks, and the Oliver Iron Mining Co. has enough for five months or more. However, they have to get their entire winter's supply before navigation closes, and if the coal mines reopened now it would be some weeks before coal could be delivered to the iron mines in this district.

The railroad situation is more serious at present. A number of men from the engineering and administrative offices in Chicago are now working in the railroad shops at Ashland. An ore train on the Soo Line was recently wrecked and seventeen cars derailed, due probably to defective couplings.

# THE MARKET REPORT

## Daily Prices of Metals

July	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
27	13.625@13.75	32.375	32.875	5.75	5.40@5.425	5.95@6.00
28	13.625@13.75	32.25	32.75	5.75	5.425	6.00@6.10
29	13.625@13.75	32.25	32.75	5.75	5.425	6.10
31	13.625@13.75	32.25	32.625	5.75	5.45	6.15
Aug. 1	13.70@13.75	32.25	32.625	5.75@5.80	5.45	6.20
2	13.725@13.75	32.00	32.25	5.75@5.80	5.45@5.475	6.20@6.25

\*These prices correspond to the following quotations for copper delivered: July 27th to 31st, 13.875@14c.; Aug. 1st, 13.95@14c.; 2nd, 13.975@14c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

## London

July	Copper			Tin		Lead		Zinc	
	Standard	3M	Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot								
27	63 <sup>5</sup> / <sub>8</sub>	63 <sup>7</sup> / <sub>8</sub>	70 <sup>1</sup> / <sub>2</sub>	162 <sup>3</sup> / <sub>4</sub>	162 <sup>3</sup> / <sub>4</sub>	25 <sup>3</sup> / <sub>4</sub>	24 <sup>5</sup> / <sub>8</sub>	30 <sup>1</sup> / <sub>2</sub>	29 <sup>3</sup> / <sub>8</sub>
28	63 <sup>3</sup> / <sub>8</sub>	64 <sup>1</sup> / <sub>8</sub>	70 <sup>1</sup> / <sub>2</sub>	161 <sup>1</sup> / <sub>2</sub>	161 <sup>1</sup> / <sub>2</sub>	25 <sup>3</sup> / <sub>4</sub>	24 <sup>5</sup> / <sub>8</sub>	30 <sup>3</sup> / <sub>8</sub>	29 <sup>7</sup> / <sub>8</sub>
31	64 <sup>1</sup> / <sub>8</sub>	64 <sup>3</sup> / <sub>8</sub>	71	162 <sup>1</sup> / <sub>2</sub>	162 <sup>1</sup> / <sub>2</sub>	25 <sup>3</sup> / <sub>4</sub>	24 <sup>5</sup> / <sub>8</sub>	31 <sup>1</sup> / <sub>2</sub>	30 <sup>3</sup> / <sub>8</sub>
Aug. 1	64 <sup>3</sup> / <sub>8</sub>	64 <sup>1</sup> / <sub>8</sub>	71	162 <sup>3</sup> / <sub>4</sub>	162 <sup>3</sup> / <sub>4</sub>	25 <sup>1</sup> / <sub>4</sub>	24 <sup>1</sup> / <sub>2</sub>	31 <sup>1</sup> / <sub>2</sub>	30 <sup>3</sup> / <sub>8</sub>
2	65 <sup>3</sup> / <sub>8</sub>	65 <sup>3</sup> / <sub>8</sub>	71	159 <sup>3</sup> / <sub>4</sub>	159 <sup>3</sup> / <sub>4</sub>	25 <sup>3</sup> / <sub>8</sub>	24 <sup>1</sup> / <sub>2</sub>	31 <sup>3</sup> / <sub>4</sub>	31 <sup>1</sup> / <sub>2</sub>

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

## Silver and Sterling Exchange

July	Sterling Exchange "Checks"	Silver			July and Aug.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
27	444 <sup>1</sup> / <sub>2</sub>	99 <sup>5</sup> / <sub>8</sub>	69 <sup>3</sup> / <sub>4</sub>	35 <sup>3</sup> / <sub>4</sub>	31	443 <sup>1</sup> / <sub>2</sub>	99 <sup>5</sup> / <sub>8</sub>	69 <sup>1</sup> / <sub>2</sub>	35 <sup>1</sup> / <sub>2</sub>
28	444 <sup>1</sup> / <sub>2</sub>	99 <sup>5</sup> / <sub>8</sub>	69 <sup>3</sup> / <sub>4</sub>	35 <sup>1</sup> / <sub>2</sub>	1	444	99 <sup>5</sup> / <sub>8</sub>	69 <sup>1</sup> / <sub>2</sub>	35 <sup>1</sup> / <sub>2</sub>
29	444	99 <sup>5</sup> / <sub>8</sub>	69 <sup>1</sup> / <sub>2</sub>	35 <sup>3</sup> / <sub>4</sub>	2	443 <sup>3</sup> / <sub>4</sub>	99 <sup>5</sup> / <sub>8</sub>	69 <sup>1</sup> / <sub>2</sub>	35 <sup>1</sup> / <sub>2</sub>

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

## Metal Markets

### New York, Aug. 2, 1922

The week has been quiet in the non-ferrous metal markets so far as copper and tin are concerned. Zinc and lead were active, especially zinc, which continued its spectacular rise, each day creating a new high record for the year.

### Copper

Sales have been light, and the market on its best days was little better than dull. Foreign buying has picked up slightly, but domestic consumption remains the mainstay to prices. Sales

earlier in the week were divided between 13<sup>3</sup>/<sub>4</sub> and a 14c. delivered basis. Producers generally quoted 14c. and occasionally lost sales at that price. Since Monday, however, it has become difficult to procure any metal below 14c., and practically all business has been done on that basis. It is doubtful whether any but a relatively small amount of copper can be had today below 14c. Nearly all producers are in a comfortable position so far as sales go. One reports that his business for July was better than that of June, which was a good month. They can therefore afford to wait until buying

## Average Metal Prices for July

<b>Copper:</b>	
New York Electrolytic.....	13.654
London Standard .....	63.137
London Electrolytic .....	70.321
<b>Lead:</b>	
New York .....	5.729
St. Louis .....	5.447
London .....	24.869
<b>Silver:</b>	
New York, foreign.....	70.245
New York, domestic.....	99.625
London .....	35.644
Sterling Exchange .....	444.165
<b>Zinc:</b>	
St. Louis .....	5.694
London .....	29.042
<b>Tin:</b>	
99 per cent.....	31.025
Straits .....	31.733
London .....	156.149
<b>Antimony .....</b>	<b>5.091</b>
<b>Quicksilver .....</b>	<b>55.000</b>
<b>Platinum .....</b>	<b>90.180</b>

becomes a little more active. The copper manufacturing centers are reported to be many weeks behind in their orders and having trouble in obtaining a satisfactory number of workers. Sales of copper have been made for delivery as far ahead as December on the same basis as that for prompt shipment.

Export business has been well diversified, all the important European purchasers being in the market. Sales were light but better than last week. The Orient is still closed to American copper because of a high tariff. European prices continue to range between 14.10 and 14.25c., c.i.f.

### Lead

The official contract price of the American Smelting & Refining Co. continues at 5.75c. per lb. New York.

The lead market continues to be active, and sales of several producers were heavy. The demand for lead has not been confined to any particular section of the country, and both Middle Western and Eastern business has been good. In New York the bulk of the business was done on a 5.75c. basis. The lots which were available last week at 5.65c and 5.70c. have entirely disappeared. In fact, demand has been so satisfactory and producers so well sold of metal that yesterday and today sales were made at 5.775c. and 5.80c. in large quantities. A consumer might experience great difficulty in procuring lead at 5.75c. in the existing market. It would appear that consumers are carrying only moderate stocks at their plants.

## Zinc

The zinc market has been no exception to the rule that a rising market induces buying, for sales have been brisk and at prices that have increased every day. The market is now well above 6c., with 6.25c. asked and obtained by at least one producer. The market shows no tendency to remain at its present levels, and higher prices are looked for. A shortage of zinc in view of the strong demand seems imminent. European consumption of zinc is also excellent, but the London and New York markets are too close together to permit of exportations being profitably made. There is no disposition on the part of producers to quote the forward market. High-grade zinc, for which a good demand continues, has advanced in price from 6½ to 7c. per lb. New York, with a freight allowance of 30 points per 100 lb.

## Tin

The market has been lifeless. The largest consumers, the tin-plate manufacturers, have remained out of the market because of a fuel shortage. A premium continues for spot 99 per cent tin, and quotations are largely nominal. Straits tin for forward delivery commands the same price as prompt tin.

Arrivals of tin in long tons: July 27, China, 75; 28th, London, 100; 31st, Straits, 325; total for July, Atlantic and Pacific ports, 5,835 tons.

## Gold

Gold in London: July 27th, 92s. 8d.; 28th, 31st and Aug. 1st, holiday; 2d., 92s. 9d.

A circulation statement of the Treasury Department as of July 1, 1922, shows the following stock of money in the United States: Gold coin and bullion, \$3,785,520,512; gold certificates, \$695,000,489; standard silver dollars, \$381,176,851; silver certificates, \$304,066,593; Treasury notes of 1890, \$1,510,543; subsidiary silver, \$271,464,942; United States notes, \$346,681,016; Federal Reserve notes, \$2,555,061,660; Federal Reserve bank notes, \$80,495,400; national bank notes, \$758,202,027; total, \$8,178,602,408 or \$39.87 per capita.

