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A Weekly Journal of the Mining and Mineral Industries

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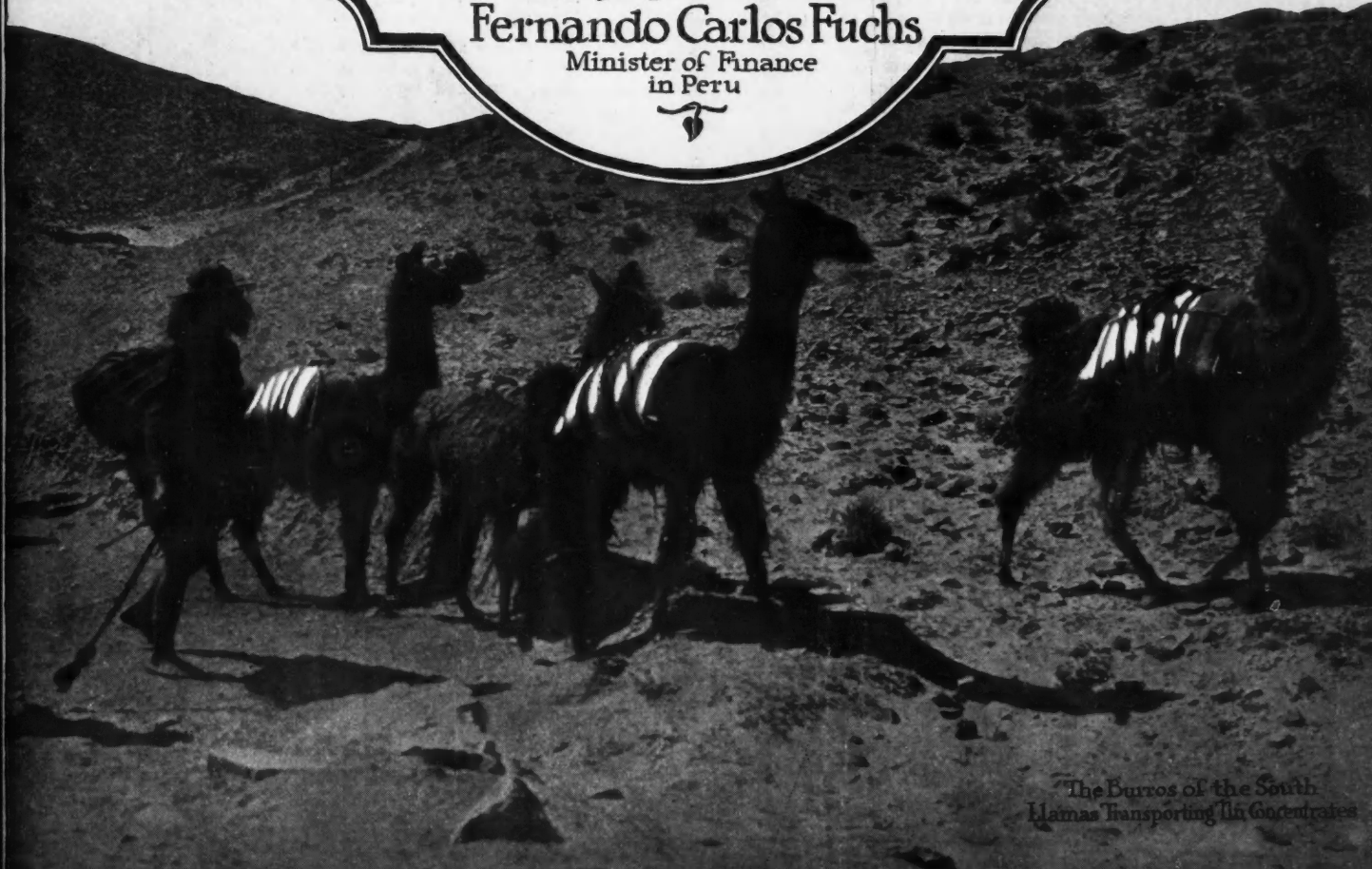
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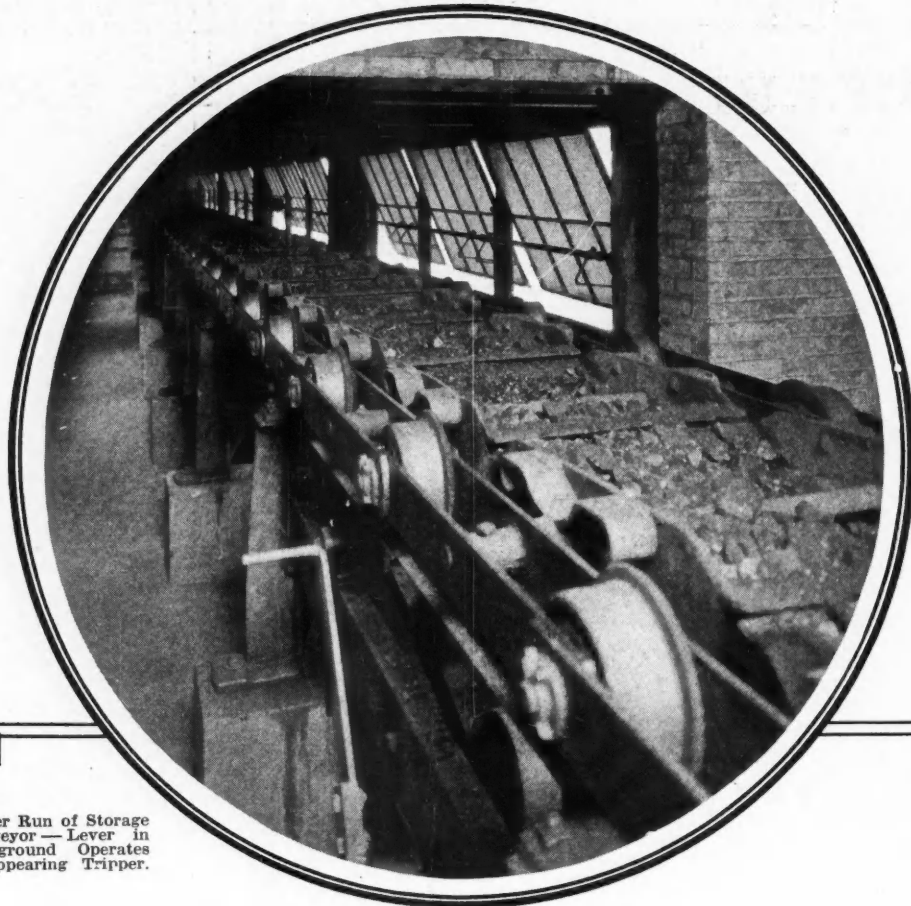
LATIN-AMERICAN NUMBER

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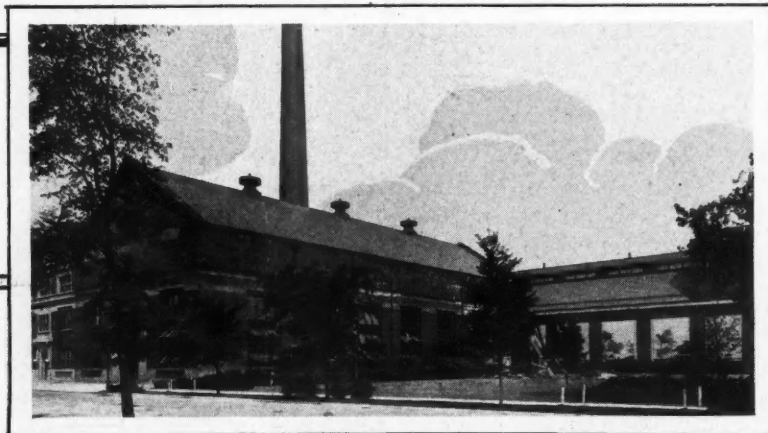
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Engineering and Mining Journal

A Weekly Journal of the Mining and Mineral Industries

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METALS

NON-METALS

PETROLEUM

Volume 109

New York, April 3, 1920

Number 14

The New West

IT HAS been aptly said that the New West, for Americans, is South America. What the Great West was for the last generation, it will not be again for any succeeding generation in the history of mankind—a rich and hospitably empty land, with treasures of mineral wealth, forest, and agricultural land untouched, waiting the hardy pioneer who would set up his tent or his cabin and work, build, and wait, till the following population made him wealthy.

The advice of Horace Greeley and others—"Go West, young man"—cannot be accepted at its face value these days. The West is still a wholesome place, but there are few unclaimed treasures, and competition is as active as in the East. Farming land in the West is as high in price as in the East, or more so. Doubtless, the irrigated valley lands of the West are more productive, and so more valuable; but if one wants cheap agricultural acreage he can get it within a few hundred miles of New York, and Boston, and Washington, much easier than he can in Arizona or California.

The gold rush to California in '49 was followed by many discoveries and rushes—the Comstock, the Leadville, the Black Hills, and others; most recently, Cripple Creek, Alaska, and the new Nevada camps. Already the cream has been skimmed off these fields, and in some cases the milk has been drunk. The prospector, discouraged, is passing into the vision of the past, with the other symbolic figures of the Old West. Intensive development and exploration of mineral resources, the like of which no country and no age have ever seen, have swiftly dug out our buried wealth and distributed it to the world at the best price obtainable. Finally, have come the machines and the processes to utilize the low-grade ores, hitherto scorned—the 1½ per cent copper ore, the gold-bearing gravels with ten to twenty cents a cubic yard, and even—in vain—the gold rock-ores carrying a dollar a ton. This era also has swung into full maturity for the West.

Mining companies must henceforth look forward to liquidation, to going into oil, or to expanding beyond the United States. Many great companies are now doing one of these three. Those which with prophetic and safe vision are adventuring abroad, are engaging in operations in Asia, Africa, South America—even in Europe.

Of all these, South America is the most obvious. It is, indeed, the New West, for Americans. Go South, young man; and pray for a wise government in Washington which will look kindly upon the country's adventurers in foreign though friendly lands—but go. The future of South America is bound up with that of North America. As the mineral production of the North declines, that of the South will be in the ascendant. Mexico, Central America, and South America from Panama to the Strait of Magellan await the Pan-American glory which is in store. Difference in race or speech cannot prevail against the common ties of interest, of governmental form, and of democratic manners and ideals.

Trade and Investment in South America

SOUTH AMERICA exports certain basic commodities for the most part belonging to the raw-material class. Of minerals and metals, there are sodium nitrate, tin, tungsten, manganese ore, copper, vanadium ore, silver, and diamonds. Of organic products, coffee, rubber, resins, wool, wheat, meats, hides, hard woods, and bitumen, or natural asphalt. Many of these products come to the United States, and in return for them we sell to the people of South America a wide variety of manufactured products, ranging from steel rails and locomotives to textiles and a great variety of household articles.

In the March 20 issue of *Engineering and Mining Journal*, R. H. Hepburn makes a cogent plea for the cultivation of South American trade by a reasonable exchange of commodities. Though his argument is specifically directed to the case of tungsten ores, in a larger sense it applies to the whole situation. At present, while the export trade of the United States has slackened, a condition that is temporary, the United States is in the favorable position of being one of the most important sources of supply for manufactured articles, and until her rival manufacturing nations overcome readjustment conditions, will continue to occupy this position.

We cannot continue to sell Señor Brazil, nor Señor Argentina, nor a score or more of good peoples, unless we are liberal in our buying from them. Good will in business retains customers. Homely though the truth may be, we are under the necessity of cultivating national good will in a similar way. In the case of South America, it is a relatively simple thing to do—we have merely to keep faith with South Americans by honest selling, reasonable credits, and honest buying. As Mr. Hepburn says, we must look to the future, else we will lose a permanent trade of great importance to our market for surplus manufactured products.

The interest of the United States in Latin America is not alone in buying, but also in investment in basic industries. South America is rich in mineral deposits. To the mining engineer it affords a wide range of opportunity. Braden, Cerro de Pasco, Chuquicamata and Potrerillas are classic examples of the investment of American capital in mining. Other instances might be named; and there are still many opportunities awaiting our enterprise.

The Importance of Chilean Nitrate

TWO giants of industry in the United States—one somewhat past the first youth, but rugged and lusty, the other just out of the infant class, but clean-limbed, buoyant, and hopeful—stand and ask that we, the American people, look carefully to their future. American agriculture and the American chemical industry are calling for a sound consideration of their present

and future needs for nitrogen. Indirectly, the mining industry is interested, for the reason that the manufacture of explosives requires a cheap source of nitric acid. The coke industry is also a factor, inasmuch as part of the supply of nitrogen is now obtained from byproduct coke ovens, which have increased greatly in number.

In a recent number of *Chemical and Metallurgical Engineering*, Alfred H. White has presented a quantitative estimate of the future demand for fixed inorganic nitrogen. Starting with a base figure of 145,000 tons of inorganic nitrogen required in 1913, he has assumed a 7 per cent cumulative annual increase. For the year 1913 there was imported 626,000 tons of Chilean nitrate, of which 39.2 per cent, 245,400 tons, were used in the manufacture of explosives, 45.5 per cent, 284,800 tons, in the manufacture of fertilizers, and 15.3 per cent, 95,800 tons, in the manufacture of chemicals and for miscellaneous uses. On the basis of the cumulative annual increase, Mr. White estimates the total nitrogen requirement for 1920 to be 232,000 short tons. Of this, 92,700 tons will be produced from byproduct coke ovens, 41,500 tons (perhaps) from the U. S. Nitrate Plant No. 2, leaving 97,800 tons to be imported. This would be equivalent to 508,000 long tons of Chilean nitrate, or, if the Government plant fails to make production, to 710,000 long tons. For the year 1930, the respective figures, assuming the same rate of increase, are 1,600,000 and 1,900,000 long tons.

Undoubtedly, the production of domestic nitrogen will increase. It is wise to stimulate synthetic nitrogen and byproduct coke oven sources of supply. But even an optimist as to the possibilities of domestic production meeting our varied needs must admit the importance of the Chilean nitrate supply.

Much is heard about our participation in the foreign development of primary sources of petroleum supply. Is it not also equally desirable that we seek to develop primary sources of nitrate? It is squarely up to our mining engineers to interest American capital in Chilean nitrate deposits. There is a field here for the productive employment of capital, not to mention the patriotic duty to our two giant industries. The field is still open. It behooves us to make speed. Our entrance into the Chilean nitrate fields will further develop our friendly interest in South America. It will promote trade by affording additional outlet for our manufactures.

Possibilities for Hydro-Electric Development in South America

THE determination of the extent and economic possibilities of water resources is today among the important factors governing the expansion of the mining industry in South America. Unlike many industries, which may be promoted with little thought as to physical surroundings, mines are "where they are," and their exploitation depends almost entirely upon the providing of the necessary capital and the proper fuel or motive supply. South America, in its present stage of development, offers little in the way of a fuel supply—either of coal or oil—but holds considerable promise for the development of potential water supplies.

There remains, however, a great need for further study concerning local hydrology, and we have recently read with interest an extensive preliminary report on

the possible development of hydro-electric power in British Guiana. In this report, many conditions are pointed out which may well apply to other portions of South America, and it would appear that an increased utilization of the natural water power will add greatly to the development of the mineral resources of our South American neighbors.

In the older countries, where hydro-electric installations have been undertaken, the initial expenses have of necessity reached large figures, due to the fact that there have been legal and physical compensations to overcome, but with the building up of transmission lines and plants in practically virgin country, much of this expense may be eliminated, and the promoters can also profit greatly by work which has already been done along lines of modern methods elsewhere. The art of power transmission today makes light of long distances, so that a few large developments are capable of extending power over considerable area, and offer great promise for the development of South America's industries. The success of such enterprises will depend, of course, upon the co-operation accorded local or outside investors by the various governments.

Already, we have notable examples of successful hydro-electric plants in South America that have been promoted by United States mining companies, among which may be mentioned the Braden Copper Co.'s Pangal project, in Chile, rated at 20,000 kw., and that of the Cerro de Pasco Copper Corporation in Peru.

Getting Money for Latin-American Mines

CITIZENS of the United States are often told that they would achieve greater success in their business ventures in Latin America if they would take the trouble to familiarize themselves with the Latin America's methods and customs, but little has been said regarding the proper procedure for the South American mine owner who seeks capital in the United States.

The American capitalist who is willing to risk his money in a mining project anywhere in the United States is certain to demand definite information regarding the physical condition of the property offered for exploitation, and he is likely to be particularly cautious in reviewing such information if the property in question is a long way from home. To the successful mining financier, distance does not lend enchantment, and the South American who comes to New York to get capital to develop a mine in his own country should be careful to include in the presentation of his property all the information that is sure to be demanded, especially in support of claims or statements that can be confirmed only at great expenditure of time and money.

In view of the inherent disadvantages faced by the North American investor in developing and operating mines in South America, such as costly investigations, time lost in travel, expensive metallurgical experimentation, difficulties of local transportation, local labor problems, perhaps an unhealthy or rigorous climate, and difficulty of maintaining a competent operating staff, the promoter or vendor of property in Latin America should offset these handicaps by the completeness, clearness, and accuracy of his presentation. A vendor's report prepared by a mining engineer who understands what is wanted by the capitalist would go a long way toward bringing the mine owner and the capitalist together, to their mutual advantage.

Wild Cats, Metal Mining, And Oil Cats

THERE are differences in degree between the so-called "oil game" and that of the "metal miner." Yet in an emotional way there are similarities. In both there is the elemental desire for a short-cut to wealth, with its allurements of ease or its enhanced power, whichever way the individual may look upon the successful outcome of his struggle. The trapper and the hunter are driven by the love of adventure into far-away regions. The pelts they take provide the wherewithal to continue the game. The prospector, too, has the love of adventure, but stronger still is the desire for wealth, for a rich strike.

Jim Butler found the Mizpah, and was content to sell it for \$300,000. This sum was enough for him. A million would have been a cheap price for the mine. But this is "hindsight" again. How little we distinguish between "foresight" and "hindsight." Jim Butler found an outcrop. Pieces broken from it gave high assays. The length of the vein, its width and its comparatively paltry depth were unknown. The presence of other veins was probably suspected at the time, as the area contiguous was quickly snapped up.

In the miner's parlance, neighboring claims of this kind, that is, having no definite evidence of vein or ore upon the surface, are called "wild cats." Just where the term originated we do not know, but we do know that Bret Harte tells an excellent story about the Devil sitting on the ridge-pole of a church on a busy thoroughfare in San Francisco and nonchalantly casting with fishline and bait into the stream of humanity below. He was finally successful, and hauled a fat, perspiring, and gasping broker up on the ridge-pole beside him. The broker was ashamed at having been caught by such a cheap device, but after watching the continued fishing operations, which were unsuccessful, ventured to suggest that he should be given a try at the fishing. The Devil consented, and the broker took the rod and affixed a new bait. Casting into the stream there was an immediate strike, and soon another victim sat upon the ridge-pole. Again and again success attended the broker's casts, and when the ridge-pole was crowded with silk-hatted individuals, plumbers, landlords, widows, and others of lesser degree, the Devil shyly asked "What bait are you using?" The broker, after dickering with the Devil, showed him the tiny scrap of paper which had been so effective as a bait. On it were the two words "Wild Cat."