## Foreign Exchange

The feature of the foreign exchange market has been the setting of a new low record for the mark. On Tuesday, Aug. 1, francs were 8.17c.; lire, 4.53c.; marks, 0.1495c.; Canadian exchange ½ per cent discount.

## Silver

The market continues dull and featureless, with the demand for San Francisco silver limited. There has been a little inquiry for prompt New York delivery, which has held the price steady, but the strength of the market is on account of scarcity of offerings rather than on broad demand.

Mexican Dollars—July 27, 53½; 28, 53½; 29, 53½; 31, 53½; Aug. 1, 53½; 2d, 53½c.

## Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—20.10c. per lb. for 99 per cent grade; 19.10c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.75@18.25c. for 98@99 per cent virgin grades.

Antimony—Chinese and Japanese brands, 5.25c.; firm. W. C. C., 6@6.25c. Cookson's "C" grade, spot, 7@7.5c. Chinese needle antimony, lump, nominal, 3.75@4.25c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb<sub>2</sub>O<sub>3</sub>, 6.75@7c.

Bismuth—\$2@\$2.10 per lb.

Cadmium—\$1.20@\$1.25 per lb.

Cobalt—Metal, \$3@\$3.25 per lb.; black oxide, \$2 per lb. in bbls.

Iridium—\$180@\$185 in New York. One Middle Western dealer quotes \$160.

Magnesium—Sticks, 1½ in., 99.9 per cent, \$1.25 per lb.

Molybdenum Metal—In rod or wire form, 99.9 per cent pure, \$32@\$40 per lb., according to gage. Powder, 95 per cent, \$5 per lb.

Monel Metal—Shot, 32c.; blocks, 32c. per lb., f.o.b. Bayonne, N. J.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market quiet at 31@33c. per lb.

Osmium—No quotation reported. Recently \$70 per troy oz.

Palladium—\$55 per oz.

Platinum—\$93 per oz.

Quicksilver—\$55 per 75-lb. flask, San Francisco wires \$54. Strong.

Rhodium—\$100@\$115 per troy oz.

Selenium—Black powdered, amorphous, 99.5 per cent pure, \$1.75@\$1.85 per lb.

Thallium Metal—Ingot, 99 per cent pure, \$20 per lb.

Tungsten Metal—Powder, 97 to 98 per cent, 45@60c. per lb. contained tungsten.

## Metallic Ores

Chrome Ore—Many inquiries, but prices on imported material considered too high. Indian ore, \$18.50 per ton. Refractory ore, \$15.

Iron Ore—Lake Superior ores, per long ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, \$5.95; Mesabi bessemer, 55 per cent iron, \$5.70; Old Range non-bessemer, 51½ per cent iron, \$5.20; Mesabi non-bessemer, 51½ per cent iron, \$5.05.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, \$4.50 per long ton; old bed concentrates, 63 per cent, \$5.25; Harmony, cobbled, 63 per cent, \$5.25; new bed low phosphorus, 65 per cent, \$7.50.

Manganese Ore—29c. per long ton unit, seaport.

Molybdenum Ore—45@50c. per lb. of MoS<sub>3</sub>, for 85 per cent MoS<sub>3</sub> concentrates.

Tantalum Ore—Hand-sorted ore, 70 per cent combined columbite-tantalite, 40c. per lb., South Dakota.

Titanium Ores—Ilmenite 52 per cent TiO<sub>2</sub>, 1½@2c. per lb. for ore. Rutile, 96 per cent TiO<sub>2</sub>, 8@10c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Chinese ore, \$3@\$3.50 per long ton unit of WO<sub>3</sub>.

Uranium Ore (Carnotite)—Ore containing from 2 to 2½ per cent U<sub>3</sub>O<sub>8</sub>, \$3.50 per lb. of contained U<sub>3</sub>O<sub>8</sub>.

Vanadium Ore—No quotation. Recently \$1 per lb. of V<sub>2</sub>O<sub>5</sub> content.

Zircon—Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

## Zinc and Lead Ore Markets

Joplin, Mo., July 29.—Zinc blende per ton, high, \$37.45; basis 60 per cent zinc, premium, \$37@\$37.50; Prime Western, \$36; fines and slimes, \$34@\$33; average settling price, all grades of blende, \$33.92.

Lead, high, \$81.60; basis 80 per cent lead, \$78.50; average settling price, all grades of lead, \$79.87 per ton.

Shipments for the week: Blende, 9,273; lead, 1,761 tons. Value, all ores the week, \$455,190. Shipments for seven months: Blende, 271,375, calamine, 866; lead, 53,986 tons. Value, all ores seven months, \$11,668,560.

Sellers held up sales until after 3 o'clock today, until buyers compromised on a basis. Sellers were asking \$38 premium and \$37 Prime Western. Buyers had offered only \$36 premium and \$35 Prime Western. Buyers asserted there was little need of purchasing ore with the rail strike holding up shipments, and only 6,400 tons was bought.

Platteville, Wis., July 29.—Blende, basis 60 per cent zinc, \$38 per ton. Lead, basis 80 per cent lead, \$78 per ton. Shipments for the week: Blende, 266; lead, 35 tons. Shipments for the year: Blende, 9,148; lead, 1,129 tons. Shipments during the week to separating plants, 837 tons blende.

## Non-Metallic Minerals

Asbestos—No. 1 crude, \$700@\$750 per ton, f.o.b. Quebec mines; No. 2, \$350@\$450; long spinning fibre, \$200@\$300; spinning fibre, \$175@\$300; shingle stock, \$65@\$100; paper stock, \$27.50@\$35; cement stock, \$14@\$17; floats and shorts, \$8.

Barytes—Washed crude ore, 92 per cent BaSO<sub>4</sub>, guaranteed, \$8 per long ton, Georgia; \$9, New York. Ground, off-color, No. 1 grade, \$20, New York; No. 2, \$15.

Bauxite—American, crushed and dried, \$6@\$9 per gross ton; pulverized and dried, \$12@\$14 per gross ton; calcined, \$22@\$25 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at \$5@\$8 per metric ton, c.i.f. Atlantic ports, depending upon grade.

<sup>1</sup>Furnished by Foote Mineral Co., Philadelphia, Pa.

**Borax**—Granulated and refined, crystals or powdered, in bags, carloads, 5½c. per lb.; in bbls., 5½c. Boric acid, 11c.

**Chalk**—English, extra light, 5c. Domestic light, 4½@4¾c.; heavy, 3½@3¾c. per lb., all f.o.b. New York.

**China Clay (Kaolin)**—Crude, \$6@ \$8; washed, \$8@ \$9; powdered, \$12@ \$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, \$13@ \$20, f.o.b. Virginia points. Imported lump, \$13@ \$18, f.o.b. American ports; powdered, \$35@ \$45, f.o.b., New York. 1A grade, refined, \$13.50 per ton, Delaware.

**Emery**—Turkish and Greek manufactured emery, 6@8c. per lb. American, 4@6c. Inferior grades, 3½c., f.o.b. New England points.

**Feldspar**—No. 1 pottery grade, \$6.50 @ \$7.50 per long ton; soap grade, \$7, f.o.b. North Carolina points. Ground to 140 mesh, \$16.50 per ton; 40 to 100 mesh, \$10, f.o.b. mill. Maine producer reports pottery grade at \$18. Canadian \$20, f.o.b. cars at mill.

**Fluorspar**—Gravel, \$17.50@ \$20 per ton, f.o.b. mines in Middle West. Acid, \$40@ \$45 in bulk. For enameling and glass uses, \$35@ \$40. Imported acid grades, \$21, f.o.b. Atlantic seaboard.

**Fuller's Earth**—16 to 30 mesh, \$17 per ton; 30 to 60 mesh, \$20; 60 to 100 mesh, \$18; 100 mesh and finer, \$10; f.o.b. Florida mines.

**Graphite**—Ceylon lump, first quality, 5@5½c. per lb.; chip, 4@4½c.; dust, 3½ @3¾c. Mexican crude amorphous, \$15@ \$35. Market dull.

**Gypsum**—Crushed rock, \$3 per ton in most states. Ground, \$3.50@ \$4, f.o.b. shipping points.

**Kaolin**—See China Clay.

**Limestone**—Crushed, New York State shipping points, ½ in. and larger, \$1.10 @ \$1.35 per net ton. Agricultural limestone, \$2.50@ \$3 net ton, f.o.b. eastern shipping points.

**Magnesite**—Crude, \$8@ \$12 per ton. High-grade caustic calcined, lump form, \$30@ \$45 per ton. Plastic calcined, \$45@ \$50 in bbls., carload lots, f.o.b. California points. Atlantic seaboard, \$60.

**Dead-Burned**—\$33 per net ton, Chewelah, Wash.; \$58@ \$64, Chester, Pa. Austrian grains, \$30 per ton, f.o.b. Baltimore. (Magnesite brick—See Refractories.) Industry on Pacific Coast inactive. Prices of American grades nominal.

**Mica**—India block mica, slightly stained, per lb.; No. 6, 35c.; No. 5, \$1.25; No. 4, \$2.25; No. 3, \$2.90; No. 2, \$4; No. 1, \$5.20. Clear block: No. 6, 50c.; No. 5, \$1.75; No. 4, \$3; No. 3, \$4.75; No. 2, \$6; No. 1, \$7.50; A1, \$9; ground, wallpaper grade, \$90@ \$200 per ton (depending upon quantity); ground roofing mica, \$25@ \$70, all f.o.b. New York. Water-ground mica, 160 and 200 mesh, 6½@8c. per lb., f.o.b. Virginia points.

**Monazite**—Minimum 6 per cent ThO<sub>2</sub>, 6@8c. per lb.

**Phosphate Rock**—Per long ton, Florida ports, pebble grade, for export: 77 per cent tricalcium phosphate, \$7.50 (\$8.50 for hard rock); 75 per cent, \$6.50; 70 per cent, \$4.50; 68@66 per cent, \$4.25. 72 per cent B. P. L., \$6.50 per long ton, Tennessee.

**Pumice Stone**—Imported lump, 3@ 40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

**Pyrites**—In boulder form, \$7 per long ton, f.o.b. Massachusetts; concentrates, \$9 per long ton.

**Silica**—Glass sand, generally \$1.75@ \$2.50 per ton, f.o.b. shipping point; sand-blast material, \$2.50@ \$5. Ground 250 to 450 mesh, \$17@ \$40, f.o.b. mills.

**Sulphur**—\$16@ \$18 per ton for domestic, f.o.b. Texas and Louisiana mines; \$18@ \$20 for export, f.a.s. New York.

**Talc**—200 to 300 mesh, including containers, \$13.50@ \$14.75, f.o.b. New York state mills; 20 to 50 mesh, \$7.50; 150 to 200 mesh, \$9@ \$14 per ton, f.o.b. Vermont points; \$1 extra for bags; 200 mesh, \$18; 300 mesh, \$25, f.o.b. California points. Powdered talc in Georgia, \$8.25@ \$11 per ton. Demand fair.

#### Mineral Products

**Arsenious Oxide (White Arsenic)**—7.50c. per lb.

**Copper Sulphate**—Large crystals, 6.25c. per lb. Prompt shipment scarce.

**Potassium Sulphate**—Powder, domestic, \$1 per unit, basis 90 per cent, f.o.b. New York.

**Sodium Nitrate**—\$2.50 per 100 lb., ex vessel Atlantic ports.

**Sodium Sulphate**—\$20@ \$25 per ton, New York.

#### Ferro-Alloys

**Ferrocerium**—Per lb., \$12@ \$15.

**Ferrochrome**—1 to 2 per cent carbon, 25c. per lb.; 4 to 6 per cent carbon, 10½c. per lb.

**Ferromanganese**—Domestic, 78@82 per cent, \$67.50 per gross ton, f.o.b. furnace. English, \$67.50, c.i.f. Atlantic seaports. Spiegeleisen 19@21 per cent, \$36, f.o.b. furnace; 16@19 per cent, \$35.

**Ferromolybdenum**—\$2@ \$2.50 per lb. of contained molybdenum for 50 to 55 per cent grades.

**Ferrosilicon**—10 to 15 per cent, \$38 @ \$40 per gross ton, f.o.b. works; 50 per cent, \$58@ \$60; 75 per cent, \$115@ \$120.

**Ferrotitanium**—For 15 to 18 per cent material, \$200@ \$225 per ton, f.o.b. Niagara Falls, N. Y.

**Ferrotungsten**—Domestic, 70 to 80 per cent W, 45@50c. per lb. of contained W, f.o.b. works. Improving.

**Ferro-uranium**—35 to 50 per cent U, \$6 per lb. of U contained, f.o.b. works.

**Ferrovandium**—\$3.50@ \$4 per lb. of V contained, f.o.b. works. Market active.

#### Metal Products

**Copper Sheets**—New York base, 21c. per lb.; wire, 15.50@15.75c.

**Lead Sheets**—Full lead sheets, 8.75c.; cut lead sheets, 9c. in quantity, mill lots.

**Nickel Silver**—28c. per lb. for 18 per cent nickel Grade "A" sheets.

**Yellow Metal**—Dimension sheets, 18.75c.; rods, 15.75c. Price advanced during week.

**Zinc Sheets**—\$7.75 per 100 lb. less 8 per cent on carload lots, f.o.b. works.

#### Refractories

**Bauxite Brick**—\$50 minimum, per net ton, f.o.b. St. Louis.

**Chrome Brick**—\$40@ \$42 per net ton, f.o.b. shipping point.

**Chrome Cement**—\$23@ \$30 per net ton, f.o.b. shipping point.

**Firebrick**—First quality, 9-in. shapes, \$32@ \$35 per 1,000, Pennsylvania, Ohio, Illinois, and Kentucky.

**Magnesite Brick**—9-in., straights, \$56 per net ton, f.o.b. works.

**Magnesite Cement**—\$40@ \$55 per net ton, f.o.b. shipping points.

**Silica Brick**—9-in., per 1,000, \$33 @ \$41, f.o.b. shipping points.

**Zirkite**—Powdered, \$50@ \$60 per ton; brick, \$100 per ton.

#### The Iron Trade

Pittsburgh, Aug. 1, 1922.

On the whole, steel production is holding up better than might have been expected with the shortage in coal due to the transportation disability of the last few weeks. Ingot production has hardly declined as much as 10 per cent from the rate late in June, the highest rate this year.

Ending of both the railroad and coal strikes is expected for the near future, but restoration of regular conditions in coal and transportation will take considerable time, and steel production may decrease somewhat more.

Mills are fully sold up, and buyers are fairly well covered for the next two or three months. For delivery late in the year neither sellers nor buyers are disposed to act, the result being that there is a quiet market. In some lines there is inquiry for early deliveries, with somewhat stiffer premiums, but the buying public will pay premiums on but a small tonnage, relatively speaking.

There is strong pressure on mills for delivery of material already bought. Shipments have decreased somewhat more than production. In some lines there is shortage of labor in shipping departments, and there is a marked shortage of box cars.

**Pig Iron**—Inquiry is almost lacking and there are practically no offerings. The market is largely nominal. Last sales reported were at \$25 for bessemer, \$24 for basic, \$27 for malleable, and \$25 for foundry, f.o.b. Valley furnaces. Forced purchases may develop higher prices, but consumers appear able to stay out of the market.

**Connellsville Coke**.—Offerings are light. Demand is chiefly from foundries. Furnace coke, \$14; foundry, \$15.



# COMPANY REPORTS

## Silversmith Mines, Ltd.

A report of operations of Silversmith Mines, Ltd., for the fiscal year beginning June 1, 1921, shows a gain of \$65,-891.06, according to the following profit and loss account:

Mining in Ore .....	\$26,651.70
Mining expense .....	18,078.35
Development .....	654.00
Milling .....	19,896.76
Power plant .....	2,451.11
Boarding house .....	293.29
Insurance .....	2,964.88
Royalty .....	6,000.00
Taxes .....	3,578.37
Interest .....	2,355.78
General expense .....	14,597.96
Depreciation reserve .....	17,320.65
Depletion reserve .....	55,280.10
<b>Gain for year ending May 31, 1922 .....</b>	<b>170,122.95</b>
	65,891.06
	<b>\$236,014.01</b>
<b>Cr.</b>	
Received from sales of 1,585 tons silver-lead concentrates, and 293 tons crude ore .....	\$161,614.01
Estimated value of 1,500 tons mine concentrates, and 412 tons silver lead concentrates in transit and unsettled for at May 31, 1922 .....	74,400.00
	<b>\$236,014.01</b>
<b>Surplus Account as at May 31, 1922</b>	
To balance at May 31, 1921 .....	\$1,136.86
Gain for year 1922 .....	65,891.06
	<b>\$67,027.92</b>
By present surplus .....	<b>\$67,027.92</b>
	<b>\$67,027.92</b>

Balance sheet as of May 31, 1922, is as follows:

<b>Assets</b>		
Mining property .....	\$330,466.10	
Less depletion .....	128,087.70	
		\$202,378.40
Machinery and equipment .....	143,185.28	
Buildings .....	60,042.64	
		203,227.92
Less depreciation .....	42,914.93	
		160,312.99
Stock subject to call 2,500,000 common shares at 5c. per share .....		125,000.00
Current Assets .....		20,336.42
Accounts receivable .....		74,401.00
Bills prepaid .....		6,461.21
		<b>\$588,890.02</b>
<b>Liabilities</b>		
Authorized capital stock .....	\$750,000.00	
Less treasury stock unissued .....	250,000.00	
		\$500,000.00
Issued stock .....		
2,500,000 common stock @ 20c. per value .....		20,000.00
Bills payable .....		1,862.10
Accounts payable .....		65,891.06
Profit and loss account and gain for year 1922 .....		1,136.86
Surplus .....		<b>\$588,890.02</b>

## Hollinger's Half Year Shows Progress

BY ALEXANDER GRAY

Access to official data permits presenting the comparative operating results of Hollinger Consolidated Gold Mines, Porcupine, Ont., which are as follows:

	Half Year Ended June 30, 1922	Whole Year 1921
Tons milled .....	665,115	1,072,493
Average value per ton .....	\$8.82	\$9.67
Gross value .....	5,866,902	10,367,901
Loss in tailings .....	198,175	336,850
Net value recovered .....	5,668,727	10,031,050
Average tons milled a day .....	3,959	2,938
Profit .....	\$3,034,966	\$5,091,659
Surplus (approximately) .....	7,500,000	6,596,060
Cost per ton milled .....	4.39	4.8698

Bearing in mind that the premium upon gold was in effect during 1921, and that it was carried into daily operations, it will become more obvious that the milling grade

during the first half of the current year was maintained at about the 1921 average. The per ton profit of \$4.53, with the premium almost eliminated, is the largest reported in recent years, and the tonnage milled is a record in gold mining, being at the rate of 1,330,230 tons per annum. This profit is increasing in ratio to the increasing tonnage handled, and by reason of further reduction in costs. Recent returns make the per ton cost \$3.85, and for two weeks at the close of the half year crushings averaged 4,500 tons per day. The management is satisfied that with slight modifications the Hollinger mill will have a daily average of 5,000 tons or over. Hence it becomes a matter of securing adequate power to enable the company to more than surpass all other milling results.