Thus do we know at least that the term has been long in use, but it has never, until perhaps recently, been in savory repute. When a metal-mining wild cat made good, the fact that it had been such was promptly lost sight of. Nevertheless, there are shafts which have been sunk in the naked desert without hair or hide of an outcrop. These are blatantly wild cats, and rarely, indeed, does one become a mine. In metal mining, the prospect has at least the dignity of having an outcrop, or it may present the possibility of finding a parallel vein or an extension of a well-known deposit in the near vicinity. This does not mean five miles away, but almost an arm to arm propinquity.

In the "oil game," the "outcrop" of a virgin field becomes "seepage," oil films, bituminous matter in sedimentaries, favorable geological horizons, and "structure." These evidences are more subtle than those

which confront the metal-mining prospector. The "foresight" of the oil prospector is more nebulous and his need for the term "wild cat" to designate highly speculative operations in prospective oil fields is greater. It is, therefore, not a surprising fact that the petroleum industry has accepted this questionable term of the metal miner and has clothed it with a significance which has some justification for respectability.

Until geological engineers and well-trained and experienced oil geologists are considered vitally essential in the preliminary investigations of prospective oil areas, there will be unwise and useless expenditure. A wild cat which has been subjected to the rigorous examination of a competent oil geologist, if it passes favorably, attains a position similar to that of a prospect which shows an excellent outcrop. A wild cat which does not meet this test differs in no wise from the metal-mining kind.

Increase of Washington Salaries

THERE is great interest in Washington among the 107,000 Government employees over the recommendation to Congress concerning salaries. Altogether the average raise of pay approximates 8 per cent over the existing bonus, but in some cases the increase is more.

For the Geological Survey, the lowest classified geologist, the "Aid in Geology," receives a salary, according to the new classification, of from \$1,200 to \$1,800. The next grade, the Junior Geologist, who must have the equivalent of a college training and something additional, receives from \$1,800 to \$2,100. Above this comes the Assistant Geologist, who must have had two years' post-graduate experience, and receives \$2,400 to \$3,000; next comes the Associate Geologist, with five years of professional experience, at salaries of from \$3,240 to \$3,840; and then the full Geologist, with eight years of post-graduate experience, to receive from \$4,140 to \$5,040. Still higher comes the Senior Geologist, with twelve years' experience, whose salary is to be fixed by the Civil Service Commission, as is that of the Director.

In the Bureau of Mines, the classification and compensation are identical. The Mining Engineering Aid is to receive \$1,200 to \$1,800; the Junior Mining Engineer from \$1,800 to \$2,160; the Assistant Mining Engineer from \$2,400 to \$3,000; the Associate Mining Engineer, \$3,240 to \$3,840; and the Mining Engineer from \$4,140 to \$5,040; while the salary of the higher Senior Mining Engineer and the Director remain unfixed.

Altogether, and with due consideration for all circumstances, these standards of salary are considered satisfactory. As a basis of comparison, the salary of the classes of Geologist and of Mining Engineer before the war probably did not average over \$3,600 and would now average around \$4,600, an increase of 30 per cent. When we consider that the cost of living has at least doubled, this is insufficient; but if, as seems likely, prices of necessities have reached their peak, and will now tend to sag, there should be a gradual adjustment to pre-war prosperity.

Where the Bureau of Mines and the Geological Survey will get the money to pay these salary increases, if approved by Congress, is another problem. There is little indication that appropriations will be increased this year, and a possibility that they may be cut down. In this event, the only answer would appear to be a diminished personnel with more adequate pay.

WHAT OTHERS THINK

Treating Oxidized Copper Ores By Flotation

You will perhaps permit me to correct a statement appearing in Mr. Rudolph Gahl's article "The Present Status of Flotation," published in the Jan. 17 issue of *Engineering and Mining Journal*.

The statement in question is as follows: "The one deficiency that has been felt most and, therefore, worked on most, is the failure of the process, even in the hands of skillful experimenters, to treat oxidized copper ores."

More than two years ago, the London technical staff of Minerals Separation, Ltd., developed a new method for the treatment of oxidized copper ores. Owing to the war, however, it was not practicable to apply the method on a commercial scale. Last year, a Minerals Separation plant with a capacity of 100 tons per day was installed at the Bwana M'Kubwa Copper Mining Co.'s mine, in South Africa, for the purpose of testing the new methods. Five thousand tons of crude ore, 90 per cent of the copper contents of which is in the form of silicate and carbonate of copper, have been treated with an average recovery of 78 per cent with a 28 per cent copper concentrate, the value of the ore ranging from 4 to 5 per cent copper. The metallurgist in charge of operations is of the opinion that he will ultimately effect a considerable improvement on these results.

WALTER BROADBRIDGE.

London, England, Feb. 26, 1920.

Laboratory Stills and the Dry Law

Your short article on the "By the Way" page of the issue of Feb. 14 has been noted with surprise and dismay. What chemical laboratory does not contain a water still, a Liebig condenser, and other apparatus that could be used for illicit purposes? I am a strong dry advocate, yet I can readily see how a Government agent with more enthusiasm than discretion could easily make trouble for an unsuspecting chemist. A ruling or permit certainly should be obtained, and I think would be granted readily when the proper authorities were given the facts.

MINNESOTA TESTING LABORATORIES,
Duluth, Minn., March 1, 1920. By C. A. Graves.

Eastern vs. Western Co-operation

I was very much interested in your recent article on "Eastern and Western Co-operation." Probably no one realizes the "close corporation type" here in the East better than the librarians in some of these misled institutions.

The special library of these business houses represents the index to the thoughts of men, that have been crystallized into print. Today we go no further than the trade periodical or society publication. Yet there is hardly a large organization supporting a research force that does not at least type the results of these researches. An exchange index system of these reports would not only

save a man making a trip that finally proved worthless, but would save thousands of dollars annually in time conserved by not performing what some other firm had already found worthless.

Where our narrow-minded men get the idea that they are protecting themselves is hard to see. If firms would only permit of freedom of intercourse between their libraries, they would be surprised at the results. It would follow in this taking away of current barriers, just as surely as to make it a rule to never undertake any research until all printed information on that line has been examined, that thousands of dollars would be saved.

A more Beneficial act for American business could not be performed than to break down the old superstition of secrecy. The waste resulting in duplicate investigation is immeasurable.

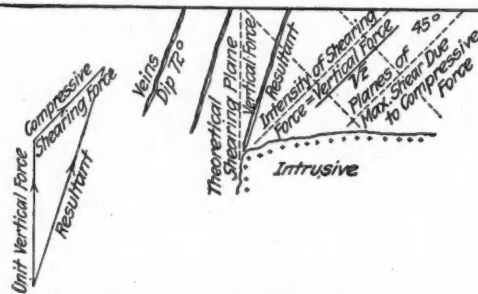
LIBRARIAN.

Brooklyn, N. Y., March 20, 1920.

Is It True?

In regard to the 70 deg. dip mentioned in your editorial in the Feb. 28 issue of *Engineering and Mining Journal*, I enclose a diagram in which I have attempted to explain how I would account for the same. Compressive strain above the intrusive or batholithic rock would produce 45-deg. shearing planes. Superimposed on this is the vertical shearing force along the edge of the contact; the resultant comes out above 72-odd deg. I confess, however, that I have not yet arrived at a clear conception of this.

As you say not to mention the exception to the "east



DIAGRAMMATIC SUGGESTION TO ACCOUNT FOR
70 DEG. DIP

and west rule" for the majority of western North American veins, I will desist. Yet—I would like to reel off a few of the big producing districts where the reverse is true—I am disinclined to believe the rule and would split it about fifty-fifty between the north-south and east-west veins. I think more of them would either fall in the neighborhood of N. 20° W. and N. 70° E., namely, parallel and at right angles to the Rocky Mountain systems. The simplest case would be on the contact of a linear intrusion of great length, as the British Columbia Coast Range. Though the Juneau belt is parallel to the axis of the Coast Range, the Premier vein in the Salmon River strikes at right angles, or N. 80° E. In like manner in the Alice Arm district, also on

the eastern contact of the Coast Range, the prevailing strike is decidedly N. 70° E., including the Dolly Varden. There are veins in the same district which show the northerly strike, however. The parallel veins to the contact are considered to be formed as shown in the diagram. The right-angle veins, corresponding to the "cross-slips" of some contact deposits, are more difficult to explain, but might be the effect of differential movement in adjacent sections of the parallel veins; in other words, differing displacements in sections. Of course, the majority of districts are harder to account for, and I think would be too complicated to try to explain by mathematics.

HEWITT O. FEARN.

Talache, Idaho, Feb. 7, 1920.

The Panacea

I had intended giving you my impression of your opening paragraphs in the article entitled "The Panacea," which appeared in the issue of Jan. 31, but had neglected to do so until receiving the issue of Feb. 28.

You certainly hit the nail on the head in your "Panacea," and gave expression to the two fundamentals underlying personal relations in industry in concise language.

We need an understanding of our personal relationships as well as of our work.

T. O. MCGRATH

Bisbee, Ariz., March 4, 1920.

"Mr. Hoover Requests"

The *Engineering and Mining Journal* is known to be a warm admirer of Mr. Hoover, and, as far as a technical publication may properly go in political matters, an advocate of his candidacy for President of the United States. Believing that the engineering profession practically *en masse*, together with a high percentage of their associates in the business, manufacturing, and financial world, hold identical views, the question is how to reach the mass of voters of independent minds and inspire them with some of the enthusiasm we feel.

During that period of the Great War when America was an active participant, or preparing to do her part, Mr. Hoover was at the head of the food-control department of the Government, and every one who can read will recall the millions of posters that were distributed around the country, in public places and in homes, all bearing the heading "Mr. Hoover Requests"—followed by an invitation to all the family to do this, that, and the other thing in the matter of food conservation. Those were taking posters. They commanded almost everywhere attention and commendation. To "Hooverize" was to do not only the patriotic but the *proper* thing under the circumstances. To refrain from compliance was shameful. In those stirring days this invitation, without the backing of any argument, commanded the implicit obedience of every decent citizen of this nation of over one hundred million souls. It is doubtful if ever before in the history of the world has one man, then almost unknown outside of his own circle, secured such a wonderful response as he did to a simple "request."

At the present time Mr. Hoover is urgently requesting us all *not* to do something. But that phase will pass. In due time he will be drafted, and will need the vote of every American who is weary of partisanship. When

that time comes is there any campaign slogan that will be more familiar to the masses of our citizenry, or rouse any deeper feeling, than the simple phrase "Mr. Hoover Requests"?

NON-PARTISAN.

New York, March 24, 1920.

Interchanging Hose Connections

The article by Mr. Waters "Applying the Blue-Print Round," appearing in *Engineering and Mining Journal* of Feb. 7, is quite in line with the present effort among mine managers to master all the details of underground work. Mr. Waters, without doubt, has given the subject a great deal of intelligent study, and the article is, in the main, constructive.

The last paragraph of the paper, however, is unfortunate. It reads as follows: "Perhaps one of the most annoying and exasperating things about rock drills, as they are turned over by the manufacturers to the mine management, is the premeditated policy of trying to make the mine management purchase the manufacturers' line of drills, each manufacturer making his connections different from the other fellow's, so that all attempts to test out other makes of drills will be hampered as much as possible." This is followed by other remarks on the subject.

Mr. Waters has generalized somewhat too broadly, and has taken the wrong attitude toward the drill manufacturers, for, in the first place, American-made rock drills are not "annoying and exasperating," but are the world's best product in this line, as is evidenced by the fact that they are sold the world over, despite the handicaps imposed by foreign tariffs, differentials in exchange, and the low first cost of European drills.

As for the lack of interchangeability of hose connections, this is not as serious as the article would indicate, as, for example, the air ports in all Waugh drills are threaded for either three-quarter or one-inch standard pipe thread, the size of the opening depending upon the size of the drill. Any air hose spud tapped to standard pipe thread can be used on these drills without difficulty.

As for the water-hose connection spud, it is true that a special thread is used, but, again, the port in the backhead is fitted with a standard pipe thread, and it is a simple matter to turn a one-half inch pipe thread on any other maker's water connection spud, and by so doing use it in the Waugh machine.

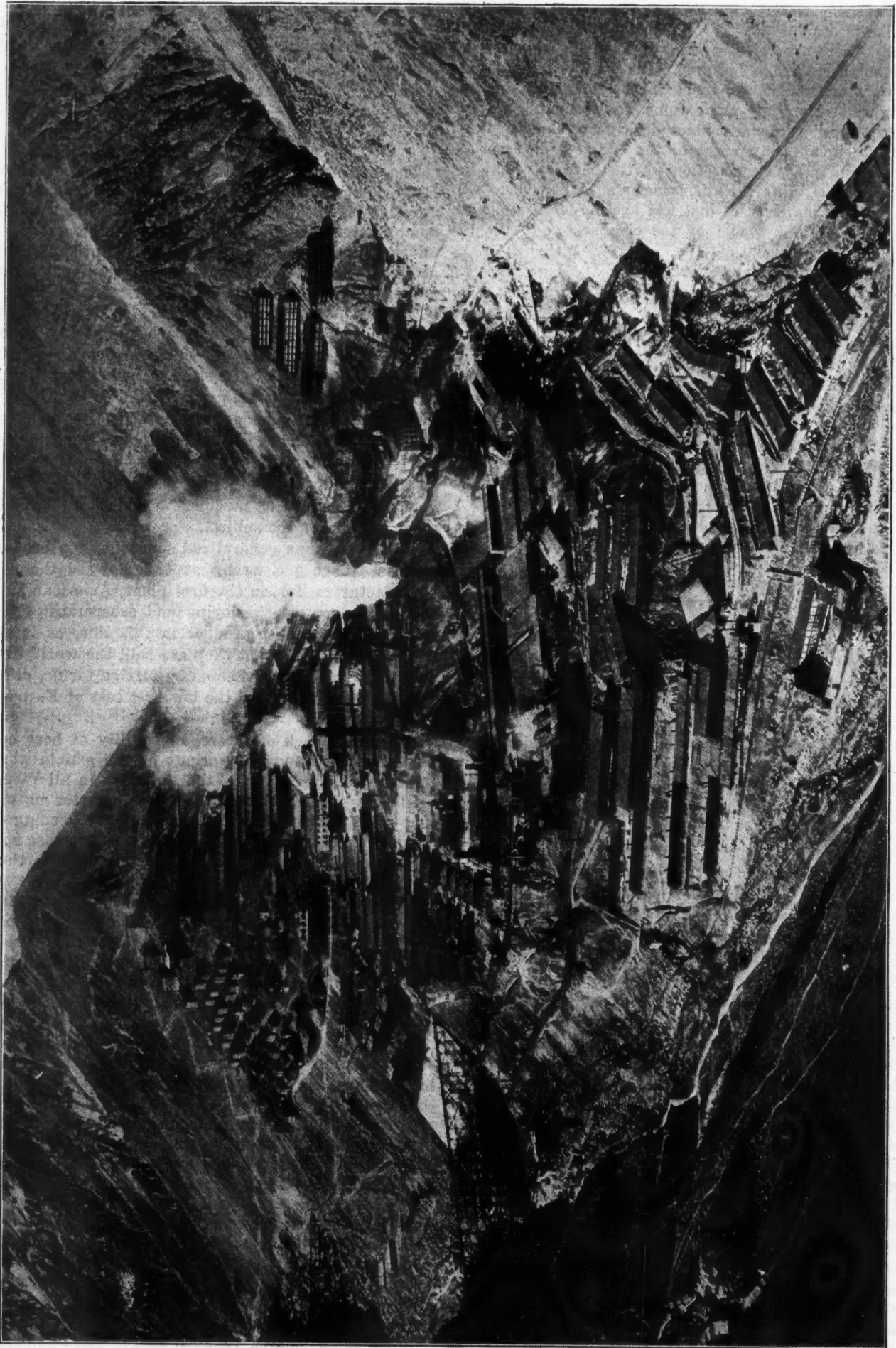
When the West was wild, wooly, and alcoholic, it was not unusual to see a sign hung over the piano in a saloon reading, "Don't shoot the professor; he is doing his damndest." The same is true of the drill makers; they are doing their best to solve the difficulties arising from a multiplicity of different hose connections that were made to meet certain conditions of the past.

The drill makers are always willing to co-operate with the mine managers, and if difficulties arise over hose connections, any good drill salesman can easily straighten the matter out.

Standardize the mine on one hose connection, and there will be no trouble in fitting the machines to it. Don't try to fit the hose to the machine; rather fit the machine to the hose. As outlined above, it isn't difficult, is it?

HOWARD DRULLARD.

Butte, Mont., March 12, 1920.



GENERAL VIEW OF THE BRADEN COPPER CO.'S OPERATIONS NEAR RANCAGUA, CHILE

The Mining Industry of Bolivia

Operations Conducted Since 1544—Potosi Mountain the Oldest Mining Camp in Western Hemisphere—Incas' Wealth in Part Derived From Mines—Tin, Silver, Bismuth, Copper, and Tungsten Produced

BY GEORGE W. SCHNEIDER AND BENJAMIN L. MILLER

Written exclusively for *Engineering and Mining Journal*

FROM the earliest settlement of Bolivia, mining has been the predominant industry of the country and has contributed the bulk of the nation's wealth. This inland republic contains in the Potosi Mountain the oldest mining camp of the Western Hemisphere, as mining has been carried on there continuously, according to all available accounts, from 1544 to the present. Even before the coming of the Spaniards the metalliferous ores were worked and furnished part of the wealth of the Incas.

The mineral products which Bolivia has furnished are not numerous in variety, and, indeed, until the closing years of the last century, consisted principally of silver, with subordinate amounts of gold and copper. To these have been added tin, which now constitutes the major part of the mineral wealth; bismuth, tungsten, antimony, and lead.

Although considerable rubber is annually gathered in the Amazon River drainage basin of northeastern Bolivia, and some wool and hides of alpacas, llamas, vicunas, and sheep are marketed by the residents of the Andean plateaus, the exports consist mainly of the mineral products, most of which are shipped to foreign countries as hand-picked ore or as mill concentrates. The almost complete lack of any fuel other than the llama dung (taquia) throughout the mining districts has seriously militated against the erection of local smelters. Practically all of the mineral products are exported.

The Great War at first caused stagnation in some of the mining camps of Bolivia, but this was later overcome, so that, in 1918, the exports are reported as showing an increase of 277 per cent over those of 1914.