The average daily crushing in June was 4,281 tons. On that basis, if nothing better is accomplished, the last half of this year should total at least 750,000 tons, which, added to the 665,115 tons treated in the first half, would make the grand total about 1,415,000 tons. Taking current costs and the greater tonnage being milled, the profits for the year, if the grade is maintained, will be over \$6,500,000, as compared with \$5,091,659, the latter including the gold premium.

It is through the courtesy of President Noah A. Timmins that these informative figures are made available. In the circumstances, they are remarkable in their indication of progress, despite power difficulties now about to be removed.

The Hollinger now is leading New Modderfontein and Crown Mines in tonnage milled. The following monthly returns for the half year just closed are offered in evidence: January, 111,206; February, 114,731; March, 110,316; April, 107,841; May, 101,166; June, 11,855. Total, 665,115.

## Alaska Treadwell Gold Mining Co.—Alaska Mexican Gold Mining Co.—Alaska United Gold Mining Co.

A report of operations of the Alaska Treadwell, Alaska Mexican, and Alaska United gold mining companies, distributed by the Exploration Co., Ltd., for the year 1921, shows receipts of \$74,860.12 and expenditures of \$46,498.82 for Alaska United; receipts of \$119,747.89 and expenditures of \$143,238.22 for Alaska Treadwell; and receipts of \$22,887.84 and expenditures of \$50,302.75 for Alaska Mexican.

## Mining Dividends for July, 1922

The following dividends were paid by mining and metallurgical companies during July, 1922:

Companies in the United States	Situation	Per Share	Total
American Smelters Sec. pfd. "A" .....	U. S.	\$1.50Q	\$146,071
American Smelters Sec. pfd. "B" .....	U. S.	1.25Q	39,855
Cresson Consolidated Gold .....	Col.	0.10QX	122,000
Eagle-Picher Lead, pfd. ....	Mo., Okla.	1.50Q	15,000
Homestake Mining, g. ....	S. D.	0.25M	62,790
Mohawk Mining, c. ....	Mich.	1.00	100,000
Phelps Dodge Corporation, c. ....	U. S., Mex.	1.00Q	450,000
Silver King Coalition, s.l.z. ....	Utah	0.15	182,415
Tonopah Belmont Development, s.g. ....	Nev.	0.05Q	75,000
Tonopah Extension, s.g. ....	Nev.	0.05Q	64,636
United Eastern, g. ....	Ariz.	0.15Q	204,450
U. S. Smelting, Ref. & Min., pfd., s. ....	U. S., Mex.	0.87½Q	425,556
Companies in Other Countries			
Asbestos Corporation .....	Quebec	1.50Q	45,000
Asbestos Corporation pfd. ....	Quebec	1.75Q	70,000
Dome Mines, g. ....	Ontario	0.50Q	238,333
Hollinger Consolidated Gold .....	Ontario	0.05 4 wks	246,000
Kerr Lake, s. ....	Ontario	0.125Q	75,000
Lucky Tiger Combination, g. ....	Sonora	0.10 X.SX.	71,534
N. Y. and Honduras Rosario, g.s. ....	Honduras	0.25Q	50,000
Nipissing, s. ....	Ontario	0.15Q	180,000
Silversmith Mines, s.l.z. ....	B. C.	0.01	25,000
Wright-Hargreaves, g. ....	Ontario	0.025Q	68,750

Q, quarterly; M, monthly; X, includes 5c. extra; SX, includes special extra 5c.; g, gold; s, silver; l, lead; c, copper; z, zinc.

**METAL STATISTICS**

**Monthly Average Prices of Metals**

Silver					
	New York		London		Sterling Exchange
	1921	1922	1921	1922	1921 1922
January.....	65.950	65.450	39.985	35.035	372.650 421.750
February.....	59.233	65.290	34.745	33.891	385.932 435.511
March.....	56.023	64.440	32.479	33.269	389.806 436.912
April.....	59.337	66.575	34.250	34.080	391.784 440.715
May.....	59.810	71.154	34.165	36.023	396.580 444.106
June.....	58.510	71.149	34.971	35.900	377.236 444.615
July.....	60.260	70.245	37.481	35.644	362.565 444.165
August.....	61.597	.....	38.096	.....	364.505
September.....	66.160	.....	40.082	.....	371.725
October.....	70.970	.....	41.442	.....	386.315
November.....	68.234	.....	38.750	.....	396.315
December.....	65.760	.....	35.645	.....	414.880
Year.....	62.654	.....	36.841	.....	384.191

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper					
	New York		London		
	Electrolytic	Standard	Electrolytic	Standard	1921 1922
	1921	1922	1921	1922	1921 1922
January.....	12.597	13.465	70.964	65.226	79.119 72.321
February.....	12.556	12.864	70.925	60.250	75.925 66.125
March.....	11.976	12.567	67.565	59.245	71.190 65.739
April.....	12.438	12.573	69.381	58.799	71.786 64.028
May.....	12.742	13.111	73.196	61.092	74.298 66.554
June.....	12.697	13.575	71.852	61.988	75.682 69.333
July.....	12.170	13.654	71.155	63.137	75.286 70.321
August.....	11.634	.....	68.614	.....	72.705
September.....	11.948	.....	67.977	.....	72.295
October.....	12.673	.....	67.327	.....	73.476
November.....	13.035	.....	66.614	.....	74.386
December.....	13.555	.....	66.706	.....	74.525
Year.....	12.502	.....	69.356	.....	74.223

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead					
	New York		St. Louis		London
	1921	1922	1921	1922	1921 1922
January.....	4.821	4.700	4.747	4.388	23.387 23.667
February.....	4.373	4.700	4.228	4.396	20.650 20.681
March.....	4.084	4.720	4.000	4.421	18.911 21.266
April.....	4.356	5.115	4.272	4.946	20.589 22.993
May.....	4.952	5.420	4.784	5.281	23.399 24.462
June.....	4.485	5.745	4.292	5.563	22.563 24.685
July.....	4.410	5.729	4.260	5.447	23.399 24.869
August.....	4.382	.....	4.217	.....	23.489
September.....	4.600	.....	4.392	.....	23.148
October.....	4.690	.....	4.439	.....	23.679
November.....	4.683	.....	4.356	.....	24.483
December.....	4.700	.....	4.369	.....	25.322
Year.....	4.545	.....	4.363	.....	22.752

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin					
	New York		Straits		London
	99%	1922	1921	1922	1921 1922
January.....	31.470	31.480	36.000	32.100	190.464 163.065
February.....	28.534	29.835	32.142	30.767	166.250 149.850
March.....	27.296	28.426	28.806	29.171	156.024 143.152
April.....	28.990	29.810	30.404	30.605	163.905 149.840
May.....	31.431	30.149	32.500	30.971	177.411 150.163
June.....	28.514	30.707	29.423	31.497	167.506 152.512
July.....	26.755	31.025	27.655	31.733	164.530 156.149
August.....	25.662	.....	26.301	.....	155.318
September.....	26.280	.....	26.680	.....	156.750
October.....	27.278	.....	27.655	.....	156.380
November.....	28.592	.....	28.935	.....	158.898
December.....	32.106	.....	32.486	.....	169.738
Year.....	28.576	.....	29.916	.....	165.265

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc					
	New York		St. Louis		London
	1921	1922	1921	1922	1921 1922
January.....	5.413	4.691	25.262	26.321	.....
February.....	4.928	4.485	24.850	24.213	.....
March.....	4.737	4.658	25.077	25.467	.....
April.....	4.747	4.906	25.530	26.576	.....
May.....	4.848	5.110	26.923	27.304	.....
June.....	4.421	5.346	26.750	27.893	.....
July.....	4.239	5.694	26.262	29.042	.....
August.....	4.186	.....	25.068	.....	.....
September.....	4.235	.....	25.256	.....	.....
October.....	4.605	.....	26.315	.....	.....
November.....	4.667	.....	25.949	.....	.....
December.....	4.835	.....	26.900	.....	.....
Year.....	4.655	.....	25.845	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum					
	Antimony (a)		Quicksilver (b)		Platinum (c)
	New York		New York		New York
	1921	1922	1921	1922	1921 1922
January.....	5.258	4.463	48.440	49.960	73.400 97.260
February.....	5.250	4.416	49.545	48.295	70.227 89.545
March.....	5.282	4.319	46.796	50.204	72.463 87.500
April.....	5.157	4.980	45.423	52.280	73.404 87.500
May.....	5.250	5.467	47.000	54.885	73.740 85.529
June.....	5.087	5.145	46.846	55.115	74.942 87.212
July.....	4.735	5.091	44.950	55.00	70.440 90.180
August.....	4.597	.....	45.028	.....	73.222
September.....	4.564	.....	42.660	.....	75.960
October.....	5.085	.....	39.840	.....	81.800
November.....	4.734	.....	39.804	.....	82.609
December.....	4.500	.....	49.212	.....	78.192
Year.....	4.957	.....	45.462	.....	75.033

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh					
	Bessemer		Basic		No. 2 Foundry
	1921	1922	1921	1922	1921 1922
January.....	33.96	21.55	31.96	20.15	33.88 21.34
February.....	28.96	21.46	26.96	19.71	30.25 20.88
March.....	28.16	21.35	26.46	19.96	27.85 20.83
April.....	26.96	22.50	24.46	21.26	26.77 22.70
May.....	26.21	26.36	23.84	26.87	25.56 25.96
June.....	24.96	26.96	22.66	26.96	24.38 25.96
July.....	22.84	.....	20.76	.....	22.36
August.....	21.96	.....	20.29	.....	21.53
September.....	21.96	.....	21.21	.....	22.82
October.....	21.96	.....	20.96	.....	22.96
November.....	21.96	.....	20.96	.....	22.74
December.....	21.96	.....	20.65	.....	21.96
Year.....	25.15	.....	23.43	.....	5.26

(a) In dollars per long ton.

Monthly Crude Copper Production				
	1922			
	March	April	May	June
Alaska shipments.....	4,899,827	5,892,923	7,969,538	6,321,793
Anaconda.....	13,100,000	14,508,955	17,700,000	(a)
Arizona Copper.....	(a)	(a)	(a)	(a)
Calumet & Arizona.....	3,167,070	3,756,000	3,566,000	3,362,000
Calumet & Hecla.....	(a)	(c)	(c)	(c)
Other Lake Superior.....	6,000,000	(c)	(c)	(c)
Chino.....	(a)	(c)	(c)	(c)
Con. Ariz. Smelting.....	(a)	(a)	(a)	(a)
East Butte.....	(a)	(c)	(c)	(c)
Inspiration.....	4,965,000	(a)	(c)	(c)
Magma.....	(a)	(a)	(c)	(c)
Miami.....	5,242,000	5,327,000	5,546,000	5,923,000
Nevada Cons.....	(a)	(c)	(c)	(c)
New Cornelia.....	1,606,977	1,496,242	1,544,770	1,565,442
Old Dominion.....	(a)	1,164,000	2,690,000	(a)
Phelps Dodge.....	5,540,000	5,881,000	6,228,000	7,512,000
Ray.....	(a)	(a)	(c)	(c)
Shattuck Arizona.....	(a)	(a)	(a)	(a)
United Verde.....	(a)	(a)	670,000	4,570,000
United Verde Extension.....	2,014,886	3,517,902	2,790,136	2,941,054
Utah Copper.....	(a)	(c)	(c)	(c)
Others, estimated.....	9,170,000	.....	18,750,000	14,800,000
Total United States.....	55,705,760	.....	.....	.....
Imports: Ore and concentrates, matte.....	3,974,424	10,816,696	6,270,622	.....
Imports of black and blister, unrefined.....	17,205,149	19,015,875	9,700,997	.....
Imports of refined and old.....	17,943,178	9,766,230	11,361,330	.....
Grand total.....	94,828,511	.....	.....	.....
Backus & Johnston.....	910,000	888,000	1,108,000	1,276,000
Boleo.....	1,117,384	838,000	1,499,120	1,377,500
Cananea.....	(a)	(a)	(a)	(a)
Cerro de Pasco.....	4,702,000	4,830,000	6,234,000	5,868,000
Chile.....	4,000,000	(c)	(c)	(c)
Cons. M. & S. of Canada.....	124,000	464,000	153,115	53,020
Falcon Mines.....	550,682	596,570	586,000	.....
Furukawa.....	3,211,868	2,590,344	2,820,880	.....
Granby Cons.....	1,922,462	(c)	2,294,025	2,263,339
Hampden Cloncurry.....	(a)	(a)	(c)	(a)
Katanga.....	6,740,000	7,285,000	8,370,792	8,859,690
Mount Morgan.....	(a)	(a)	(a)	(a)
Mount Lyell.....	(a)	(a)	(c)	(c)
Phelps Dodge Mexican.....	397,000	379,000	862,000	1,098,000
Sumitomo.....	1,806,888	2,029,660	2,751,843	.....
Wallaroo & Moonta.....	489,599	(a)	(a)	(a)

(a) No copper produced during this month. (c) Not available.

Comparative Annual Copper Production				
	1919	1920	1921	1922
January.....	135,733,511	121,903,744	90,596,597	32,010,292
February.....	111,649,512	117,540,000	86,682,941	45,957,530
March.....	102,040,460	120,309,316	91,046,345	55,705,760
April.....	98,808,998	116,078,871	46,946,523	.....
May.....	92,652,975	114,964,207	25,310,511	.....
June.....	95,856,570	116,107,856	24,623,693	.....
July.....	100,369,247	109,729,610	22,033,739	.....
August.....	107,994,040	112,460,254	23,248,398	.....
September.....	108,703,075	104,919,562	23,855,316	.....
October.....	115,143,143	105,231,571	23,312,572	.....
November.....	117,289,735	106,700,178	28,341,442	.....
December.....	102,997,633	95,709,009	29,629,137	.....