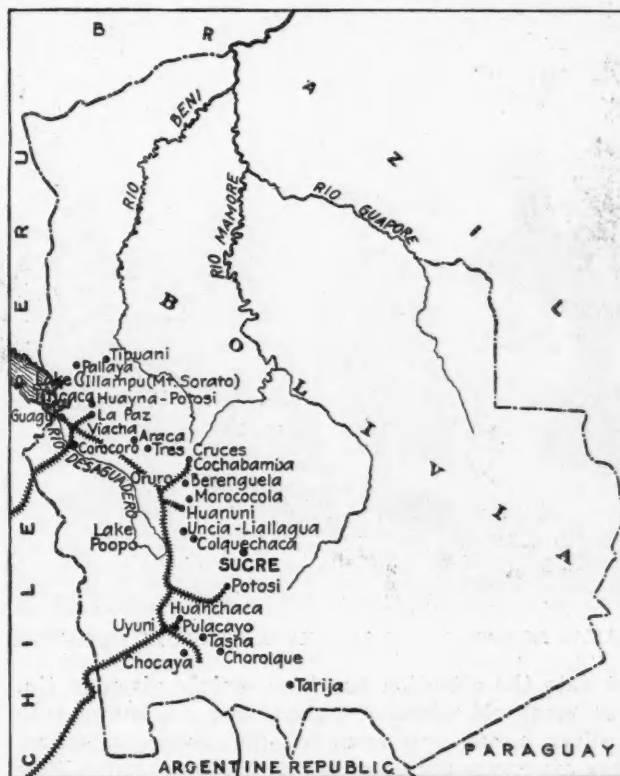
BOLIVIA APPRECIATIVE OF VALUE OF RAILROADS

Bolivia as a nation has been thoroughly awakened to appreciate the immense value of railroads, and strenuous efforts are being made to secure capital for the building of new lines. At present La Paz is connected with Antofagasta, Chile, by a direct line 711 miles in length; with Arica, Chile, by a line 278 miles long; with Mollendo, Peru, by railroad and steamboat across Lake Titicaca, a combined total of 520 miles, and lacks only about 60 miles of having a continuous connection with Buenos Aires, distant 1,640 miles. Several branch lines connect some of the principal mining districts. The total mileage of railroads in Bolivia itself is slightly in excess of 1,000, but four lines now in process of construction will increase this about one-third, and a two-thirds increase is under consideration.

Besides the building of new lines of transportation, there seems to be considerable agitation for the acquisition of a portion of northern Chile that would obviate the necessity of sending all exports and imports through the ports of Chile or Peru, even though amicable commercial relations are maintained. In the disastrous war ending in 1883, in which Peru and Bolivia were defeated

by Chile, Bolivia lost her coastal territory, which now constitutes a part of the Chilean province of Antofagasta. Although she cannot hope to recover the rich nitrate territory which she formerly possessed, if reports can be credited there is a probability that Chile will grant her a port in the Tacna-Arica region, to which Peru still lays claim. The possession of an outlet to the Pacific Ocean within her own territory would undoubtedly be of extremely great value to Bolivia.

In 1919 mining operations were somewhat reduced, on account of the derangement of the metal markets following the signing of the armistice. The demand for



SITUATION OF MINING PROPERTIES IN BOLIVIA

tungsten ores ceased temporarily, and the prices of other metal ores were lowered. More recently the mining industry again became prosperous, especially in the tin, silver, and copper districts. With the material increase in the price of silver, and the activities of the Guggenheim Exploration Co. in the tin industry, the future of the Bolivian mining industry is especially promising. There are many old silver mines that will doubtless be reopened under the increased stimulus of high prices, and developments may be expected in the mines long operated for silver. The investigations of the Guggenheims, which are being carried on in a systematic manner, and their extensive purchases or leases, would lead one to expect decided advances in

the tin industry during coming years, so that Bolivia may finally become the predominant tin-producing country of the world.

TIN, SILVER, BISMUTH, AND TUNGSTEN ORES IN CLOSE ASSOCIATION

There is such an intimate relation between the tin, silver, bismuth, and tungsten ores of Bolivia that it is difficult to separate the districts on the basis of metaliferous ores. This is especially true in regard to the tin and silver minerals, which in many cases are found in the same veins or in different veins in the same region. Bismuth and tungsten minerals are also found in conjunction with the tin-silver ores, but less widely distributed. Up to 1890, in all such ores, no attention was given to anything other than silver, whereas since

tematic examinations are being carried on, as well as extensive exploration work with a force of about 100 American engineers and geologists. Much development work is planned, including the construction of a branch railroad line to connect with the Oruro-La Paz line, tramways, concentrating mills, and other equipment. A large tin production is assured with these improved facilities.

In the Berenguela district, the Berenguela property, operated by a British company, is producing about thirty tons a month. The ore, which is low grade, occurs in large orebodies. The mill has recently been remodeled.

In the Oruro district the principal operators are the Compañía Minera de Oruro, owning concentrating mills at Machacamarca, and the Compañía Minera de San



LLAMAS LOADED WITH YARETA, A COMPACT, MOSS-LIKE PLANT WHICH, WHEN DRIED, MAKES A DESIRABLE FUEL

that date the attention has been mainly given to tin. Thus, many old mines now abandoned are known only as silver mines, and many of the modern tin-silver mines are commonly described as tin mines, with little reference to the silver values. In a few places the bismuth or the tungsten minerals are sufficient to make the ores more valuable for these metals than for the tin or silver. Therefore, in any classification of the ore districts of Bolivia, this intimate association of tin, silver, bismuth, and tungsten must always be kept in mind. It is probable that the formation of all these orebodies represents a single period of mineralization, constituting a metallogenetic epoch.

The production of the Araca mines amounts to about 100 tons a month. In the Tres Cruces (Quimsa Cruz) district the Guggenheim Exploration Co. has purchased or holds under option practically the entire granite (so-called) area, which includes several large properties. The principal mine is the Coracoles, which, at present, with a small experimental mill, is producing thirty tons of concentrates per month. Comprehensive and sys-

José, with mills at Poopo, both owned by Chileans. In addition to the tin content, the ore contains from 30 to 60 oz. of silver per ton. The usual production was maintained during 1919, and the companies are preparing to increase their output, in response to the stimulus of the high price of silver.

The Totoral property, in the Pazna district, is operated by a Chilean corporation, as is also the Chaulla Grande, at Avicaya, owned and operated by Señor Abeli and associates, and situated in the opposite side of the hill. At the latter plant the old mill has been remodeled, and a campaign of development is under way, for the purpose of increasing the production to what it was formerly.

About 25 kilometers southeast of Oruro, Messrs. Penny and Duncan are operating the Morococala property. Extensive developments are under way, including the sinking of a shaft and the installation of Diesel engines, which have effected a saving of 20,000 bolivianos (about \$660) per month. The Diesel engines operate General Electric generators, and the power is

distributed to the mill and to the hoists and pumps of the mine. The old buddle method of concentration, the buddles arranged in series, is still employed in the mill. The production has been increased from 100 tons to 200 tons per month.

The mines of the Huanuni district, owned and operated by Simon I. Patiño, have an output of 250 tons of tin concentrates per month. A new 350-ton mill, operated with power furnished by Diesel engines, designed to treat $1\frac{1}{2}$ to $2\frac{1}{2}$ per cent tin ore, has just been completed.

The Uncia and Llallagua mines, operating on opposite sides of the same hill, are the two leading tin mines of Bolivia. The Uncia mines, owned by Simon I. Patiño, have a production of 850 to 1,000 tons of concentrates per month; the adjoining Llallagua mines, owned and operated by the Chilean Compañia Estanifera de



PART OF THE TOWN OF POTOSI AND THE FAMOUS CERRO RICO DE POTOSI

Llallagua, have a monthly output of 2,000 tons of concentrates, averaging 68 per cent tin, and the production is being increased. In both cases the power for mines and mills is furnished by Diesel engines. The ore reserves of the Llallagua are more extensive than those of any other tin mine of Bolivia, and place it among the big mines of the world.

It has long been known that the Uncia-Llallagua ores carry a high bismuth content in the form of bismuthinite, and extensive experiments are being carried on by Durward Copeland, metallurgist in charge of the Llallagua plant, for the purpose of separating the bismuth from the tin concentrates. The results obtained are promising. The Llallagua company owns and operates a tin smelter at Arica, Chile

SIX IMPORTANT COMPANIES OPERATE IN DISTRICT OF POTOSI

In the famous silver-tin district of Potosi six important companies are at present operating. The symmetrical conical hill known as the Cerro Rico de Potosi, with an elevation of about 16,000 ft., is honey-combed with old workings from summit to base, and is supposed to have yielded more than one billion ounces of silver and perhaps double that amount. Mining seems to have been carried on continuously since the discovery of rich silver ore in 1544, but only within the last twenty-five years has much attention been given to the tin content, which within recent years has been more important than the silver. Louis Soux, a Frenchman, is the largest operator on the mountain. Hydro-electric power is used in both mines and mills. Recently, an Ingersoll-Rand air compressor has been

installed at the mines, and improvements have doubled the capacity. Another French company, Bebin Hermanos, has just completed the erection of a modern fifty-ton mill using Diesel engines for power.

The total production of the Potosi mines is from 400 to 500 tons of tin concentrates per month. The concentrates carry considerable silver. In the past there have been attempts to consolidate all of the workings on the mountain, and there is now a rumor to the effect that such a consolidation is about to be effected. If this should be done an early output of 1,000 tons of tin-silver ore could be expected.

In the Chocaya district, the Oploco mine, owned and operated by the Compañia Minera y Agricola de Oploco, a Chilean corporation, is producing from 500 to 600 tons of tin concentrates per month. The ore and the concentrates carry some silver. The mine has large ore reserves in a long, continuous oreshoot. Preparations are under way for a much larger production.

Tin and silver ores have been discovered recently in well-defined veins north of Mount Sorata (Illampu), in the neighborhood of Ancoma. This is important, as it enlarges the area of the tin belt to a total distance of about 400 miles in the eastern Andes (the Cordillera Real). Reports from the other outlying tin districts of Bolivia are favorable and indicate larger production in the near future.

SILVER PRODUCTION ACTIVE, IN RESPONSE TO HIGH PRICES

In the foregoing descriptions mention has been made of the silver in several districts, especially in the Potosi and Oruro mines, and if the price of silver remains at its present high level it may be that some of these mines will in time yield greater returns from their silver content than from the tin values.

The Pulucayo (Huanchaco) district, near Uyuni, contains the famous Pulucayo mine, operated by the Compañia Huanchaco de Bolivia, a French company. The railroad line from Antofagasta to Uyuni was constructed in 1891 to afford better transportation facilities for this rich mine. Since 1895, when hot waters with a temperature of 70 deg. C. broke into the mine, it has been difficult to operate, but plans are now under way for the installation of an extensive plant to handle the warm acid waters. The monthly shipments to the coast amount to about 800 tons of ore carrying 100 oz. of silver per ton.

The Colquechaca district, which formerly contained very productive silver mines, is being revived. Simon I. Patiño has recently taken over one of the old producers and is installing hydro-electric power for the purpose of unwatering the old workings, after which development work on a large scale will be undertaken. A Bolivian-Chilean company has recently installed a flotation plant to treat the silver-tin ores.

Unlike the other metallic products of Bolivia, copper deposits of commercial importance are found in a single belt near the western edge of the high interior plateau, and practically all the copper production of the country comes from the Corocoro district. The greater part of the ore occurs as native copper, and in the list of native copper districts Corocoro ranks second only to the important Lake Superior region.

The country rocks are sandstones of a prevailing red color, shales, and conglomerates. The orebodies consist of layers of the sandstone through which are disseminated numerous small particles of native copper. Con-

siderable gypsum is present in the beds. Near the surface some of the ore-bearing strata contain chalcocite, cuprite, malachite, and azurite. Occasional large sheets of native copper are encountered. The bulk of the ore contains from 2½ to 4 per cent copper.

Only two important companies are operating in the district. The Compañía Corocoro de Bolivia, a Chilean concern, has recently completed a new flotation mill for the treatment of ores containing chalcocite and cuprite. The company's monthly production amounts to about 750 tons of 52 per cent copper concentrates. The Corocoro United Copper Mines, Ltd., an Anglo-French company, is treating about sixty tons of ore per day, yielding approximately 150 tons of high-grade concentrates per month. In addition, a quantity of 20 per cent copper concentrates is produced for the company's new smelter on the Chilean coast.

BISMUTH PRODUCTION A LARGE FACTOR IN WORLD'S SUPPLY

Bolivia continues to furnish the greater part of the bismuth of the world, much of which comes from some mines in which tin is the chief product. The firm of Aramayo Francke & Co., with its principal mines at Tasna and Chorolque, is the chief producer. The Llallagua and Uncia tin mines also produce some bismuth, as do several small mines in the Huayna Potosi district north of La Paz.

TUNGSTEN PRODUCTION STOPPED SINCE ARMISTICE

The production of tungsten has practically ceased since the signing of the armistice, owing to the decrease in the demand, and there is little promise for it in the future if it occurs independently of other ores. If an import tax is placed on tungsten ores by the United States, the tungsten industry of the country will be still further reduced, even though some persons are of the opinion that, next to China, tungsten ores can be produced in Bolivia at a lower cost than anywhere else in the world. In association with tin or silver minerals some tungsten concentrates will continue to be produced in Bolivia.

The occurrence and geologic features of tungsten ores are similar to those of the tin deposits, whether the tungsten minerals are found alone or associated with tin minerals. Wolframite is the most common mineral, although in some cases scheelite occurs. Tungsten has been produced in the departments of Potosi, Oruro, La Paz, and Cochabamba.

GOLD PLACERS ALONE ACTIVE

The Incaoro mines, at Pallaya, and the Olla de Oro mine, east of La Paz, the only lode gold mines of consequence operated within the last few years, were idle during the last year, owing to the present unfavorable conditions for gold mining.

In the placer-gold district northeast of Lake Titicaca, the natives continue to wash gold along the banks of several gold-bearing streams. The entire gold production for the year probably came from this source. It is supposed that some of this gold is surreptitiously taken across the border into Peru without the payment of customs duties, and hence not accounted for in the figures of annual production.

The operations on the Tipuani River have been confined to development work carried on by the Bolivian Gold Exploration Co., a North American concern, that owns and controls the principal placer deposits of the

lower course of the river, a region which was formerly fairly productive. The company has been engaged in the construction of a ten-mile ditch, which has taken considerable time, owing to adverse climatic conditions, scarcity of labor, and difficult construction. It was necessary to build nine tunnels. The ditch will be com-



BOLIVIAN WOMEN SORTING ORE. LLAMAS AND MINE BUILDINGS IN THE BACKGROUND

pleted in March, 1920, when water taken from the Gritado River will afford ample power for the continuous operations of the hydraulic elevators installed on the Colorado playa. Active operations, however, were to begin Jan. 1, 1920, as the water supply during the wet season was considered sufficient to run the operations until the completion of the ditch.

How To Record Steel-Tape Readings

BY S. H. HAMILTON

Written exclusively for *Engineering and Mining Journal*

A mine survey free from errors is a necessary prerequisite to successful operation. Hardly anything is so difficult as high precision under the conditions existing in most mines. Checking horizontal angles and checks on vertical angles are practiced. Distance measurements present a real difficulty. What is so annoying as to find in the office a distance given that "looks wrong"? Suppose your recollection of a "shot" was that "the distance was about a hundred feet," but the notes as taken indicate "89.0." A lot of time and energy are wasted in wondering if the notes ought to have read 98.0. Finally, you get into your "digging clothes" to check it up.

The next time you have a measurement to record "in the hole" where you can hardly see, where the ground is dangerous and you are afraid of gas, just remember the little trick of "making money" you learned in your youth. Place the tape near the place to be permanently recorded, under the page of the note book. Then rub over the page with the end of the pencil or a lead bullet. Then mark the exact point with an arrow. The result is a reproduction of the numbers and marking upon the tape, and may be read accurately in the office.

Uruguay has local supplies of granite, marble, porphyry, limestone in limited quantities, and cement, according to the Bureau of Foreign and Domestic Commerce. There is also abundance of excellent clay for brickmaking, but it has not been fully utilized. No clay roofing tiles or sewer pipe are made in Uruguay. All fire bricks and plaster of paris are also imported. There is a developing demand for many types of construction tools and machinery, and for heating and elevator installations.

New Mining Fields in Eastern Nicaragua

Low-grade Gold Ores in Quantity—Two Types of Veins—Present Production Is the Result of Mining—Railroad, New Ore-Treatment Methods and Large-Scale Operations Are Necessary for Profitable Production

BY LOUIS GARBRECHT

Written exclusively for *Engineering and Mining Journal*

NICARAGUA is the largest of the Central American republics. Its area is 49,200 square miles, and its population, 690,000. In natural resources it is by far the richest, although the least developed, of all of the countries lying immediately north of the Panama Canal. The United States should have a special interest in the development of the country, for, by the terms of the lease to our Government of the Nicaraguan canal route, and the acquisition of a coaling station in the Bay of Fonseca, on the Pacific, and another coaling station on Corn Island, in the Caribbean, Nicaragua will be brought as close politically as Cuba and Panama are.



LOUIS GARBRECHT

Nicaragua is the backward child of the Central American family of republics. The necessity to provide shelter, food, and clothing, which elsewhere forms the principal incentive to progress, is lacking, or, if it does exist, is present only to slight extent. Gifted by nature with an equable and mild climate and with an abundance of ever-ripening foods, the natives are innocent of the recurring problems that daily spur the average householder in less favored countries to efforts which make for civilization and advancement, even though the underlying cause for this same average householder's efforts may have been only to keep one lap ahead of the rent agent or the income-tax collector.

History records that, after a severe storm, Columbus landed on the eastern coast of Nicaragua and offered thanks for his safe delivery. The cape near which he landed is known today as "Cabo Gracias á Dios." A mining engineer who had occasion to land on about the same spot, but more recently, maintains that Columbus offered his thanks to God not on landing but on leaving the place. However, allowances must be made. Mining

engineers who nowadays are engaged in trying to make a gold mine pay with the price of an ounce of gold anchored to a fast-sinking \$20.67 are likely to be in a cynical mood. But there is no moral obloquy in stating that 400 years of contact with civilization has worked little change in eastern Nicaragua and its inhabitants. A machete, an iron cooking pot, an axe, a muzzle loader and a mosquito bar are the essentials with which the native starts a household of his own. The number of his implements need never be increased to enable him to raise a family in health, wealth, and happiness. He cares not for the joys that come with the finding of the pay-streak after painful search along the elusive stringer. Neither does he know of the worries resulting when the consumption of cyanide climbs to two pounds per ton, nor of the moral involved where a cyanide plant has been installed under conditions requiring oil flotation. Wealth means nothing to him. Fortunately, however, he has cultivated a taste for white man's food, and "plun apo" are the magic words which send terror into his soul, located in his stomach, and drive him to toil.

On the coins and also on the seal of Nicaragua, a number of volcanoes appear as the decoration. They are symbolic not only of its geologic but of its political history as well. Up to the revolution of 1909, when Zelaya was ousted with the aid of American marines, and order restored, the political history was rather turbulent. The long-continued disturbances retarded growth and progress. In the last decade, however, political Nicaragua has reformed. Revolutions at present are decidedly unfashionable. A small garrison of American marines, acting as a legation guard, has perhaps contributed to make the reformation effective.