MINING STOCKS

Week Ended July 29, 1922

Stock	Exch.	High	Low	Last	Last Div.	Stock	Exch.	High	Low	Last	Last Div.	
<b>COPPER</b>						<b>GOLD</b>						
Ahmeek	Boston	66	61	63	Sept. '20, Q	\$0.50	Alaska Gold	New York	1	1	1	
Alaska-Br. Col. new	N. Y. Curb	2	2	2			Alaska Juneau	New York	1	1	1	
Alloues	Boston	25	25	25	Mar. '19	1.00	Atlas	Toronto	*26	*23	*23	
Anaconda	New York	54	52	53	Nov. '20, Q	1.00	Carson Hill	New York	†12	†10	†11	
Arcadian Consol.	Boston	3	3	3			Cresson Consol. G.	N. Y. Curb	2	2	2	July '22, Q, X
Aris. Com'l.	Boston	9	9	9	Oct. '18, Q	0.50	Dome Mines	New York	30	29	30	July '22, Q
Big Ledge	N. Y. Curb	*13	*8	*12			Florence Goldfield	N. Y. Curb	*13	*11	*13	
Bingham Mines	Boston	†15	†14	14	Sept. '19, Q	0.25	Golden Cycle	Colo. Springs	*87	*87	*87	June '21, Q
Calumet & Arizona	Boston	61	60	60	June '22, Q	0.50	Goldfield Consol.	N. Y. Curb	*5	*5	*5	Dec. '19, Q
Calumet & Hecla	Boston	277	275	275	June '20, Q	5.00	Gordon Murray	Toronto	*30	*28	*30	
Canada Copper	N. Y. Curb	*20	*17	*17			Hollinger Consol.	Toronto	9.45	9.38	9.43	July '22, M
Centennial	Boston	9	9	9	Dec. '18, SA	1.00	Homestake Mining	New York	69	69	69	July '22, M
Cerro de Pasco	New York	38	36	38	Mar. '21, Q	0.50	Keora	Toronto	*13	*11	*11	
Chile Copper	New York	22	21	22			Kirkland Lake	Toronto	*41	*35	*37	
Chino	New York	30	28	30	Sept. '20, Q	0.37	Lake Shore	Toronto	2.30	2.24	2.25	Nov. '21, K
Columbus Rexall	Salt Lake	*31	*30	*30			McIntyre-Porcupine	Toronto	16.40	16.00	16.35	May '22, K
Con. Arizona	N. Y. Curb	*50	*50	*50	Dec. '18, Q	0.05	Porcupine Crown	Toronto	*21	*21	*21	July '17, Q
Con. Copper Mines	N. Y. Curb	*50	*50	*50			Porcupine V. N. T.	Toronto	*20	*18	*20	
Copper Range	Boston	44	43	43	Mar. '22, Q	1.00	Portland	Colo. Springs	*39	*35	*39	Oct. '20, Q
Crystal Copper	Boston Curb	1	*89	*90			Schumacher	Toronto	*75	*74	*75	
Davis-Daly	Boston	7	7	7	Mar. '20, Q	0.25	Silver Pick	N. Y. Curb	*10	*10	*10	
East Butte	Boston	10	10	10	Dec. '19, A	0.50	Teck Hughes	Toronto	*61	*58	*59	
First National	Boston Curb	*66	*55	*55	Feb. '19, SA	0.15	Tom Reed	Los Angeles	*55	*50	*53	Dec. '19, Q
Franklin	Boston	2	1	2			United Eastern	N. Y. Curb	1	1	1	July '22, Q
Gadsden Copper	Boston Curb	86	85	85	May '19, Q	1.25	Vindicator Consol.	Colo. Springs	†7	†4	*4	Jan. '20, Q
Graeb Consol.	New York	30	29	30	Nov. '20, Q	1.25	White Caps Mining	N. Y. Curb	*7	*7	*7	
Greene-Cannana	New York	30	30	30			Wright-Hargreaves	Toronto	2.90	2.70	2.70	July '22, Q
Hancock	Boston	2	2	2			Yukon Gold	N. Y. Curb	1	*95	1	June '18, Q
Howe Sound	N. Y. Curb	2	2	2	Jan. '21, Q	0.05	<b>SILVER</b>					
Inspiration Consol.	New York	41	40	41	Oct. '20, Q	1.00	Batopilas Mining	New York	1	1	1	Dec. '07, I
Iron Cap	Boston Curb	†7	†6	7	Sept. '20, K	0.25	Beaver Consol.	Toronto	*33	*30	*31	May '20, K
Isle Royale	Boston	24	23	23	Sept. '19, SA	0.50	Coniagas	Toronto	1.30	1.25	1.30	May '21, Q
Kennecott	New York	36	35	36	Dec. '20, Q	0.50	Crown Reserve	Toronto	*17	*15	*16	Jan. '17, Q
Keeweenaw	Boston	2	2	2			Kerr Lake	N. Y. Curb	3	3	3	July '22, Q
Lake Copper	Boston	4	4	4			La Rose	Toronto	*31	*27	*30	Apr. '20, Q
La Salle	Boston	1	1	1			McKinley-Dar-Sav.	Toronto	*25	*22	*24	Oct. '20, Q
Magma Copper	N. Y. Curb	27	27	27	Jan. '19, Q	0.50	Mining Corp. Can.	Toronto	1.05	*90	*90	Sept. '20, Q
Majestic	Boston Curb	†10	†5	*10			Nipissing	N. Y. Curb	5	5	5	July '22, Q, X
Mason Valley	Boston	†2	†1	2			Ontario Silver	New York	7	7	7	Jan. '19, Q
Mass. Consolidated	Boston	3	3	3	Nov. '17, Q	1.00	Ophir Silver	N. Y. Curb			†12	Jan. '12, Q
Miami Copper	New York	30	29	30	May '22, Q	0.50	Temiskaming	Toronto	*35	*25	*32	Jan. '20, K
Michigan	Boston	1	1	1			Threthewey	Toronto	*44	*3	*3	Jan. '19, Q
Mohawk	Boston	62	60	61	July '22, Q	1.00	<b>GOLD AND SILVER</b>					
Mother Lode Coa.	N. Y. Curb	10	9	10	June '22, I	0.50	Boston & Montana	N. Y. Curb	*20	*15	*20	
Nevada Consol.	New York	16	16	16	Sept. '20, Q	0.25	Cash Boy	N. Y. Curb	*8	*6	*7	
New Cornelia	Boston	19	19	19	May '22, K	0.25	Dolores Esperanza	N. Y. Curb	2	2	2	July '22, Q
North Butte	Boston	12	12	12	Oct. '18, Q	0.25	El Salvador	N. Y. Curb	*5	*4	*5	
Ohio Copper	N. Y. Curb	*10	*10	*10			Jim Butler	N. Y. Curb			*4	Aug. '18, SA
Old Dominion	Boston	25	25	25	Dec. '18, Q	1.00	Jumbo Extension	N. Y. Curb			*4	June '16, Q
Oscela	Boston	35	33	34	June '20, Q	0.50	MacNamara M.&M.	N. Y. Curb	*8	*7	*8	May '10, Q
Pheips Dodge	Open Mar.	†175	†160	†160	July '22, Q	1.00	Tonopah Belmont	N. Y. Curb	1	1	1	July '22, Q
Quincy	Boston	45	43	43	Mar. '20, Q	1.00	Tonopah Divide	N. Y. Curb	*80	*75	*75	
Ray Consolidated	New York	16	16	16	Dec. '20, Q	0.25	Tonopah Extension	N. Y. Curb	1	1	1	July '22, Q
Ray Hercules	N. Y. Curb	2	1	2			Tonopah Mining	N. Y. Curb	1	1	†1	Apr. '22, SA, X
St. Mary's Min. Ld.	Boston	†48	†45	47	Apr. '22, K	2.00	West End Consol.	N. Y. Curb	1	1	1	June '22, SA
Seneca Copper	Boston	12	12	12			<b>SILVER-LEAD</b>					
Shannon	Boston	†1	†85	*85	Nov. '17, Q	0.25	Caledonia	N. Y. Curb	*8	*8	*8	Jan. '21, M
Shattuck Arizona	New York	9	9	9	Jan. '20, Q	0.25	Cardiff M. & M.	Salt Lake	†80	†76	*80	Dec. '20, Q
South Lake	Boston	†1	†85	1			Chief Consol.	Boston Curb	5	5	5	May '22, Q
Superior & Boston	Boston	1	1	1			Consol. M. & S.	Montreal	25	25	25	Oct. '20, Q
Tenn. C. & C. cfa.	New York	10	10	10	May '18, I	1.00	Daly Mining	Salt Lake		†1.35		July '20, Q
Tuolumne	Boston	*70	*68	*70	May '13, Q	0.10	Daly-West	Boston			1	Dec. '20, Q
United Verde Ex.	Boston Curb	29	27	29	May '22, Q	0.25	Eagle & Blue Bell	Boston Curb	†3	†2	†2	Apr. '21, K
Utah Consol.	Boston	†3	†3	†3	Sept. '18, Q	0.25	Electric Point	Spokane	*7	*5	*7	May '20, SA
Utah Copper	New York	65	64	65	June '22, Q	0.50	Federal M. & S.	New York	13	13	13	Jan. '09, I
Utah Metal & T.	Boston	1	1	1	Dec. '17, Q	0.30	Federal M. & S. pfd.	New York	51	50	50	June '22, Q
Victoria	Boston	1	1	1			Florence Silver	Spokane	*35	*34	*35	Apr. '19, Q
Winona	Boston	1	1	1			Grand Central	Salt Lake	†65	†60	*61	Jan. '21, K
Wolverine	Boston	12	11	11			Hecla Mining	N. Y. Curb	6	6	6	June '22, Q
<b>NICKEL-COPPER</b>						<b>SILVER-LEAD</b>						
Internat. Nickel	New York	17	17	17	Mar. '19, Q	0.50	Iron Blossom Con.	N. Y. Curb			*31	Apr. '22, Q
Internat. Nickel, pfd	New York	†83	†72	83	May. '22, Q	1.50	Judge M. & S.	Salt Lake	2.50	2.50	2.50	Sept. '20, Q
<b>LEAD</b>						<b>SILVER-LEAD</b>						
National Lead	New York	101	98	101	June '22, Q	1.50	Marsh Mines	N. Y. Curb	*16	*15	*15	June '21, I
National Lead, pfd.	New York	†113	†111	113	June '22, Q	1.75	Prince Consol.	Salt Lake	*8	*7	*7	Nov. '17, Q
St. Joseph Lead	New York	15	14	15	June '22, Q	0.25	Rambler-Cariboo	Spokane	*5	*4	*4	Feb. '19, Q
<b>QUICKSILVER</b>						<b>SILVER-LEAD</b>						
New Idria	Boston	†15	†10	*10			Rex Consol.	N. Y. Curb	*9	*8	*8	
<b>ZINC</b>						<b>SILVER-LEAD</b>						
Am. Z. L. & S.	New York	18	17	18	May '20, Q	1.00	Standard Silver-Ld.	N. Y. Curb	*19	*19	*19	Oct. '17, Q
Am. Z. L. & S. pfd.	New York	46	43	45	Nov. '20, Q	1.50	Stewart Mines	N. Y. Curb	*8	*6	*6	Dec. '15, Q
Butte C. & Z.	New York	7	6	7	June '18, Q	0.50	Tamarack-Custer	Spokane	3.40	3.35	3.40	Jan. '21, K
Butte & Superior	New York	30	28	30	Sept. '20, Q	1.25	Tintie Standard	Salt Lake	2.00	2.00	2.00	Dec. '21, Q
Callahan Zn-Ld.	New York	8	7	7	Dec. '20, Q	0.50	Utah Apex	Boston	2	2	2	Nov. '20, K
New Jersey Zn	N. Y. Curb	144	144	144	May '22, Q	2.00	Wilbert Mining	N. Y. Curb	*10	*9	*9	Nov. '17, Q
Yellow Pine	Los Angeles	*55	*55	*55	Sept. '20, Q	0.03	<b>VANADIUM</b>					

\*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M Monthly. K, Irregular. I, Initial. X, Includes extra.  
 Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

## NEW MACHINERY AND INVENTIONS

### The Hawkesworth Detachable Drill-Bit

Large Scale Tests at Butte Will Demonstrate Practicability of This Promising Device

By FELIX EDGAR WORMSER

Assistant Editor, *Engineering and Mining Journal-Press*

A DETACHABLE drill-bit is nothing new. Removable drill points have been devised repeatedly but have generally had some mechanical defect that prohibited their use in the strenuous work of mining. Butte is the birthplace of the latest aspirant for the honor of producing a successful device of that nature—the Hawkesworth detachable drill-bit—and at present the Anaconda Copper Mining Co. is making a large scale experiment using it in an effort to give it a thorough test. Should this prove satisfactory, the present method of drilling rock may very likely be revolutionized. Arthur L. Hawkesworth, the inventor of the bit bearing his name, is a master mechanic in the employ of the Anaconda Copper Mining Co. The problem of making a practical detachable bit has received his attention for twenty years, but it is only recently that his work has met with success.