Geographically, Nicaragua is divided into two parts, the Pacific slope, generally referred to as the "interior," and the Atlantic slope, referred to as the Costa Atlántica. The latter division constitutes about two-thirds of the area of the country, but contains only about 10 per cent of the population. At an earlier period it was known as the "Mosquito Coast," not from the abundance of mosquitoes, however, but because of the fact that Mesquit Indians inhabited it. At a still earlier time it was a part of the Spanish Main of the days of the pirates. Descendants of these pirates, grave, religious folk, are still the dominant, coastwise, seafaring people.

The interior is fairly well developed. It has several hundred miles of roads and about 170 miles of railroad. Most of the towns and villages are connected by telegraph. In the past, whatever disturbances have arisen have been confined chiefly to this portion of the country. This applies to geological as well as political upheavals. Eastern Nicaragua as far west as latitude 84° 15' formed part of the Mosquito reserve, which for a long time was under British dominion, but in 1894 was ceded back to Nicaragua. Being but sparsely settled and rather inaccessible, its potential wealth in minerals and

"No grub."

timber unknown, it was, in politics, treated as the Cinderella of the Nicaraguan states.

The Atlantic coast has little in common with the interior. Hardly sufficient time has elapsed since its union with the interior for it to have become fully amalgamated with the rest of the country. Its climate and natural resources, the industries of the people and the very people themselves are different, and until recently the coast used a different coinage and had different custom laws. The people of the interior are Indo-Spanish. Those on the coast are chiefly Indians, negroes coming next in number, and a sprinkling of Indo-Spanish officials and foreigners. Although Spanish is the official language, English is more commonly spoken. There is little communication with the interior except by telegraph, as neither roads nor railroad connect the two divisions. Locally all communication is along navigable rivers or along the coast. Bluefields is the only town of any consequence. At present, it is the only port on the Atlantic coast. Its chief intercourse is with New Orleans.

Owing to the lack of transportation and general inaccessibility, eastern Nicaragua is little known or prospected. From a prospector's point of view it is practically a virgin territory, and, with the exception of gold, the mineral resources are unknown. At present, gold and silver are the only metals mined on a commercial scale, although fairly large deposits of copper and high-grade hematite ores have been discovered and developed within the last three years. Silver is found associated with gold in the gold-quartz veins, but is of minor importance.

In the limited areas where sedimentary rocks are exposed, indications of the presence of oil were noted. Specimens of gilsonite, manjak, and other residual deposits of petroleum have been found in a number of places. From samples of shale found in the Chontales district, both petroleum and paraffin were distilled. In several localities the geological conditions are favorable for the finding of oil in commercial quantities. The conditions essential for a productive oil or gas field are present, such as large bodies of bituminous rock, structural conditions favorable for oil accumulation in porous beds, and a non-porous cover. It is probable that coal will also be found. Although no deposit came under my observation while on a geological reconnaissance, geological conditions are favorable for coal.

In the present state of development of the mineral resources, gold is the only metal of importance that is mined. Placer gold has probably been produced since the days of the earliest Spanish fortune hunter. With an instinct for finding the precious metals that was almost uncanny, these early prospectors and their native imitators worked most of the placer ground of the accessible regions. Eastern Nicaragua was an uninviting field for the hardy explorers, and it still remains a difficult country for prospecting, on account of the rank growth of the vegetation and heavy capping of soil, obscuring whatever signs of mineralization may be present on the surface.

Placers were the source of most of the gold produced, until, in recent years, the introduction of modern methods of treatment permitted the profitable working of the medium and low-grade gold-quartz veins of somewhat refractory nature. Most of the gold now produced comes from the operation of a number of small mines working a medium-grade ore. Nearly all of the producing mines are owned by American capital. The

export of gold and silver from Nicaragua, in recent years, is as follows:

Year	Gold	Silver
1916	\$ 938,943	\$ 9,330
1917	925,628	135,469
1918	1,245,484	227,623

The total production of gold is slightly larger than the amount shown in the export figures, as some gold, principally placer, is used locally for the manufacture of jewelry. The export of gold from eastern Nicaragua was, in 1917, \$429,072; in 1918, \$495,761; in 1919, \$680,000 (estimated). The increase in production in 1919 was due to the regular production during the year of the Eden Mining Co., operating in the Pis-Pis district.

GEOLOGY OF THE IMPORTANT DISTRICTS

Eastern Nicaragua, in a large measure, is overlain by a series of volcanic flows, consisting chiefly of andesites and gabbros, probably of Tertiary age. Sedimentary rocks, usually limestone or shale, occur in a number of places in isolated patches and of limited area in extent. However, it is likely that they underlie all of the area covered by the volcanic flows, excepting those occupied by granite intrusions. In no instance were sedimentary rocks observed whose exposures could be traced in any one direction for more than ten to twelve miles. Usually the area exposed was much smaller. Sedimentaries sometimes occur in small blocks or in narrow strips several hundred yards wide and up to several miles in length.

The isolated blocks of sedimentaries apparently are not connected, and represent various horizons stratigraphically. Some of the blocks present a horizontal stratification, which makes them appear as metamorphosed float-blocks, resting on the intrusives, having been detached from the main masses at the time of the intrusion of the porphyries. It is more probable, however, that these seemingly detached blocks represent the re-exposed crests or peaks of sedimentary rocks of the period preceding that of the volcanic flows which buried them. Both limestone and shale occur in the Siuna district and also to the northwest of the Pis-Pis, and again between Tunky and Oconguas, at Monte Carmelo, and on the Zopilote River and other places.

Granite intrusions occur in a number of places. Among the largest areas found are those at Waukiwas and Wawa districts. Another large area is to the north and northwest of the Pis-Pis and Siuna districts. Smaller intrusions of granite were found a few miles southeast of Tunky and at a number of other places.

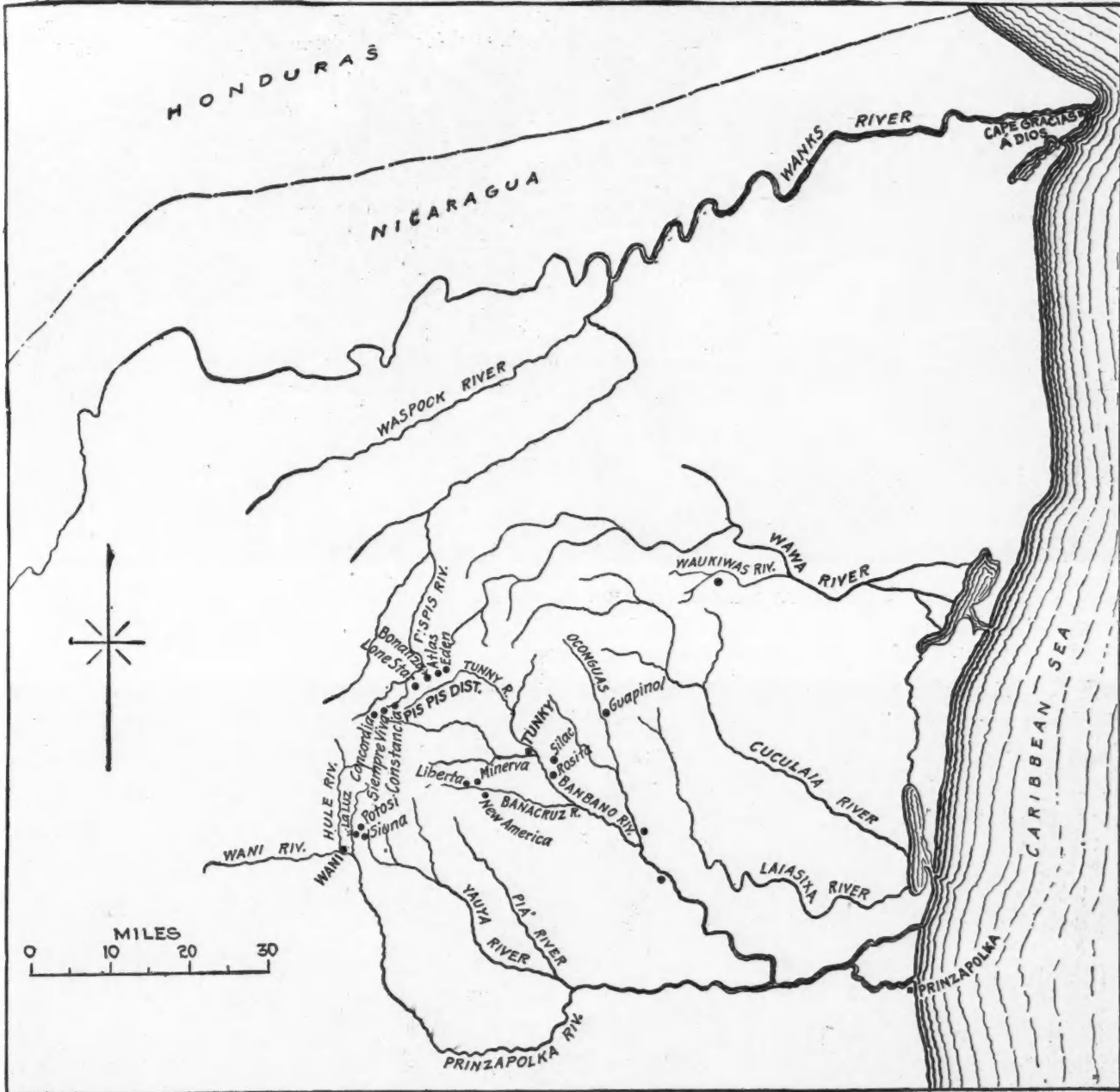
Gold in varying amounts occurs at Waukiwas in the granite. At Siuna a block of sedimentaries has been intruded by a number of dikes of andesite, and the whole mass is more or less mineralized, thus making the block a body of low-grade gold ore, which has been worked for a number of years. Quartz veins are, however, the chief source of gold throughout eastern Nicaragua. They have a wide range of distribution. Their mode of occurrence in the volcanic flows and their general characteristics are similar in nearly all the districts. They are most numerous in the Pis-Pis district, and it is here that they are of greatest commercial importance.

The mineralized area of the Pis-Pis district embraces a strip fifteen miles long and about three miles wide. It is drained by the Pis-Pis, Banbano, and Tunky rivers, tributaries of the Wanks and Prinzapolca rivers. Topo-

graphically this region is rugged, consisting of a series of sharp-crested hills and spurs, alternating with deep gorges. The ridges rise to a maximum height of about 1,800 ft., culminating in the conical-shaped peak known as Wawa, seven miles to the northeast of the district. The latter is about 3,500 ft. in elevation and is the highest peak in the district. The country rock consists principally of augite-andesite, cut by dikes of andesite of a later period and differing slightly in texture and ap-

The veins are the filling of the primary fissures. They are only slightly mineralized, and the gold in them ranges in value from \$3 to \$8 per ton. Only the surface ores of the veins have been mined, as the unoxidized portion is slightly refractory, necessitating fine grinding and cyanidation. Under present conditions and costs this method of treatment would not be profitable on ores of the grade indicated.

The other system of veins represents a filling of sec-

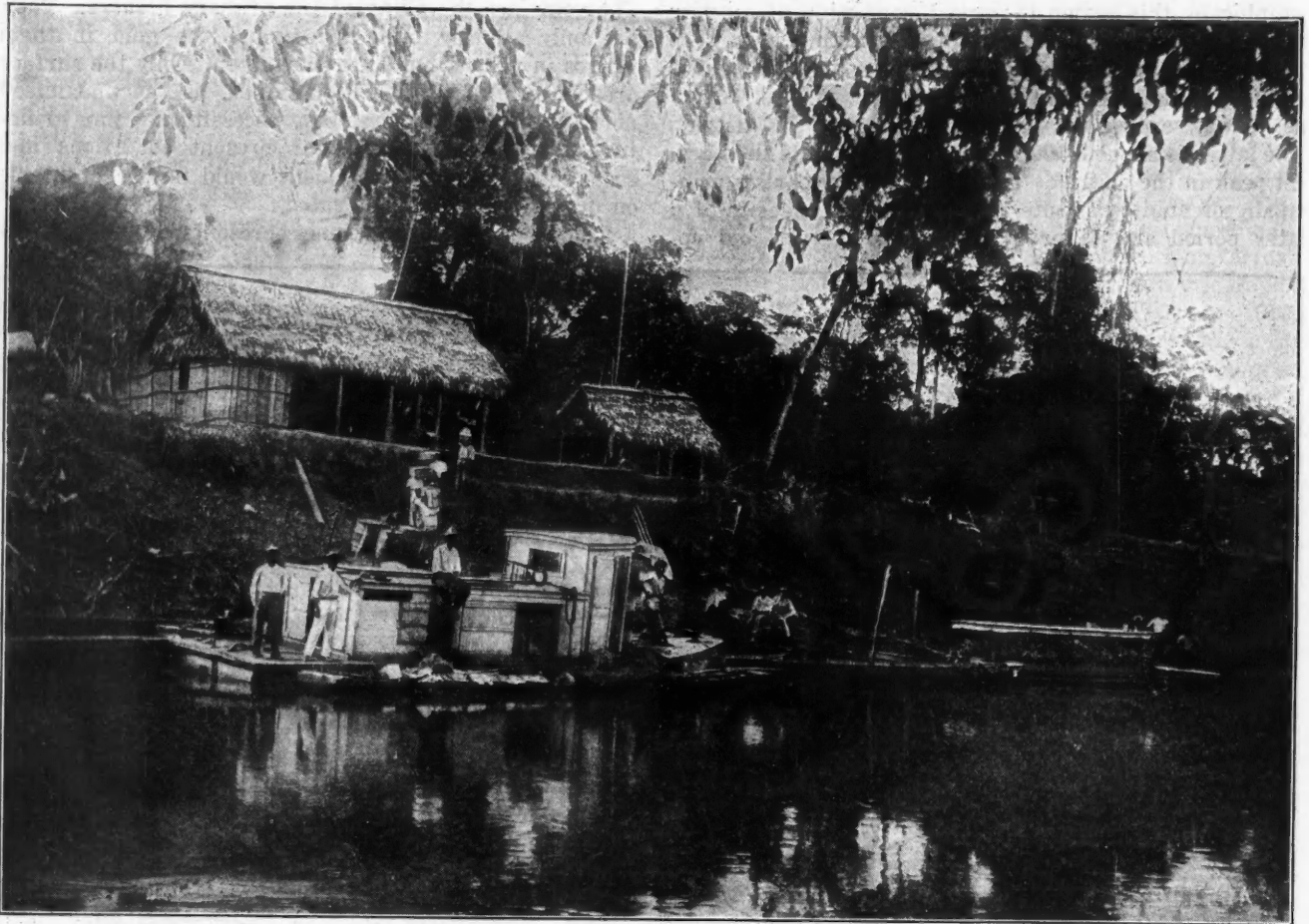


MAP OF EASTERN NICARAGUA

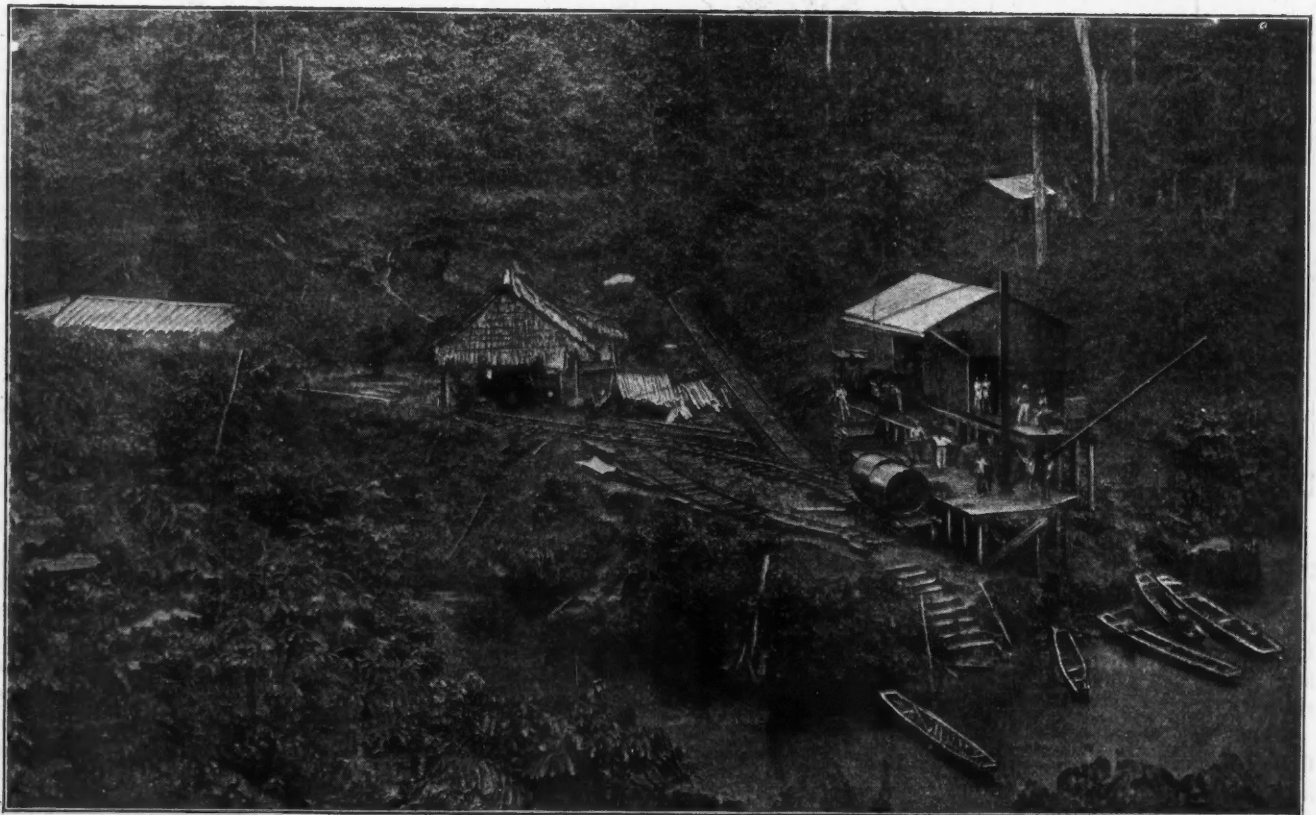
pearance. Toward the northeastern part of the district a more acidic phase of the andesite is found, and still further to the northeast, in the area embraced by Wawa Peak and its foothills, the rocks are reported, by the late Major Cassius E. Gillette, to consist entirely of rhyolite.

There are two systems of veins in the district. The first consists of a series of prominent quartz ledges, averaging from twenty to thirty ft. in width and with a maximum width, in places, of 70 to 78 ft. These can be traced for distances from 2,000 ft. up to two miles.

ondary fissures as compared with the primary fissures. They are probably of a later period, and may be considered to be supplementary to the first. Their mineralization is considerably greater than that of the first group, and the gold content is higher. They are much smaller in size, and are not traceable to a great length. The general direction of the strike of both systems is northeast to southwest. The veins of the second group usually strike at an oblique angle to the larger veins and not at a great distance from them, but so far as known no instance of their intersection has been recorded.