The feature which commends the Hawkesworth detachable drill-bit when it is first observed is its extreme simplicity. Reduced to its simplest parallel the bit might be termed a modified dovetail joint in which the shank is the mortise and the bit the tenon. An important modification, however, prevents the ordinary dovetail joint from becoming a loose arrangement, and con-

sists essentially in tapering the tenons and the mortises to fit, so that, when the bit is slipped on the shank, the pieces will wedge firmly with each other. Reference to Fig. 1, which illustrates the Hawkesworth principle, as applied to a cross-bit and a single-edge bit, will make this point clearer. In Fig. 1d it will be noticed that the width of the tenon at *m* is greater than that at *n*; similarly how the mortises taper from *p* to *o* and from *s* to *r*. This principle of construction is followed in the design of shank, which is made to fit the bit snugly. As a consequence, when the bit is slipped on the shank the tapered tenons and mortises form a firm joint which effectually prevents the bit from slipping off the shank except in the direction it was put on.

One other important detail of the bit's construction will show how, in operation, the bit cannot even move in its one available direction and so become loose, possibly detaching itself from the shank. This detail is the slant or angle given the faces of the bit joint. This is noticeable in the figures illustrating the shank and the bit, particularly in Fig. 1 at *c* and *h*, Fig. 2 and Fig. 3. With this construction, as the drill is used the bit and shank will tend to become more firmly



Arthur L. Hawkesworth

wedged together by the blows of the drilling machine, rather than become disengaged. Fig. 3 represents shank and bit assembled ready for drilling and shows the obliquity of the joint.

Although the Hawkesworth bit has only recently received much notice, it has been used experimentally in Butte mines for three years, during which time it was subjected to many tests to determine its practicability. That it has proven entirely successful under these tests is indicated by the step which the Anaconda Copper Mining Co. has taken to provide the machinery necessary to manufacture both bits and shanks on a large scale for their wholesale introduction into one of its Butte mines. The equipment will extend only to one of the Anaconda properties, but if this installation is found satisfactory the other properties will be similarly equipped.

A detachable drill-bit has many ad-

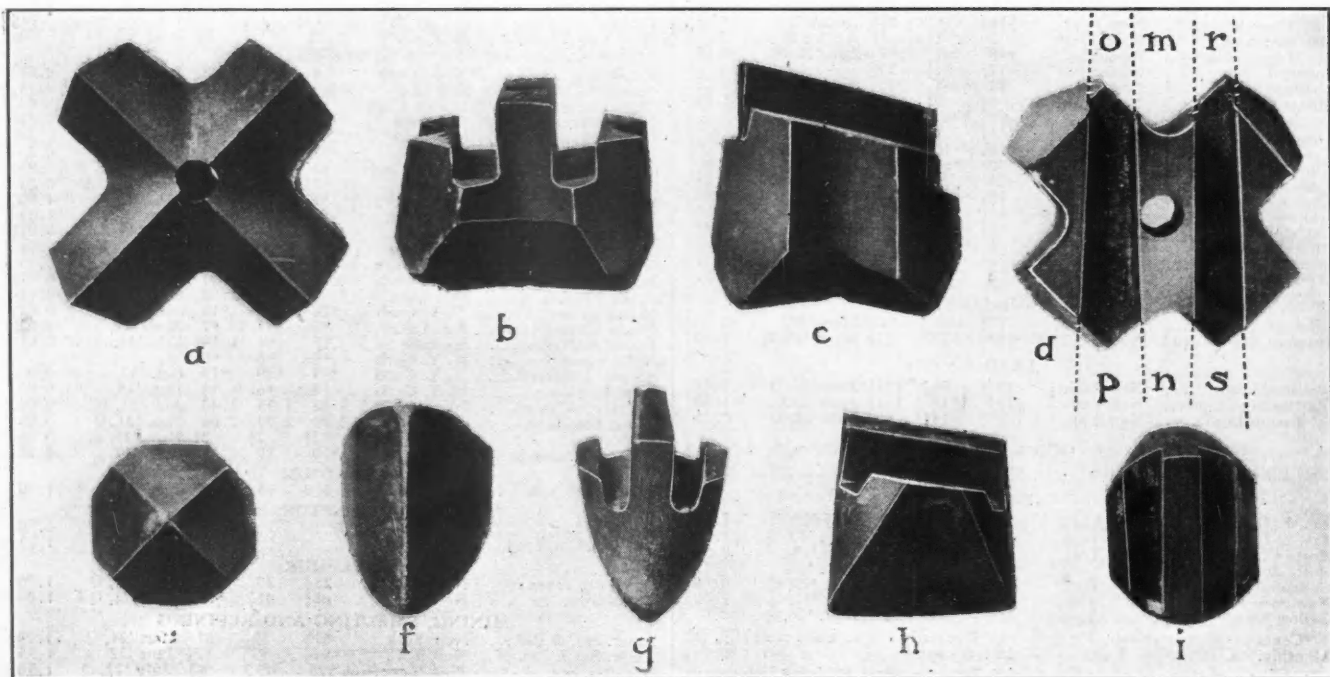


Fig. 1—Views of the Hawkesworth cross-bit, single-edge bit, and moil

vantages and few disadvantages. The advantages are: (1) Smaller investment in drill steel. (2) Less handling of drill steel. (3) Elimination of accidents in handling drill steel in shafts and elsewhere. (4) Greater drilling speed through the use of alloy steel bits. (5) Less waste in lost steel. (6) Lighter drilling equipment for the prospector.

Disadvantages serious enough to affect the success of the bit are yet to be discovered. The present work of the Anaconda Copper Mining Co. will help immensely in revealing any unforeseen deficiencies. Probably the most valid objection voiced so far is the possibility of losing the bits through the carelessness of the miners and the resulting injury the drill-bits might cause by getting into the milling operations and damaging the crushing machinery. However, both these difficulties should surely be overcome.

Can the bit be turned out by the thousands and be perfectly interchangeable? That is a mechanical difficulty which should also be solved in these days of large-scale machine production. Perhaps an objection will be found in that the miners may allow the shanks to become rusty or will injure the shank portion of the joint, thereby preventing an effective jointing of the bit. The operating difficulties that may present themselves are still largely a matter of conjecture but should soon become apparent.

I have stated that one of the chief advantages in a detachable drill-bit lies in the use of alloy steel as a bit material. Alloy steels such as vanadium, chrome, tungsten, molybdenum and others, although desirable from many standpoints, have not found wide favor in mining owing to their higher cost than that of ordinary carbon drill-steel, but if the drill-bit only is made of an alloy steel the increased expense for material is easily bearable.

The effect of using a detachable drill-bit of alloy-steel was strikingly brought out by a test of the Hawkesworth bit which I witnessed at the St.

eleven inches. The performance was repeated with the Hawkesworth bit and its hole measured—twenty inches and a fraction—or almost twice as far as the ordinary carbon-steel. At the end of the two-minute run the carbon-steel cross-bit was ready for the sharpener and had a decidedly blunt face. The vanadium-steel bit appeared fit for several minutes' more drilling in the hard granite.

The holes drilled by the two classes of bits were also in sharp contrast to each other. The carbon-steel bit made a hole that was distinctly corrugated, that of the Hawkesworth bit resembled a diamond-drill hole in its smoothness. Although fast drilling speed is a desirable asset, this advantage alone would not perhaps be sufficient to induce the mine operator to use it. The majority of them would be perfectly content with present average drilling speeds if they could secure some of the other advantages of using a detachable drill-bit.

In starting a hole with the Hawkesworth bit the drill-bit is loosely wedged to the shank and the whole piece tapped a few times against the face to be drilled. The shank is then secured in the drill and the hole carefully started. Once the hole has been cut a short distance there seems to be no chance of the drill bit coming off the shank. Drilling wedges it tighter. To remove the bit from the shank a light blow from a single jack on the proper point of the bit is all that is necessary.

The objection may be raised that if an imperfect wedging is secured due to dirt, a defect in manufacturing, or for some other reason, drilling might be affected seriously and prejudice the user against the bit. That this contingency is not likely to carry much weight seems to be shown by a test I saw conducted in which the Hawkesworth bit, although firmly wedged, was still a little—one-sixteenth inch—out of line with the shank, but which nevertheless drilled a perfect hole.