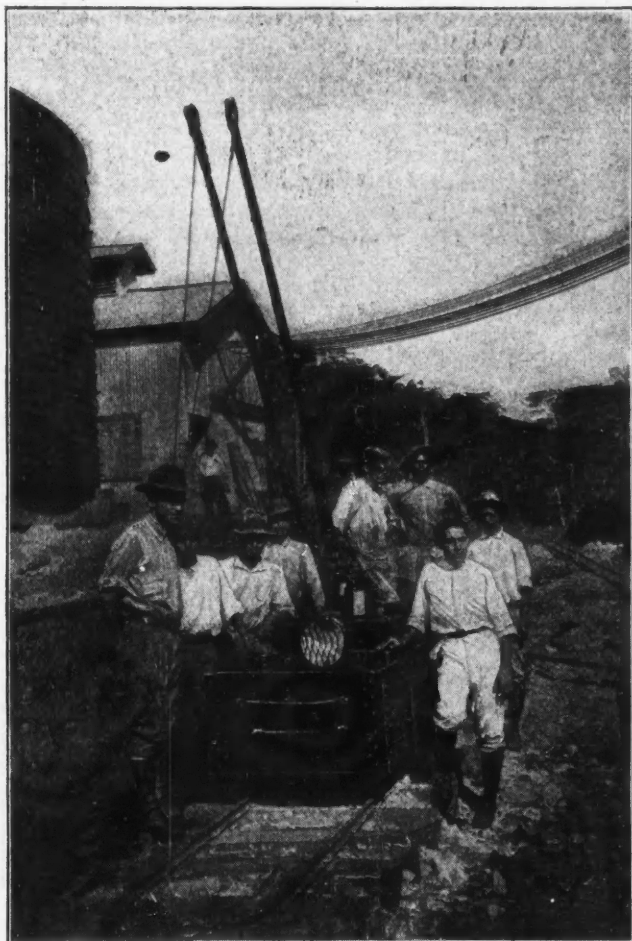
SUPPLY TRANSPORTATION AT YAWALTARA, EDEN MINE



FREIGHT AND SUPPLY TRANSFER AT MIRANDA, EDEN MINE

Most of the large veins are easily traceable. In many places they outcrop boldly, forming cliff-like ridges of quartz, which are a prominent feature of the landscape. Being harder than the inclosing rocks, they weather less readily and therefore form the top of all the main ridges and spurs. With but few exceptions, all the principal ridges as well as the spurs occurring within the mineralized zone contain one or more veins. In one area of about four square miles, no less than twenty-six distinct and separate veins have been found.

The smaller or secondary veins carry a fine-grained hematite and heavy sulphides, consisting of zinc-blende, galena, chalcopyrite, and pyrite. Gold is associated in these veins with the disseminated blende. In some of the veins the sulphides occur in banded structure. The sulphides in the upper zones have been oxidized and



MEMBERS OF ELECTRICAL DEPARTMENT OF THE EDEN MINE

leached. The assays are therefore slightly higher than in the unoxidized portion, but only proportionately to the difference of the specific gravity of the two classes of ore. No secondary enrichment of gold and silver has been observed. Pay ore consists of mineralized wall rock, as well as of the vein filling. Ore occurs in shoots, and the assays are irregular, averaging around \$12 per ton for the whole district for this class of veins.

The larger veins consist of a coarsely crystalline quartz carrying small amounts of disseminated pyrite. The gold is associated with the pyrite. Assays are not uniform in these veins, varying between \$3 and \$8. There are shoots in some of the veins, notably the Vesuvio, Highland Mary, Neptune, Mars, and the Comal,

which contain ore averaging \$6 per ton. The Vesuvio vein of the Constancia mine has a shoot 2,500 ft. in length, averaging \$5.90 per ton. The Neptune has one of almost equal length averaging slightly higher. As a rule, however, the assays of the larger veins are lower, averaging about \$4.50 per ton for the district. The available tonnage of this ore is immense, as may be deduced from the fact that fourteen large veins are known. A few of them have been partly developed, showing a length ranging from 2,000 ft. up to two miles.

GOLD PRODUCTION

Gold from quartz veins has been produced in the Pis-Pis district for about thirty years. The district has a recorded production of from \$12,000,000 to \$14,000,000. Among the largest producers have been the Bonanza, Concordia, Leticia, Constancia, Siempre Viva, Lone Star, and the Eden. Most of the production represents gold obtained from the working of the oxidized portions of the veins and mantos. Excepting the Constancia and Eden mines, mining was carried on by individuals or small stock companies in a haphazard fashion. Having limited capital, only the simplest and cheapest plants were installed, and, therefore, only the oxidized ores could be treated. Light stamps and Huntington mills were used for crushing. The latter proved exceptionally efficient for this ore. At the Bonanza mine, ore was mined and milled, including cyanidation of the tailings, for \$3.50 per ton. However, all the ores amenable to this cheap method of treatment have been exhausted, and the cost of mining and milling the sulphide ores is much greater.

Besides the Pis-Pis district, the Siuna, Oconguas, Wawa, Siquia, and the Indian River districts have produced considerable gold. Among the largest individual producers in these districts are the La Luz and Los Angeles, Potosi, Guapinol, Topaz, and others. Of these the La Luz mine is the only one now operating. In these districts, as is the case in the Pis-Pis, only the oxidized portions of the veins have been worked.

In addition to the producing mines, there are a number of promising properties that lack only equipment to put them in the producing class. Of the more prominent are the America mine, in the Bana Cruz district, and the Oro Fino and Guapinol, in Oconguas. The America has about 40,000 tons of \$12 ore blocked out. During the last few years there has been a tendency in the Pis-Pis district toward consolidation of groups of the smaller mines. Recently Philadelphia capital has acquired control of the Concordia, Lone Star, and the Bonanza groups of mines. The company is the Nicaraguan Mines Co. This practically completes the consolidation of all producers into three operating companies, the Eden and the Constancia Consolidated being the other two.

The Eden Mining Co., a subsidiary of the Tonopah Mining Co., bought a mining area of nine square miles from the Panama Mining Co., together with properties of the Morning Star and Mars mines. On the properties no less than thirty veins are known. Of these, the Eden, Culebra, Hidden Treasure, Philadelphia, and Morning Star are second-group veins, containing a higher grade of ore and averaging about \$12 per ton. Under present operating conditions only ore of the second group of veins can be profitably treated.

The company introduced modern methods of mining and milling, and was the first to treat successfully the

unoxidized ores of the district. It has now in operation a modern mill and cyanide plant of about 140 tons' capacity and a hydro-electric plant of 1,000 hp. Work was started in 1915, but the mine did not produce regularly until the end of 1918, when construction work was completed. Because of delays occasioned by the war, litigation and other causes, some of them avoidable, construction costs were excessive.

The Constancia Consolidated, comprising the Constancia and Siempre Viva groups, is next in importance. With a somewhat smaller equipment than the Eden, the mine handles about 100 tons per day. The ore treated is similar to that of the Eden and is of about the same value.

The Rosita disseminated copper deposit was developed

Bana Cruz, Waukiwas, Wawa, and several points in the vicinity of the Rosita deposit.

Iron ores occur in massive lenticular bodies in andesite and ferro-magnesian rocks, usually near the contact of these with sedimentary rocks. The orebodies consist of a series of lenses, very hard and massive in structure. They vary in extent from a half acre to ten acres. The belt along which the outcrops occur has been traced for about forty miles, extending from a point directly east of Pis-Pis in a southeasterly direction to the low country of the Sangsangwas River. Lenses or veins, the latter consisting of specular hematite, were observed near Tunky, north and northeast of the Rosita mine, at the mouth of the Oconguas River and on the Sangsangwas River.



MILL AND CYANIDE PLANT, EDEN MINE

by the Tonopah Mining Co. in 1917 and 1918. The mine is situated upon the Banbano River, about six miles from Tunky. The ore deposit is in the form of a steep mound, several hundred feet in height. It consists of an acid porphyry intrusion, carrying disseminated pyrite and chalcopryite, in andesite. Gold occurs associated with the sulphides.

In places the surface shows an iron capping stained with copper carbonates. The deposit carries zones of secondary enrichment containing a copper up to 10 per cent and assaying in gold high enough to have caused the zones to be worked in the past for the gold content alone. One and a quarter million tons of ore have been developed by churn drilling. The ore assays over 5 per cent in copper and contains a small amount of gold. Other copper prospects, both veins and disseminated orebodies, have been discovered in

Close to the Rosita mine the outcrops are of a sufficient size to be of commercial importance. The ore is low in phosphorus, the iron content being about 65 per cent. As the ore is harder than the inclosing rocks, it outcrops boldly, forming the crest of rather steep hills. There is practically no overburden present, and therefore the limits of the orebody on the surface are clearly discernible. Four of the larger bodies, all in close proximity to each other, have an estimated tonnage of about 25,000,000. The total amount of iron ore likely to be found in the belt cannot be estimated without extensive exploratory work.

Nicaragua, like most of Central America, has no primeval forests. Trees are of comparatively recent growth. Numerous evidences tend to prove this. In the vicinity of mines many kinds of hard woods are found. In fact, although the variety is large, the

available supply is not. However, timber sufficient for mining and construction purposes may be had free on government lands. The most commonly used woods are the Santa Maria, binbanyank, ironwood, zapotilla, nispero, and a few remaining mahogany and cedars.

In many of the districts a lack of cheap power has been one of the principal obstacles to the successful operation of the mines. The supply of wood is inadequate to permit of its use for fuel. Excepting in the Pis-Pis district, waterfalls are not near enough to the mines to make their power available for use to the small operators. The rainfall is heavy, averaging 120 in. per year. Streams are numerous, and, in their upper courses, falls and rapids are of frequent occurrence. The number of power sites available within a range of perhaps twenty-five miles of any mining district is sufficient to supply all the power likely to be required.

Labor is plentiful and cheap. Even allowing for the lower efficiency, it is cheaper here than it is in the United States. Miners receive from \$1.60 to \$2 per day, mechanics a slightly higher wage, and common labor receives \$1.30 per day. The latter are usually Mosquito Indians. The miners are Indo-Spanish, and the skilled mechanics West Indian negroes. Wages have advanced to some extent during the last few years, but the increase has only been equal to the amount of the increased cost of food per day per man.

TRANSPORTATION

Railroads and roads are conspicuous by their absence. The only wheeled vehicles on the east coast of Nicaragua are the two-wheeled carts seen on the streets of Bluefields. As previously mentioned, the rivers are the natural means of general transportation and communication. Locally, at the mines, freight is transported by mules or pack oxen. Two hundred pounds is the average load per animal. Heavy pieces of freight are dragged on mud sleighs. The trails in the dry season are passable, but in the wet season they can be traveled over safely only by amphibians. In the level stretches, the trails get in a condition that resembles pea soup—too thick to make them navigable and too thin to support animals with a load. Freight charges from New Orleans to the mines in the Pis-Pis district are from \$120 to \$140 per ton for ordinary supplies, and higher for heavy pieces. Gasoline towboats are used on the rivers up to the head of navigation, from which point the freight is poled in bateaux by Indians.

MINING LAWS

The mining laws of the country are excellent. The interpretation of them by some of the local mining judges leaves something to be desired. Taxes are moderate, and are of two kinds, pertenencia tax and capital tax. On gold it is necessary to pay an export tax. The capital tax is a late innovation, and was introduced by the American financial advisors. As is well known, the finances of the country are being administered, more or less benevolently, by American bankers. Mining machinery pays no duties, and all mining supplies are admitted duty free. The government generally favors the exploitation of mines, and is particularly friendly toward American capital. The government grants no concessions, but special contracts may be entered into with it. Coal and petroleum can be exploited only under a special contract.

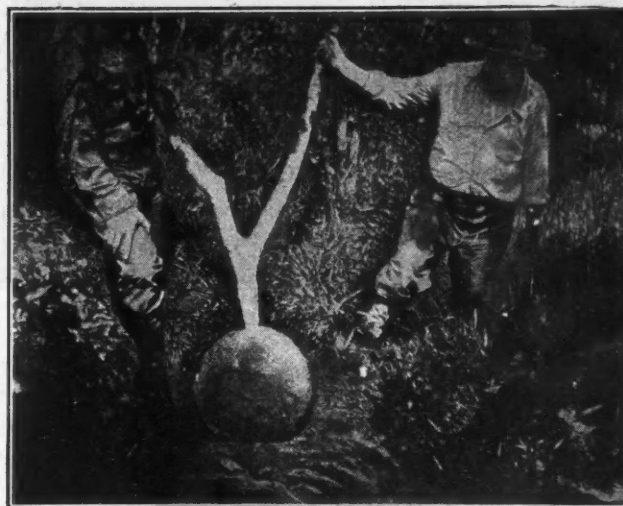
The lack of a cheap and efficient means of transportation is the only hindrance to the successful exploita-

tion of the copper, iron, and the low-grade gold deposits of eastern Nicaragua. The mines are situated from 40 to 110 miles in an air line from the coast. The country to be traversed is rich in agricultural possibilities. It is, therefore, hard to explain just why no railroad has been built to them. Gold mining on a large scale in the Pis-Pis district and elsewhere has great possibilities, but it would be folly to undertake large-scale enterprises without a railroad from the nearest harbor to the center of operation. The necessity for a railroad makes itself felt particularly during the construction period. The length of time required for construction, without railroad facilities, and the excessive freight charges, would make the initial cost of a large-sized plant prohibitive.

With a railroad it is probable that the primary veins of the district containing ore slightly above the average could be profitably worked. However, I do not think that the present method of ore treatment can be applied to the low-grade ores. The high consumption of cyanide and the excessive cost of fine grinding, due to high power consumption and comparatively low tonnage handled, are the principal difficulties. A modified method, involving moderately fine grinding, concentration and the cyanidation of the concentrates, may prove cheaper, but it is more likely that oil flotation will be the cheapest and best suited for this ore. With a railroad, it is also probable that the oil-flotation treatment of the higher grade of sulphides will lower milling costs. The principal hope for future dividends by the companies now operating in eastern Nicaragua lies in their ability to work the large orebodies profitably. This can only be done by first constructing a railroad and the initiation of large-scale operations.

Ore Reduction in Nicaragua

At first sight one might think that the accompanying photograph illustrates some form of divining rod which has just discovered a meteorite. It is in fact, however, a primitive two man-power mill, something on the order of an arrastre, for grinding rich quartz



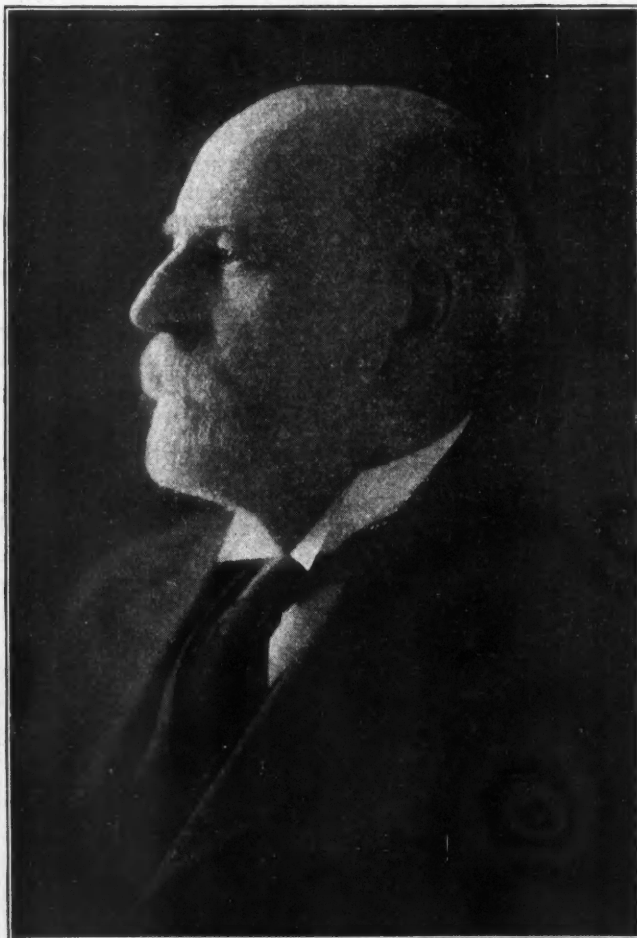
ores, probably in the presence of quicksilver. A hole was cut in the boulder, in which was fitted a forked branch. The boulder was then revolved in a rock depression in which it fitted, by two men chasing each other around in a circle. The relic was discovered by J. E. Spurr in Nicaragua.

The Economic Geology of Brazil

A Review by Benjamin L. Miller of an Important Paper Published by Dr. J. C. Branner in Bulletin 30 of the Geological Society of America—Dr. Branner's Areal Map Is Reproduced

Written exclusively for *Engineering and Mining Journal*

GEOLGY knows no national boundaries, nor do geologists confine their investigations to their own countries. In many instances, even in the European countries, foreign geologists have furnished the most valuable contributions. It is therefore not surprising to those familiar with geologic literature to learn that the most important geologic article and map of Brazil thus far published are by a North American.



J. C. BRANNER

Dr. John Casper Branner, president emeritus of Leland Stanford Junior University, a geologist of international reputation, and the foremost living authority on the geology of Brazil, has just published a geologic map of Brazil (scale 1 : 5,000,000) with a 150-page article entitled "Outlines of the Geology of Brazil to Accompany the Geologic Map of Brazil," in Vol. 30 of the Bulletin of the Geological Society of America. The basis and objects of the publication are stated by Dr. Branner in the opening paragraphs:

"The accumulation of the data for a geologic map of Brazil was begun by me in 1874, when I first went to

that country, and has been kept up, as opportunities offered, down to the present time. The gathering and study of the material and the preparation of the map may therefore be said to represent the work of a considerable portion of a lifetime.

"The data brought together on the map and in the accompanying text are published by the Geological Society of America primarily as a contribution to the world's knowledge of the geology of America; but, so far as I am concerned, it is meant especially to be of service to the Brazilian people, among whom I have spent many years, to whom I am strongly attached, and in whose welfare I am deeply interested."

COMPREHENSIVENESS OF THE WORK

The map and text bring together in usable form a summary of the available geologic data of that great country. To one unacquainted with the physical characteristics of Brazil and the numerous obstacles that confront the geologist there, it may be disappointing to note extensive vacant areas such as those in Matto Grosso, Goyaz, and Paraná, but to students of South American geology it is a surprise to learn that there are not more gaps. It is reasonable to say that Dr. Branner has overlooked few sources of reliable information. To his own extensive observations he has added those of the geologists and travelers of many countries.

To make the work useful for those geologists who may wish further details, each state description includes a brief bibliography, as well as a description of sources of the information used in the compilation of the map. The lithologic and economic products of each geologic period are first given, followed by descriptions of each of the twenty-one states.

A map such as this will do much to promote further geologic research and stimulate the development of the undeveloped mineral resources of Brazil. Any mining engineer or geologist who goes to that great Southern Republic should take a copy of this valuable publication with him. It is especially timely on account of the increasing interest in Brazil, and is a worthy companion to Dr. Branner's exhaustive "Bibliography of the Geology, Mineralogy, and Paleontology of Brazil," published in Vol. 20, pp. 1-132, of the Bulletin of the Geological Society of America. With the aid of these two publications it is comparatively easy for a geologist or mining engineer to familiarize himself with Brazilian geology.

GEOLOGICAL FORMATIONS REPRESENTED IN BRAZIL

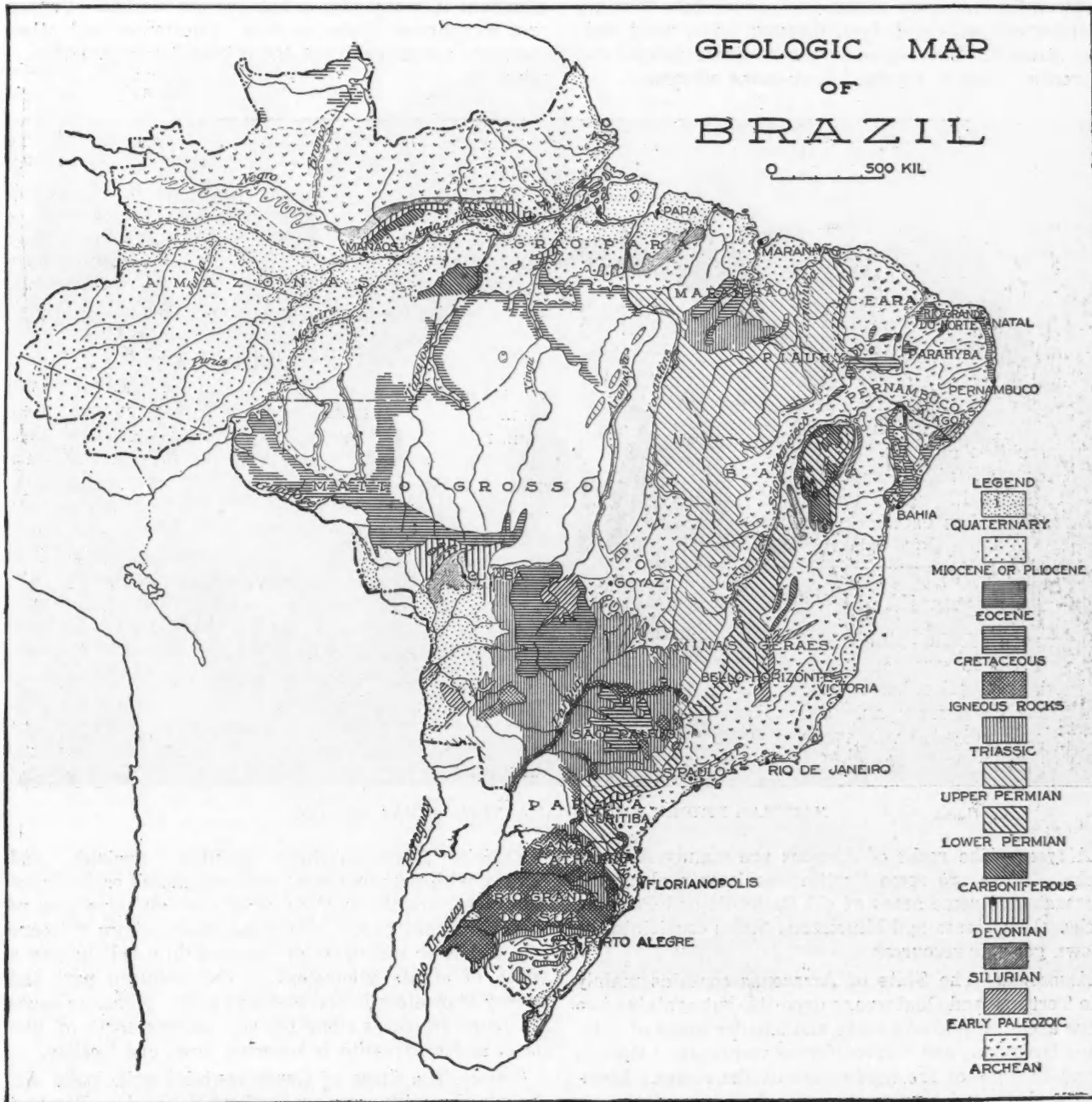
Archean Rocks—The Archean rocks of Brazil include gneisses, quartzites, marbles, and crystalline schists, with pegmatites and dike rocks. These rocks contain deposits of gold, copper, platinum and tungsten ores and mica, marble, talc, apatite, graphite, potash-bearing

minerals, precious stones, and excellent building stones, and are the original source of monazite.

Early Paleozoic Rocks—The Early Paleozoic, mainly undifferentiated, is made up principally of quartzites, schists, itacolumites, marbles, itabirites, and some unmetamorphosed sediments. They contain gold ores in the form of lodes, such as are now worked, and they were the source of the gold in the old placer districts. They also include the great iron and manganese deposits of Minas Geraes and Bahia.

Carboniferous Rocks—The Carboniferous period is represented by quartzites, conglomerates, sandstones, shales, and limestones. The diamonds and carbonados of Bahia and northern Minas Geraes are believed to have been derived from strata of Carboniferous age.

Permian Rocks—The Permian period, which, in Brazil, is unusually well represented and readily divisible into Upper and Lower Permian beds, comprises sandstones, shales, limestones, and glacial till, intruded by eruptive dikes in many places. The economic products



Silurian Rocks—The Silurian strata consists of marine sediments, mainly thin-bedded fossiliferous sandstones.

Devonian Rocks—The strata of Devonian age include conglomerates, sandstones, and shales, in places cut by diabase dikes. They are the supposed source of the diamonds of Paraná. They contain shales used in the manufacture of portland cement.

include the coal beds of Paraná, Santa Catharina, and Rio Grande do Sul, bituminous shales, and limestones suitable for the manufacture of portland cement.

Triassic Rocks—The Triassic rocks are mainly reddish sandstones with a maximum thickness of 500 meters or more.

Cretaceous Rocks—The Cretaceous strata consist of limestones and sandstones. The materials of economic

importance are mainly limestones suitable for building purposes and for the manufacture of lime or portland cement.

Tertiary Rocks—The Tertiary rocks consist of fresh, brackish-water, and marine sediments. They contain some lignites, bituminous shales, and clays.

Quaternary Rocks—The Quaternary sediments consist mainly of alluvial materials.

RÉSUMÉ OF THE GEOLOGICAL FEATURES OF THE BRAZILIAN STATES

Acre—The territory of Acre comprises Late Tertiary undisturbed sands and clays, through which wind sluggish streams. The region is one of dense forests and no roads. Gold is reported from some streams.

sands, manganese, bituminous shales, limestones, and pottery clays. Nitrate of potash has been obtained from cave deposits, and salt has been leached from the earth of old lake beds. The undeveloped mineral resources consist of marbles, iron and copper ores, mica, talc, graphite, grindstones, whetstones, and limestones and clays suitable for the manufacture of portland cement.

Ceará—The Ceará strata consists mainly of Archean granites, gneisses, and schists, but with some Permian, Cretaceous, Tertiary, and Quaternary sediments. Gold has been placed in several places. Iron ores are abundant in many places, but are not worked. Copper ore, bituminous shale, marbles, limestones, and other minerals are known, but their importance is undetermined.



NATURAL BRIDGE NEAR DIAMANTINA, MINAS GERAES

Alagoas—The rocks of Alagoas are mainly Archean rocks. There are some Tertiary sediments along the seacoast, and some areas of old Paleozoic and Permian rocks. Limestones and bituminous shales constitute the known geologic resources.

Amazonas—The State of Amazonas contains mainly late Tertiary and Quaternary deposits, but contains two large areas of Archean rocks and smaller areas of Silurian, Devonian, and Carboniferous sediments. Gold is found in some of the headwaters of the rivers. Limestones, clays, and granites are abundant in various portions. Lignites seem to be widespread in the western portion of the state. Analyses show 33 per cent fixed carbon, 39 per cent volatile hydrocarbons, and 15 per cent ash.

Bahia—The State of Bahia is composed mainly of Archean and metamorphic Early Paleozoic rocks, but with some Late Paleozoic, Cretaceous, and Tertiary sediments. The economic minerals and rocks that have been worked are gold, diamonds, carbonados, amethysts,

Espirito Santo—Archean granites, gneisses, and schists, with probably some metamorphosed early Paleozoic rocks, are the surface rocks over all the states of Espirito Santo except along the coast, where Pliocene (?) and later sediments are present in a belt having a width of eighty kilometers in the northern part and twenty kilometers in the southern part. Monazite sands are found in places along the sea beaches north of Victoria, and wolframite is reported from one locality.

Goyaz—The State of Goyaz contains principally Archean rocks, with some areas of old Paleozoics. Permian rocks are present in the northeast portion, and Triassic and Cretaceous strata in the southwest part of the state. Goyaz has produced large amounts of placer gold derived from the Archean schists, and considerable quantities of diamonds and other precious stones. Important deposits of iron ore are present in several places, and bituminous and gypsiferous shales are reported along the Tocantins River.

Maranhão—Some Archean rocks are exposed along

several rivers of Maranhão. Permian sandstones and shales are the surface rocks over about half the state, but with large areas of Triassic, Cretaceous, and Tertiary sediments. Some gold has been obtained, and bauxite, bituminous shales, iron ore, and limestones have been reported from different localities.

Matto Grosso—Little is known of the geology of Matto Grosso, the largest state of Brazil. There seem to be extensive areas of Permian, Triassic, and Cretaceous rocks, with smaller areas of Devonian, early Paleozoic, and Archean rocks. Placer gold and diamonds have been obtained from a number of the streams, and impor-



MARKET SCENE IN BRAZIL. NATIVE POTTERY DISPLAYED FOR SALE

tant deposits of manganese and iron ores resembling those of Minas Geraes are found at Urucum, in the southern portion of the state.

Minas Geraes—The geology of Minas Geraes is not well understood. The Archean rocks, including many metamorphosed early Paleozoic strata, cover about half the state. The Paleozoic metamorphics are faulted in the Archean rocks, and in many places appear as parallel ridges or mountains because of their greater resistance to erosion. There are large areas of Permian rocks in the western portion of the state, and several smaller areas of Carboniferous, Triassic, and Tertiary sediments. The following brief account is quoted from Dr. Branner's article:

"Minas Geraes is the chief mining state of Brazil. It has an unusually large number of minerals of economic importance, though only gold, manganese, iron, and diamonds have ever been extensively worked. It was in Minas that gold was first discovered in Brazil, about 1693, and the earliest mining done in that country was for gold in what is now that state. For some years Brazil was the leading gold-producing country of the world. Though there have been and still are a few notable rock mines in the old Paleozoic series where the gold originated, most of the gold of Brazil has come from placer deposits.

"The manganese deposits of Minas first attracted attention in 1893, and in 1894, 1,430 tons of the ore was exported, and since 1896 that state has been one of the great manganese-producing regions of the world. The ores occur at two horizons—in the Archean complex and in the early Paleozoic series of rocks. The mines worked are in the vicinity of Lafayette, in the Archean, and at Miguel Burnier, on the Central Ry., in the Paleozoic. Later discoveries have been made on the properties of the Saint John del Rey Mining Co. at Capitão do Matto and Cachoeirinha, near Morro Velho.

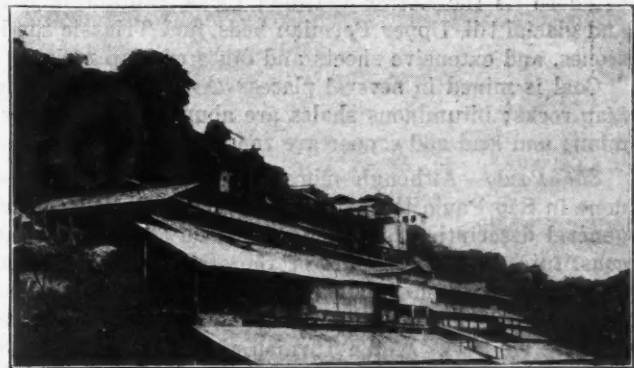
"The iron deposits of Minas have long been known, but only within a few years have they attracted the attention to which they are justly entitled. They are probably the most important iron ores known, though they are as yet but little used. The iron ores are in sedimentary rocks, either in the forming parts of the early Paleozoic rocks, or they are later deposits derived therefrom."

In addition, the following economic products have been found in various places, but remain practically undeveloped: nickel ore, platinum, marbles and limestones, asbestos, talc, mica, niter, graphite, bauxite, phenacite, and bituminous shales. The mineral waters are also of considerable economic importance.

Pará—The lower course of the Amazon flows across the State of Pará in a synclinal trough. Archean rocks are found in the north and south portions of the state, and Paleozoic, Tertiary, and Quaternary rocks occupy the inner portions of the syncline. Some gold has been obtained from the streams that flow directly into the ocean from the crystalline rocks of the northeastern portion, but comparatively little is known of the economic geology of the state.

Parahyba—With the exception of a narrow band of Cretaceous and Tertiary sediments bordering the ocean, and a small area in the western portion, practically the entire State of Parahyba is made up of crystalline rocks of the Brazilian complex, consisting of schists, gneisses, and granites. Gold-bearing quartz veins have been worked in these rocks, but no mines are now in operation. Iron ore deposits are reported, but information concerning them is lacking. Some limestone from the Cretaceous has been quarried, and marble of the crystalline area has been locally quarried for lime.

Paraná—The geology of Paraná is simple. The Archean rocks constitute the eastern portion of the state, and are succeeded westward by early Paleozoic crystallines (called, by Oliveira, the Devonian complex),



PART OF THE CONCENTRATION MILL OF THE AURO PRETO GOLD MINES OF BRAZIL, LTD.

Devonian unmetamorphosed sediments, Lower Permian, Upper Permian and Triassic strata, the latter intruded by sheets and dikes of intrusive rocks. Coal is present in the Upper Permian rocks of the northern portion of the state; diamonds have been mined along some of the streams of the Devonian area; molybdenum is said to occur in the Archean rocks; asphalt veins and bituminous shales are present in the Upper Permian; and limestones are known in many localities.

Pernambuco—Rocks of Archean age cover most of the State of Pernambuco. A band of Tertiary sediments

importance are mainly limestones suitable for building purposes and for the manufacture of lime or portland cement.

Tertiary Rocks—The Tertiary rocks consist of fresh, brackish-water, and marine sediments. They contain some lignites, bituminous shales, and clays.

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Minas Geraes—The geology of Minas Geraes is not well understood. The Archean rocks, including many metamorphosed early Paleozoic strata, cover about half the state. The Paleozoic metamorphics are infaulted in the Archean rocks, and in many places appear as parallel ridges or mountains because of their greater resistance to erosion. There are large areas of Permian rocks in the western portion of the state, and several smaller areas of Carboniferous, Triassic, and Tertiary sediments. The following brief account is quoted from Dr. Branner's article:

"Minas Geraes is the chief mining state of Brazil. It has an unusually large number of minerals of economic importance, though only gold, manganese, iron, and diamonds have ever been extensively worked. It was in Minas that gold was first discovered in Brazil, about 1693, and the earliest mining done in that country was for gold in what is now that state. For some years Brazil was the leading gold-producing country of the world. Though there have been and still are a few notable rock mines in the old Paleozoic series where the gold originated, most of the gold of Brazil has come from placer deposits.

"The manganese deposits of Minas first attracted attention in 1893, and in 1894, 1,430 tons of the ore was exported, and since 1896 that state has been one of the great manganese-producing regions of the world. The ores occur at two horizons—in the Archean complex and in the early Paleozoic series of rocks. The mines worked are in the vicinity of Lafayette, in the Archean, and at Miguel Burnier, on the Central Ry., in the Paleozoic. Later discoveries have been made on the properties of the Saint John del Rey Mining Co. at Capitão do Matto and Cachoeirinha, near Morro Velho.

"The iron deposits of Minas have long been known, but only within a few years have they attracted the attention to which they are justly entitled. They are probably the most important iron ores known, though they are as yet but little used. The iron ores are in sedimentary rocks, either in the forming parts of the early Paleozoic rocks, or they are later deposits derived therefrom."

In addition, the following economic products have been found in various places, but remain practically undeveloped: nickel ore, platinum, marbles and limestones, asbestos, talc, mica, niter, graphite, bauxite, phenacite, and bituminous shales. The mineral waters are also of considerable economic importance.

Pará—The lower course of the Amazon flows across the State of Pará in a synclinal trough. Archean rocks are found in the north and south portions of the state, and Paleozoic, Tertiary, and Quaternary rocks occupy the inner portions of the syncline. Some gold has been obtained from the streams that flow directly into the ocean from the crystalline rocks of the northeastern portion, but comparatively little is known of the economic geology of the state.

Parahyba—With the exception of a narrow band of Cretaceous and Tertiary sediments bordering the ocean, and a small area in the western portion, practically the entire State of Parahyba is made up of crystalline rocks of the Brazilian complex, consisting of schists, gneisses, and granites. Gold-bearing quartz veins have been worked in these rocks, but no mines are now in operation. Iron ore deposits are reported, but information concerning them is lacking. Some limestone from the Cretaceous has been quarried, and marble of the crystalline area has been locally quarried for lime.

Paraná—The geology of Paraná is simple. The Archean rocks constitute the eastern portion of the state, and are succeeded westward by early Paleozoic crystallines (called, by Oliveira, the Devonian complex),



PART OF THE CONCENTRATION MILL OF THE AURO PRETO GOLD MINES OF BRAZIL, LTD.

Devonian unmetamorphosed sediments, Lower Permian, Upper Permian and Triassic strata, the latter intruded by sheets and dikes of intrusive rocks. Coal is present in the Upper Permian rocks of the northern portion of the state; diamonds have been mined along some of the streams of the Devonian area; molybdenum is said to occur in the Archean rocks; asphalt veins and bituminous shales are present in the Upper Permian; and limestones are known in many localities.

Pernambuco—Rocks of Archean age cover most of the State of Pernambuco. A band of Tertiary sediments

borders the coast, and small areas of Paleozoic, upper Permian, and Cretaceous rocks are known. The known economic materials consist of marbles and limestones, employed both for building purposes and for lime, sandstones, rhyolites, and phonolites used for building and paving purposes, and some salt and saltpeter obtained as efflorescences from porous sandstones.

Piauí—Permian strata constitute most of the State of Piauí, with a few areas of Archean and Cretaceous rocks. It is an agricultural state, and no minerals are worked. Iron ore of excellent quality has been reported, but nothing is now known of the quantity.

Rio de Janeiro—Archean rocks cover all of the state except a narrow belt of Tertiary and Quaternary sediments on the coast and some isolated patches of Tertiary lake deposits in the valley of the Parahyba. The economic geologic products are chiefly building stones and clays.