The Hawkesworth bit, in order to provide adequate strength, is made in

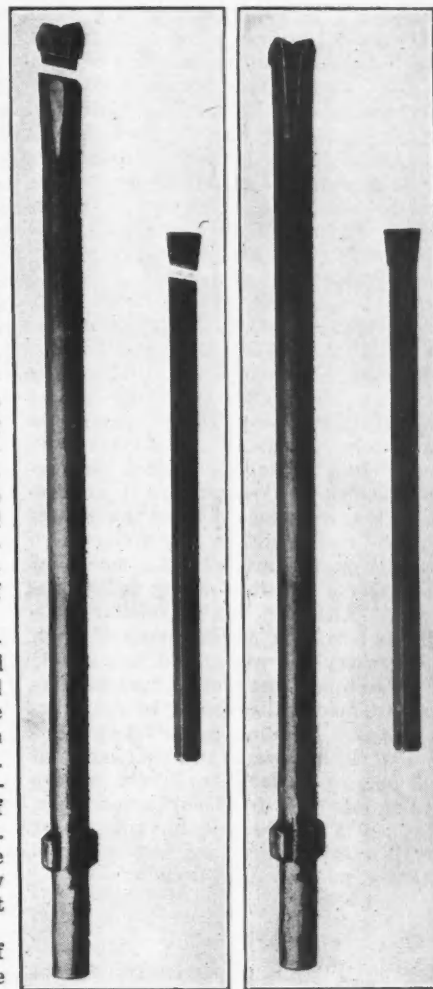


Fig. 3—The Hawkesworth bit assembled and unassembled on round and hexagonal drill steel

the bit becomes worn. Sharpening is not held to present any noteworthy difficulties; in fact it will probably be easier to temper the small bits on a large scale than it is the ordinary long lengths of drill steel with the unnecessary attendant heating of many inches

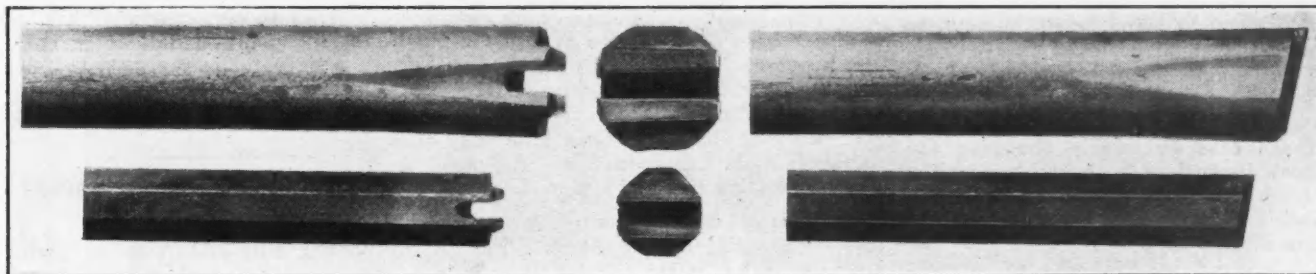


Fig. 2—Side and end views of the Hawkesworth shank. Round machine and hexagonal steel shown

Lawrence mine in Butte. Two pieces of 1½-in. drill-steel were used. One was an ordinary solid carbon steel with a cross-bit end; the other a carbon-steel shank with a vanadium-steel Hawkesworth cross-bit attached to it. A hole was first drilled with the ordinary steel bit in the Butte monzonite for exactly two minutes and its depth measured—

rather short lengths. A 1½-in. bit that I have before me measures 1½ in. in mean length. Its shortness will necessarily limit the amount of sharpening that can be done and consequently the life of the bit. The most economical treatment calls for the bit's use first with its original gage and then its reduction to the next smaller gage as

of carbon-steel near the cutting edge and the unavoidable decrease in the capacity of the tempering furnace.

The prospector would be benefited greatly by a detachable bit. Not only does it permit him to use a lighter outfit—an important consideration when packing around the hills—but it also decreases the amount of his funds re-

quired for the purchase of drill steel. The accompanying illustrations show the detachable bit as part of a prospector's drill. The principle of construction is exactly the same as that of its larger brother used in machines. It means much to a prospector to be able to have plenty of sharp steel available and to forget, if he chooses, the frequent necessity of sharpening his steel by carrying an ample supply of detachable bits.

No estimates have been made as to the cost of manufacturing the Hawkesworth bit that will give an index to the economies that might be introduced by its use. Some of the advantages, particularly the safety feature, cannot be accurately estimated in dollars and cents. But the saving in drill steel investment can. To introduce it successfully the inventor and his associates must be and doubtless are prepared to place it on the market at a cost that will show a tangible saving to the operator. Although this detachable drill-bit was born in a mining camp through the industry and resourcefulness of one of Anaconda's mechanical foremen, its greatest field will probably be construction work. Building construction, railroad work, highways and the thousand and one operations that require the drilling of rock for their accomplishment are a fertile field for the use of the Hawkesworth bit and in the aggregate are much larger than mining.

### Electrical Measuring Instruments Have Followed Development in Electrical Applications

The line of electrical measuring instruments manufactured by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has been extended from time to time following the developments in electrical applications, until it now includes instruments suitable for use on the smallest airplane or the largest control station switchboard.

The principle on which these instruments are constructed is that of the D'Arsonval moving coil, permanent magnet system, designed in the form of a single "universal" movement. The size of this movement is varied to suit the pointer length and the size of the case by merely changing the lineal dimensions without altering the electrical or other characteristics. The cases are designed to conform in sizes, forms and other features to the standardized requirements of governmental specifications which also cover all commercial requirements in the broadcast manner.

The versatility of this movement with slight variations, such as windings, springs, resistors, and thermocouples, is shown by the varieties represented which include direct current ammeters; direct current voltmeters; alternating current (radio frequency) ammeters and alternating current voltmeters, operated by thermocouples; direct cur-

rent milli-ammeters and micro-ammeters of great sensibility; electrical speed indicators; electrical temperature indicators, both search coil and thermocouple type; marine movement galvanometers, and automobile battery ammeters. The list also includes a line of portable instruments, known as the PX line, of various sizes assembled in moulded composition cases that are acid resisting and particularly serviceable for general testing work, for the garage and storage battery industry, for railway signal systems, and for radio amateurs.

### INDUSTRIAL NOTES

G. C. Townsend, for the last four years business manager of *Engineering and Mining Journal*, became actively identified with Charles Austin Hirschberg, Inc., as a vice-president of that company on Aug. 1. He has had wide experience in technical and industrial advertising.

Bethlehem Foundry and Machine Co. has announced that it has acquired all of the capital stock of the Wedge Mechanical Furnace Co., Philadelphia, Pa., and that the design, manufacture and sale of Wedge roasting furnaces will henceforth be conducted as a department of the Bethlehem Foundry and Machine Co., Bethlehem, Pa. Members of the operating staff of the former Wedge company have been retained, as well as the special facilities for laboratory research and experimental roasting.

Edward L. Brayton, formerly president and general manager of the Pelton Water Wheel Co. of San Francisco, died on July 21 at his home at Piedmont, Oakland, Cal. He was the son of A. P. Brayton, Sr., a pioneer manufacturer of mining machinery in San Francisco, who in 1887 bought the rights in the Pelton wheel from its inventor, Lester A. Pelton, and organized the Pelton Water Wheel Co. Mr. Brayton's connection with the company began soon after its organization and continued until early in the present year when he disposed of his interests to the William Cramp & Sons Ship & Engine Building Co., and resigned.

Two large foreign contracts have just been closed by the Electric Furnace Co., Salem, Ohio. The first calls for an aluminum melting furnace for Germany, and the second for a set of automatic heat treating units for Japan. The United Aluminum Works, Lautewerke, Germany, has contracted for a 200 kw. tapping type electric furnace capable of holding 4,000 lb. of aluminum. This company is turning to electric melting as the one sure method of producing clean bright aluminum, free from gas occlusions. Mitsui & Co., New York City, has

purchased, for shipment to Japan, a complete automatic set for heat treating forgings. The hardening furnace will be rated at 80 kw. and will contain five rows along which the forgings will advance. The only manual operation will be the periodic placing of material before the pusher of this furnace. Automatic arms will advance the material through the quench and 40 k.w. drawing furnace. Time clock mechanism will control the operation and prevent any piece advancing before it has received exactly the treatment specified. Two new Baily furnaces are also going into operation at the Port Huron plant of the American Bushings Corporation. The first is a 105 k.w. brass melting furnace of 1,500 lb. capacity. The second is a 60 k.w. annealing furnace for bronze bushings. This furnace has a magazine feed and contains 11 rows for advancing the bushings down to 11 discharge tubes, treating the product at the rate of one bushing every three seconds. P. and F. Corbin, New Britain, Conn., has added another Baily to its brass melting battery. The new furnace pours the metal directly into the moulds. It is rated at 75 kw. with 800-lb. hearth capacity.

### CONSTRUCTION NEWS

#### Consolidated Mining & Smelting Co. Will Erect a 1,500-Ton Concentrator

The Consolidated Mining & Smelting Co. of Canada has made a contract with the East Kootenay Power Co. for the early delivery of 3,000 hp. of electric energy to be used in operations at Kimberley, B. C. One of the requirements will be for the 1,500-ton concentrator which is to be constructed for milling of the Sullivan ores. The contract also provides for delivery of an additional 5,000 hp. within the next five years. The power company has a hydro-electric plant on Bull River, near Fernie, and water-power holdings on Elk River, a stream which drains the western slope of the Crow's Nest Pass area.

#### Hilltop Nevada Company Builds Flotation Plant

A 100-ton mill and flotation plant has been designed and is now being constructed for the Hilltop Nevada Mining Co., of Hilltop, Lander County, Nev., by A. H. Jones Co., of Salt Lake City. The plan of operations includes crushing so that 65 per cent passes a 200-mesh screen, in ball mills. Concentration is to be done by flotation. The power plant will consist of a 300-hp. internal-combustion engine, direct connected with a 200-kw. generator. It is expected that the new plant will be in operation by Oct. 1.