Rio Grande do Norte—The rocks of the State of Rio Grande do Norte consist mainly of Archean crystallines, with a coastal band of Cretaceous and Tertiary sediments. Clays and glass sands are abundant in the coastal belt, and mica and asbestos are reported from the Archean area.

Rio Grande do Sul—Tertiary and Quaternary sediments constitute the coastal belt, back of which is a band of the Archean crystalline rocks. West of this band are Permian and Triassic strata. The middle and western portions are covered with pre-Cretaceous trap rocks resting on the Triassic beds.

Coal of Lower Permian age is the principal mineral product. Copper and gold have been mined in the region of the older Paleozoic rocks. The state has also furnished many agates derived from the trap rocks. Magnesite, zinc, and molybdenum have been reported. Marble is said to occur in several places.

Santa Catharina—Archean rocks border the coast and constitute the eastern part of the Serra do Mar. West of these lie the Lower Permian rocks, containing coal and glacial till, Upper Permian beds, and Triassic sandstones, and extensive sheets and dikes of trap rocks.

Coal is mined in several places. Agates occur in the trap rocks; bituminous shales are abundant in the Permian; and lead and copper are reported.

São Paulo—Although more geologic work has been done in São Paulo than in any other state of Brazil, no general description has been published. Archean rocks constitute the eastern part of the state, with Permian, Triassic, Cretaceous, and Tertiary sediments in the central and western portions. There are extensive areas of eruptive rocks which furnish the extremely fertile red soils.

The economic geologic products are iron, marble, bituminous shales, building stones, limestones, and ceramic clays. The Ipanema iron ore deposits about a hundred kilometers west of the city of São Paulo furnished the first iron manufactured in Brazil. The iron industry has not been successful, however. Some of the bituminous shales have been used for the manufacture of gas. The marbles have been quarried in several places.

Sergipe—The small State of Sergipe contains rocks belonging to the Archean, Paleozoic, Mesozoic and Cenozoic eras, a greater variety than that found in most of the other states. The economic geologic products seem to consist of limestones and clays.

In the concluding pages of the report Dr. Branner

includes a brief résumé of the principal mineral resources of the different states, which is valuable although not exhaustive. He also gives lists of writers who have described the various occurrences. Some of the principal travel books in Brazil are listed, as well as a few good works on the climate.

The Superlative Degree

Shorty Jones and Slippery Kelly, alias "Remuda Joe," found border vigilance bad for their business, so they moved down to southwest Chihuahua. Posing as technical experts, they were employed on salary and commission basis by a Villista general, who changed politics long enough to acquire a silver mine. After "dressing" the mine in a loving manner for a few months, Shorty and pal thought it was time to flag some capitalist and cash in; so they wrote a glowing description of the property and added a rough assay plan, sketched on "Palacio de Carranza" stationary for convenience in blueprinting. A reply from New York offered encouragement, requesting that complete reports and maps be submitted, each signed by a duly-qualified E.M. Upon receipt of this, Shorty was worried. "I know that M.E. means mining engineer, mining expert, or Methodist Episcopal; but I'm just plain R.C. Does this here E.M. mean experienced miner, or what? Let's look in these here dictionaries Ramon swiped last trip." In *Appleton's New Spanish-English and English-Spanish Dictionary*, 1916, page 584, they found "E. M. Estado, Mayor," which seemed to fit their employer. In *Webster's New International Dictionary*, 1919, page 713, a footnote indicated "E.M. Abbr. Earl Marshal; electromotive; *Equitum Magister* (L., Master of the Horse)." The first item was negated on the ground that Marshall had gone to British Columbia; the second item seemed inappropriate; but, when the Latin of the third item was elucidated, Slippery brought down his fist with a bang. "That's me, with bells on." So in due time there reposed on the desk of the broker-promoter a report in Spanish, signed by General Ramon Guarache, E.M.; and a similar optimistic recital of possibilities, typed in English above the signature of J. Quantrell Kelly, E.M.

Michigan Tunnel Driving Record

In the article "Breaking the Michigan Record in Tunnel Driving," which appears on page 698 of the March 20 issue of *Engineering and Mining Journal*, the sentence on the last line of the first paragraph reads, "This betters a previous record of 348 ft. in 42 hours." This should properly have read, "This betters a previous record of 348 ft. in 342 hours." The figure 342 was the one furnished by the author of the article.

An International Power Plant, to be erected on the Uruguay River by Argentina, Brazil, and Uruguay jointly, with guarantees for the equitable distribution of power to the three countries concerned, has been proposed, according to the Bureau of Foreign and Domestic Commerce. On the site being considered it is calculated that 2,500,000,000 kilowatt hours per annum could be developed, or an energy equivalent to that of 3,000,000 tons of coal. The project contemplates the construction of two dams, one movable and one fixed, with canals to the power plant. It will utilize a fall of 77 ft. The installation would also open for navigation 419 miles of river which today is inaccessible, and would permit the inundation of adjoining zones which are suitable for agriculture.

Progress in Powdered Coal For Blast Furnaces

Midvale Lead Smelter Using the System, and Other Companies Interested—New Safety Vortex Tuyere Being Developed

By W. L. WOTHERSPOON

General Manager, Garred-Cavers Corporation, New York

Written exclusively for *Engineering and Mining Journal*

THE early experiments with the use of pulverized coal in blast-furnace smelting, conducted by the Tennessee Copper Co. and the International Nickel Co., were described in *Engineering and Mining Journal* of Aug. 16, 1919, and in the Oct. 4 issue figures were published showing comparative tests on two furnaces at the Copper Cliff smelter, with about 50 per cent of

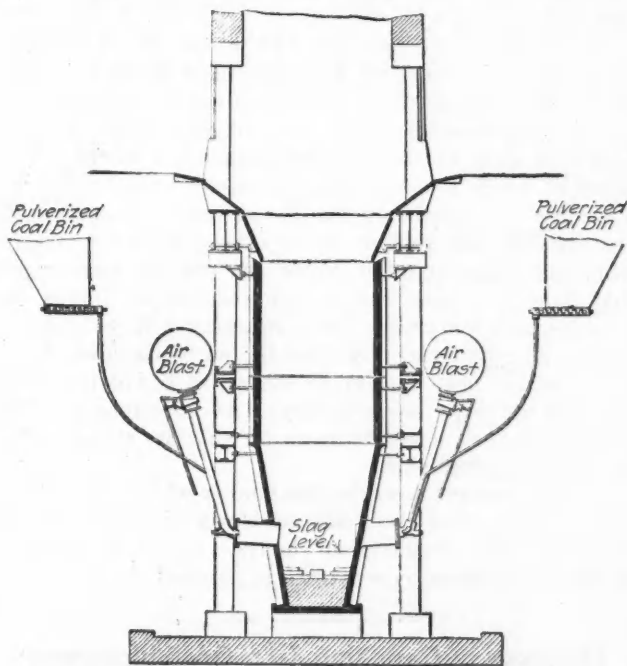


FIG. 1. ARRANGEMENT OF PULVERIZED-COAL FIRING FOR A BLAST FURNACE

the coke replaced by pulverized coal. These latter indicated a possible saving of about 25c. per ton of ore smelted.

Following this work experiments were carried out through W. J. Hamilton, consulting engineer of the Cerro de Pasco Copper Corporation, at that company's smelter in Peru, with results that showed the practicability of replacing about 50 per cent of the coke with an equivalent quantity of coal. This company has now in progress the construction of plant equipment, in order to apply the process.

The work referred to in the foregoing relates to the smelting of copper and copper-nickel ores. More recently the process has been used in a standard blast furnace at the Midvale smelter of the United States Smelting, Refining & Mining Co., in connection with lead ores. E. H. Hamilton, who is an enthusiastic supporter regarding the practicability of the process, should be given credit for the pioneer work done at Midvale. Tests have now been carried on continuously for several months, during which period about 30 per cent of the coke normally required has been replaced by pulverized coal.

In addition, work of a similar character has been in progress at the Garfield smelter of the American Smelting & Refining Co., where the percentage of coke replaced by pulverized coal is also about 30 per cent, the blast furnace construction being standard, and nor-

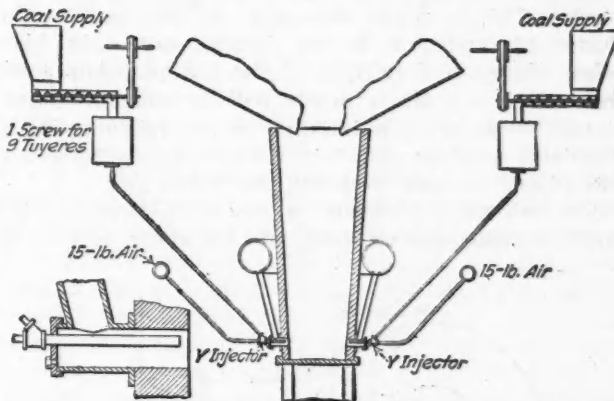


FIG. 2. APPLICATION OF PULVERIZED COAL TO A COPPER FURNACE, EMPLOYING SUBSIDIARY HIGH-PRESSURE AIR

mal blast pressures used. The general arrangement for experimental work at these smelters is shown in the accompanying illustrations.

The following companies have also shown an interest in this process: The Consolidated Mining & Smelting Co. of Canada, Ltd., S. G. Blaylock, general manager; Jules Labarthe, of San Francisco, regarding the Bunker Hill & Sullivan smelter; Société des Mines de Cuivre de Catemou, Chile; United Verde Extension Mining Co.; Burma Corporation; and Phelps Dodge Corporation, Copper Queen branch.

Owing to the encouraging results obtained in the early work at Tennessee and at Copper Cliff, the experiments will be resumed as early as operating conditions will permit. At these plants, some difficulties were met on account of the incomplete combustion of all the coal, and owing to leakage of coal dust from the tuyères while being punched. To improve the furnace construction

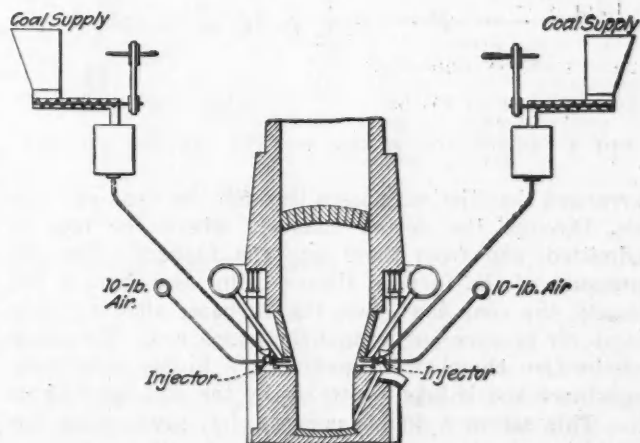


FIG. 3. PULVERIZED-COAL FIRING APPLIED TO A LEAD FURNACE

to meet these conditions, it is planned to use a special furnace jacket with a small combustion chamber, to which is fitted a safety vortex tuyère, the design of which is shown in Fig. 4. This arrangement has been designed to guarantee the full pressure of air at each tuyère and to give ignition to all the coal as it enters the furnace.

The nozzle shape of air duct through the tuyère holds the air pressure at this point about the same as at the blower (provided the main blast is large enough). This brings within the tuyère primary and secondary pressures; the primary being that of the blower side of the nozzle, and the secondary that of the furnace side of the nozzle. This is found necessary, to take care of the change of conditions in the furnace caused by blow holes, sliding, and settling of the charge. Any small obstruction to a single tuyère will be overcome immediately by the pressure building up and relieving itself. This also provides a safety device against backward flow of coal, or back-blast into the tuyère pipe.

The ball valve furnishes a means of punching the tuyère without coal escaping into the room, as it is so

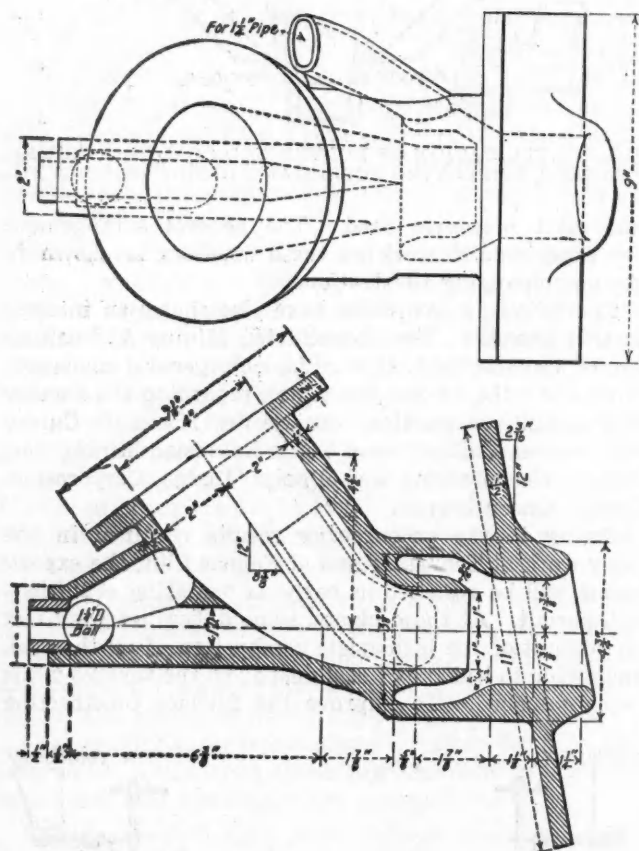


FIG. 4. DESIGN OF A NEW SAFETY VORTEX TUYÈRE

arranged that the rod passes through the clean-air nozzle, through the vortex chamber where the coal is admitted, and from there into the furnace. The air pressure of the furnace always being less than in the nozzle, the coal flows into the furnace, allowing only clean air to come out around the punch rod. The small combustion chamber is lined with a highly refractory substance and is kept white hot by the coal igniting in it. This serves a double purpose, i. e., pre-heating the air before it enters or comes in contact with the charge, and holding the smelting zone near the tuyères. The combination of these points should make a blow-torch action at each tuyère, maintaining rapid smelting at this part of the furnace.

The Diamond Market Is Now in a More Prosperous Condition than ever before. Production is largely in the hands of a single group, which controls the output and price. Stones to the value of about \$40,000,000 are now being sold annually.

Some Factors Affecting Magnetic Separation

Some of the conditions necessary for the satisfactory operation of Wetherill separators were mentioned by Hitchcock and Pound in a recent issue of the Proceedings of the Australasian Institute of Mining and Metallurgy. Attention is called to the necessity of close sizing of the feed, in order that the magnets may be brought as near as possible to the ore on which they act. A considerable amount of fine material mixed with coarser chunks had better be treated separately. Dry ore is a necessity. An even distribution of the ore over the conveyor belt is also important, and must be secured by a suitable feeder. At the Launceston works of the S. & M. Syndicate, Ltd., a shaking-bar feeder which moves with a set stroke at a given distance beneath a slot in a hopper bottom is favored. A speed of 300 ft. per min. has been found satisfactory for the cross-belts that take the magnetic particles to the side chutes of the machine.

The width of the conveyor belt is limited. As a general rule, 18 in. must not be exceeded in Wetherill separators used for feebly magnetic minerals, as constructional difficulties interfere. The magnet poles are 4 in. narrower than the belt at the Launceston works. The speed at which the conveyor belt should run depends to a considerable extent on the size of ore treated, as each ore particle must remain in the magnetic field a certain length of time, and the larger the particle the longer that time is. Best results are secured on minus 10 plus 20-mesh material. Ore containing a large amount of magnetic material must also be fed more slowly than when such is not the case, as otherwise re-treatment of the tailings may be necessary. An arrangement for varying the belt speed between 50 and 100 ft. per min. is a great convenience.

At the Launceston works, the quality of the separation is important, and the tonnage is restricted to about 1,700 lb. per twenty-four hours. A bismuthinite-cassiterite-wolfram concentrate is handled.

Decrease in Canadian Iron-Ore Shipments

Iron-ore shipments from Canadian mines during 1919, according to *Iron Age*, were lower than any that have been recorded in nineteen years, and amounted to a total of 195,970 tons, valued at \$689,386, as compared with 211,608 tons, valued at \$885,893, shipped in 1918. The total production of pig iron in Canada in 1919, excluding the production of ferro-alloys, was 917,346 short tons, having a value of \$24,536,432, as compared with a total production in 1918 of 1,195,551 short tons, valued at \$33,495,171.

Deepest Mines of the World

In our reply to the question as to the deepest shaft in the world, published under the head of "Consultation" last week, we neglected to mention one which is deeper than the No. 3 Tamarack, described as the second deepest shaft. At the Ooregum mine, in the Kolar gold-field, India, Oakley's and Bullen's shaft, at last reports, had reached the sixtieth level, 5,419 ft. vertically below the surface, with a further extension to the seventy-fifth level in prospect. On the Rand, the Simmer Deep is working at 5,000 ft. vertical, the Jupiter at 5,100, and the Village Deep even below this. A well in West Virginia is 7,579 ft. deep, the deepest hole in the world.

A Safety Crosshead for Bucket Shafts

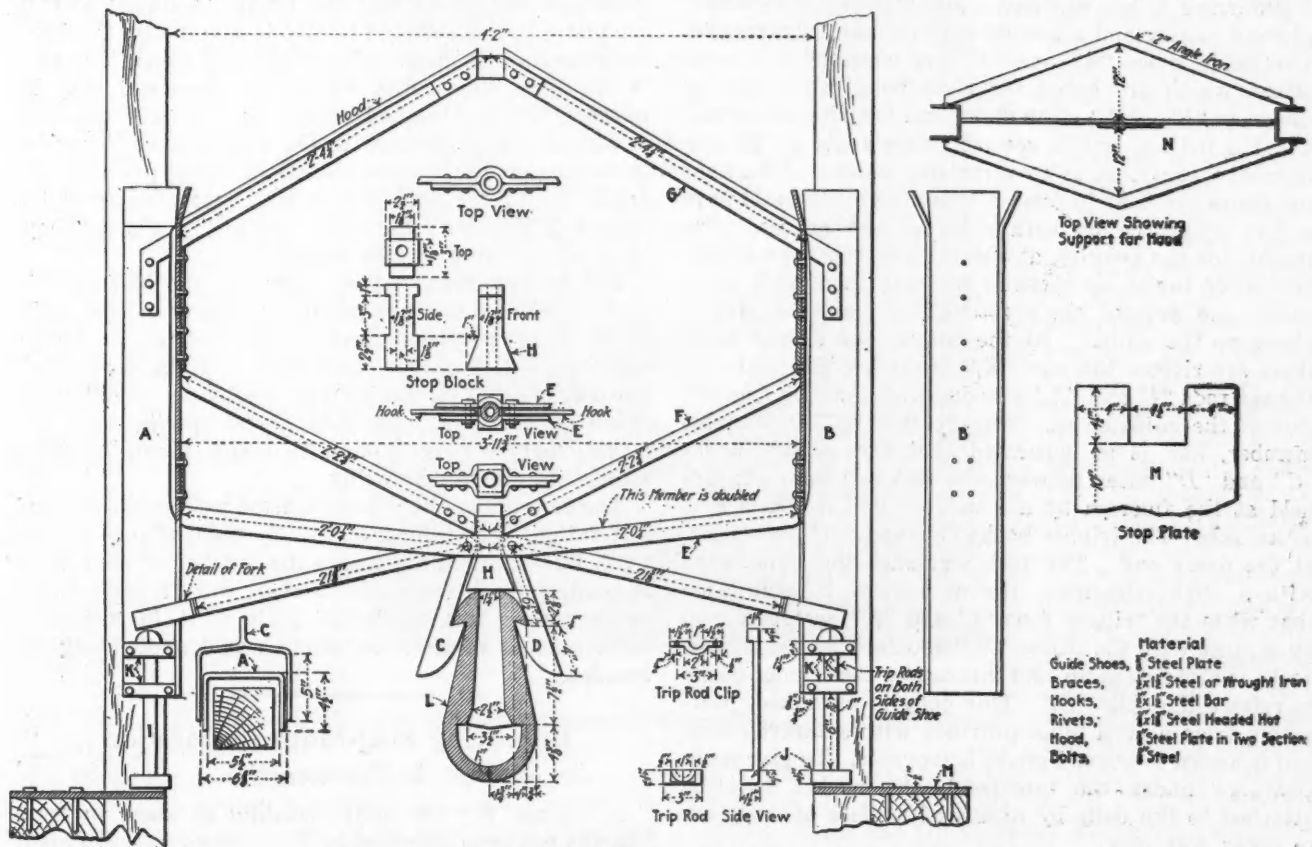
One Means of Preventing Accidents That May Occur as the Result of Unsafe Working Practices—Use of the Described Device Assures Protection to Men While They Are Riding in the Bucket

BY JAMES E. HARDING

Written exclusively for *Engineering and Mining Journal*

OWING to the fact that the exigencies of operation in many instances demand the use of a bucket instead of skips or cages in shafts, means of keeping the bucket from swaying against the sides of the shaft, or spinning on account of the twist of the cable, have been found to be necessary. When the timbering is in such condition that guides can be placed throughout the entire length of the shaft, the problem is simple, but it is necessary frequently for the bucket to be lowered beyond the guides, as in shaft sinking, hoisting water, or similar operations. Under such cir-

at the joints or are roughened by wear, especially in the region of knots in the wood, so that when the bucket is being lowered the crosshead catches. This permits the bucket to continue down the shaft while the crosshead hangs up, and the subsequent movement of the bucket causes the cable to vibrate, and the crosshead is shaken loose and falls down the shaft on top of the bucket, so that riding thereon is an exceedingly dangerous practice. My own personal experience includes six cases in which men have been killed by a falling crosshead, and in one case my own life was



SAFETY CROSSHEAD DESIGNED FOR USE IN BUCKET SHAFTS

cumstances any steadying device must necessarily stop at or near the ends of the guides and permit the cable still to be paid out.

The last-named contingency has caused what is commonly known as a crosshead to be developed, the device varying in design from the simplest "go-devil," which merely rides the guides and permits the cable to slide freely through some sort of a vertical orifice, to more or less complicated mechanical designs which are intended to do any one of several possibilities. The inherent weakness of many of these devices is that they depend entirely upon the force of gravity to keep the crosshead attached to the bucket. As long as this force operates without hindrance no difficulty is encountered, but in frequent instances guides become loosened

saved by my jumping off the moving bucket into the timber of the other compartment of the shaft through which I happened to be riding at the time.

The above incident was the inspiration for making the device shown in an accompanying cut and designed to prevent such accidents. Although the apparatus is made to fit a shaft having a compartment measuring 58 in. between plates or in the clear in all directions, it may be utilized to fit a compartment of any size by merely lengthening or shortening the center members, which, on the drawing, are designated "E," "F" and "G."

The mechanism has proved successful under working conditions covering a period of several months, and so far has developed no weakness, nor have any accidents occurred while it was being used. As a test, a bucket

loaded with rock was intentionally "hung up" in the shaft, and the tripper hooks "C" and "D" easily held the load without bending, as the calculated margin of safety is greater than that of the cable.

The crosshead is so designed as to stay with the bucket at all times unless it is stopped at the plates marked "M," which are lag bolted to the wall or end plates, to either of which the guides are attached. When the crosshead is so stopped, the cable slides freely through holes provided for it in all of the members. The plates of course may be placed at any desired point, but the practice is to fasten them on the lowest wall plates to which the guides are attached. When the bucket is lowered from the crosshead and hoisted back, the crosshead is picked up on the block "H" and the tripper hooks engage the dolly "L," which is held until again released at the plates "M." This operation is simple, and no retardation of speed is necessary, either when hoisting or lowering.

CONSTRUCTION AND ASSEMBLAGE OF CROSSHEAD

Referring to the accompanying drawing, the method of construction and assembly may be easily understood. The guide shoes "A" and "B" are made of $\frac{3}{8}$ -in. steel plates, which are bored for rivet holes while flat, as shown in "B"—"B." The upper end is split and spread, and the bottom end is cut off at an angle of 45 deg. from the part that is to form the inside. Afterward the plates are bent to form a trough, which should have a $\frac{3}{8}$ -in. clearance on both sides of the guides. The reason for the bending at the top and the bevel at the bottom of the guide shoes is to make them slide more easily and prevent their catching at joints or rough places on the guides. At the bottom end of the guide shoes are riveted the lugs "K," through which slide the tripper rods "I" and "J," also duplicated on the opposite side of the guide shoes. The crossbar "E" is a double member, and is so separated that the tripper hooks "C" and "D" enter between the two members and are held at the fulcrum by a $\frac{3}{8}$ -in. bolt which also serves as an axle. The tripper hooks "C" and "D" are forked at the outer end. The fork straddles the guide shoe with a slight clearance, the arrangement being such that when the tripper rods "I" and "J" are forced up by contact with the plates "M," the fork of the tripper hooks is also forced up, and this causes the tripper hooks to release the dolly "L." This dolly is machined, preferably from a steel billet provided with a tapered hole, and is leaded to the end of the hoist cable. To give more clearance under the crosshead, the bucket may be attached to the dolly by means of a piece of cable six to eight feet long.

The original crosshead was made as shown in the drawing, but upon being tried out it was found that there was too much slant at the head of the dolly to permit an easy release. The head was partly filed away at the point where the hooks engage, as was about one-half of the slant of the hooks, so that this dimension should be $\frac{3}{8}$ in. instead of $\frac{1}{2}$ in. The block "H" is made and inserted in such a fashion that it does not interfere with the action of the tripper hooks. A hole is bored vertically through the center of this block to permit the free passage of the cable. The arrangement of the braces "E" and "F" permits the placing of the block and holds it in place. This block has to stand much bumping, and preferably should be made from a steel billet.

A framework "N," made of angle iron, is riveted to the top of the guide shoes. Upon this framework is placed a $\frac{3}{8}$ -in. steel hood, which should be divided at the center and hinged at the sides, so that it may be opened and shut. This permits long material, such as rails, pipe, or timber, to be placed in the bucket with the upper end lashed to the cable. The hood serves to protect men riding on the bucket from objects falling down the shaft, in addition to closing the compartment from above when the men are working below.

From the above description it will be seen that when the bucket is lowered to the point where the plates "M" are fastened, the tripper rods "I" and "J" strike the plates "M" and are forced up by the weight of the crosshead. In turn, the forked ends of the tripper hooks "C" and "D" are elevated, causing the tripper hooks to release the dolly "L," and the crosshead stops and rests upon the plates while the bucket continues down the shaft.

If the crosshead hangs up it is generally pulled loose by the weight of the bucket, and if it happens that the crosshead is held so that the bucket is forced to stop completely, a man on the bucket is given time to signal the hoistman by means of the bell cord which is always at hand, to stop, after which the crosshead may be released by any method necessary. In any case the crosshead must remain with the bucket until it arrives at the plates designed to release it. This prevents the possibility of the former becoming separated from the bucket, falling down the shaft, and killing whoever happens to be riding on the bucket.

It has been found unnecessary for the hoistman to slow up when leaving or picking up the crosshead while hoisting or lowering, because its action is always positive in either case, and only a slight jar is felt when the bucket passes through the blocks at full speed going up or down. The design and specifications are intentionally strong enough to stand rough handling without bending or breaking.

The dangers of shaft work are too well known to need reiteration, but reference to the publications of the U. S. Bureau of Mines shows the number of men killed annually in such work. If in shaft work a design such as this were required by all state mine inspectors, a large number of shaft accidents would undoubtedly be avoided.

Improving Slag-Matte Separation In Forehearths

A method for the better settling of slags in forehearths has been patented by R. L. Lloyd (U. S. Patent No. 1,310,998, July 22, 1919). The process consists in building a well of refractory brick inside of the ordinary settler, under the end of the blast-furnace launder. Openings are provided around the bottom. The slag-matte stream, falling from the launder, is thus made to pass down through the well, flowing out through the holes at the bottom under the matte level in the settler. The matte settles out and the slag rises to the top, passage through the matte layer being designed to clean it of any prills of sulphides which it might otherwise contain, due to the coalescence of the matte particles. The same effect may also be obtained by building a wall, similarly perforated at the bottom, of refractory material across one end of the settler, behind which the launder discharges.

Mining Engineers in Public Life

Fernando Carlos Fuchs

THERE has just left the United States to return to Peru, the Minister of Finance of that country, Fernando C. Fuchs, a mining engineer of prominence, with a long record of practice, and a former professor of the Engineering School in Lima. A charming and unassuming gentleman, he is a worthy and shining exponent of the engineer as a citizen. Señor Fuchs is a native of Lima, the son of Pablo Fuchs and Doña Felipa Carrera. He received his degree of mining engineering from the School of Mines in his native city, from which school he was graduated with the highest rank in his class. There is a popular impression in the United States that to be class valedictorian in college means submergence in after life, but this evidently does not hold good in Peru, as Señor Fuchs' subsequent career shows. In 1893, he began his work as engineer, at the Aguas Calientes mines at Huarochiri, and for the next ten years was connected with a number of other important Peruvian mining companies. In the years 1903 and 1904, Señor Fuchs visited the United States and Europe, and studied in various countries on

the Continent the organization of art and industrial trade schools, concerning which he made a report to the Peruvian Government. Both before and after this trip he occupied the chair of metallurgy in the School of Engineers, his *alma mater* at Lima. On his return to Peru from Europe he organized the Inca Gold Development Corporation of Peru, Ltd., the company being formed to dredge the Inamabari River, and Señor Fuchs was engaged in mining in connection with various enterprises till 1909. In 1910, he volunteered to serve for his country during the conflict with Ecuador; and in the same year was appointed a member of the Provincial Council at Lima, as Inspector of Public Works, in which capacity he served till 1914, initiating various public improvements. For these services Señor Fuchs was awarded a gold medal by the City of Lima. In 1913, he progressed from public service as an engineer to service for the state as a legislator, being in that year elected a member of the Peruvian Congress, in which body he served till 1919. During this period, he took an

active part in questions of mineral and agricultural taxation, railroad development, financial problems, and other progressive and modern legislation. For two years he was chairman of the Committee on Mining of the House. What an excellent example to set for American engineers!

Has there ever been a mining engineer in Congress? What an immense step toward progress and efficiency it would be if the chairmen of the Mines and Mining committees of our American Congress were mining engineers! For six months, in 1914-15, Señor Fuchs was Minister of Government. He was also a member of the commission appointed by Congress to prepare a law for the issue of paper currency, in view of the temporary emergency caused by the world war. On Aug. 13, 1919, he was appointed Minister of Finance by President Leguía, and has been very active in that post. His visit to the United States was in the capacity of chairman of the Peruvian delegation to the Second Pan-American Conference, just terminated in Washington, and for this conference he prepared the memorandum of Peru's financial status. He has been active in attacking



FERNANDO CARLOS FUCHS

the problem of the high cost of living, which plagues the people of Peru as well as those of the United States.

Señor Fuchs has not neglected his public and professional duties as a writer, any more than in other lines. Articles have been contributed by him to various periodicals at different times; and he has repeatedly written for *Engineering and Mining Journal*. His subjects have had a wide range, from metallurgy to geology.

As a family man, Señor Fuchs meets Roosevelt's ideal of an all-round citizen, having five children, the twins, Angelica and Fernando, and Lucila, Berta, and Alida.

Señor Fuchs is a firm believer in the fitness of the engineer for public life. The engineer's training, he holds, makes him logical and reflective, careful in his decisions, and firm and well grounded in his conclusions; and he further believes that the contact with nature and dwelling in the solitudes brings out the latent powers of character and intellect. We wish him a pleasant voyage back to Peru, and better weather for his next visit to the world's metropolis.

CONSULTATION

The Troubles of a Cyanider

My sympathy goes out to the operator who gets between the devil and the deep sea of difficulties incident to zinc-shavings cyanide precipitation, as is the case with the one who set forth his troubles in your issue of March 20, 1920, because I have been there. The practical remedy is the abandonment of shavings and the substitution of zinc-dust precipitation, but of that more hereinafter.

The operator is inevitably in trouble when intermissions of days and weeks occur. If, for any reasons, he feels compelled to continue the use of zinc shavings his speediest method of recovery is to remove all of the used shavings from the precipitation boxes, and replace them with new, clean, and bright ones, and continue precipitation as before, to meet again the conditions of which he complains.

Then put the old shavings into a suitable percolation tank, and slowly but continuously percolate through them a freshly aerated cyanide solution of normal strength, from the bottom to the top of the tank, as long as the effluent solution shows by assay a content of gold and silver, or of either. Occasionally air may be introduced to the bottom of the tank to rise gradually through the percolate. If any of the "white precipitate" accompanies the solution, filter it out. Then pass the solution through the refilled precipitation boxes, with the usual mill run.

The reasons for this procedure are as follows: While the gold precipitate is in direct contact with the metallic zinc, and the gold particles are in direct metallic contact with each other, precipitation goes on uninterruptedly. But if for reasons generally misunderstood, deposits of insoluble salts, or oxides, form on the metallic zinc surfaces, the gold deposits become detached from the zinc, and the essential contact between gold and zinc ceases, thus isolating and electrically insulating them from each other, with the consequent stoppage of the galvanic reactions. Thereafter the precipitated gold is redissolved without further solution of zinc, and the solution tailings show richer than the feed.

The ultimate remedy lies in the use of pregnant solutions, deaerated or de-gassed by properly designed apparatus for transferring the solution through and from a clarifying filter to the filters used for the separation of the precipitates, and feeding continuously the small necessary quantity of zinc dust to the solution as it passes along the transferring conduit. The precipitation takes place almost instantaneously, and the quantity of zinc to be removed prior to, or by, the smelting operation is only a small percentage of that when zinc shavings are employed. Less zinc and less cyanide will be destroyed, and less labor and acid be used for refining. Shut-downs for clean-ups will be lessened by the use of presses, and avoided by bag filtration. Bag filters or filter presses may be used to separate the precipitate from the solution.

Pay for the apparatus at prevailing rates, and maybe

a moderate fee for expert assistance; but do not pay for alleged patent rights for the use of the process, because they have no legal existence as monopolies. Philadelphia, Pa., March 23, 1920. N. S. KEITH.

Grades of Tin

"Will you be kind enough to inform us regarding the purity of the various grades of tin, namely, Straits, Banca, Australian, Bolivian, American, Chinese, pure, and 99 per cent; stating percentages?"

Tin which comes from Malaya, Banca, Billiton, Penang, and Singapore is ordinarily referred to as Straits tin. The composition of the tin from these localities is variable, but typical analyses are given as follows: Banca tin, about 99.95 per cent tin, .007 per cent antimony, .018 per cent copper, and .045 per cent iron; Billiton tin, 99.96 per cent tin, .006 per cent antimony, and .023 per cent copper; Penang tin, 99.94 per cent tin, .013 per cent arsenic, .016 per cent copper, .028 per cent iron, and .004 per cent sulphur; Singapore tin, 99.87 per cent tin, .008 per cent antimony, .045 per cent arsenic, .034 lead, .003 per cent bismuth, .052 per cent copper, .003 per cent iron, .006 per cent silver, and .005 per cent sulphur.

Australian tin, or Mount Bischoff tin, from Tasmania, has about the following analysis: 99.795 to 99.9 per cent tin, .015 per cent antimony, .015 to .063 per cent arsenic, .037 to .05 per cent lead, .001 to .01 per cent bismuth, .006 to .035 per cent copper, .01 to .042 per cent iron, sometimes up to .008 per cent silver, and .005 to .008 per cent sulphur.

Bolivian tin, also known as Williams Harvey & Co. tin, or Theodore Goldschmidt tin, is usually sent to this country for refining. The Williams Harvey & Co. tin is guaranteed 99 per cent tin, and its actual composition varies as follows, depending on quality designated: 99.2 to 99.94 per cent tin, .01 to .03 per cent antimony, .022 to .065 per cent arsenic, from a trace up to .396 lead, .001 to .015 per cent bismuth, .02 to .01 per cent copper, from a trace to .016 per cent iron, sometimes up to .014 per cent silver, .005 to .013 per cent sulphur. The Theodore Goldschmidt tin is reported to contain 99.15 to 99.86 per cent tin, .004 to .122 per cent antimony, sometimes .046 per cent arsenic, .1 to .425 per cent lead, sometimes .112 per cent bismuth, .043 to .352 per cent copper, sometimes .007 per cent iron, and .006 per cent silver.

American tin refers generally to tin which is refined in this country, and most of which comes from Bolivia. Little tin is produced in the United States, the total production amounting to less than 100 tons, and most of this coming from Alaska. American electrolytic tin, or practically pure tin, is about 99.9 per cent tin, the impurities being negligible in amount.

Tin which is commonly referred to as 99 per cent tin is metal guaranteed to contain 99 per cent tin, but which may run from 99 to 99.25 per cent, as in the case of the Williams Harvey & Co. brands. Tin of this grade can be used for most purposes to which tin is put.

BY THE WAY

As the Romans

"Did'st thee h'ever stop to think, m'son, that this 'ere worl' be quite a wonderful place?" said Cap'n Dick. "No matter w'ere thee gaws thee'll fin' things bein' done, but 'ardly two places alike, an' the queer part o' that is that h'each chap thinks 'e's got sumpthin' better than the h'other. Take this 'ere business o' transportation. Down in h' Africa they use h'elephants. Gert, 'ulkin' creatures, big as tha side of a 'ol bloody barn, an' with two tails, as Jan Pollard says (but that's h'another story)—but, min' you, m'son, it do take a 'eap to feed tha likes o' they. Then down in h'Arizona an' Mexico they use these 'ere burros for 'aulin.' They be stalwart little beggars, but stubborn—like a lot o' chaps I naws. Of h'all beasties I ever 'eard of, though, this 'ere llama, o' 'as a corner on the 'aulin' in South h'America, is by far tha mos' contrary. 'Alf camel an' 'alf mule, 'e seems to naw jus' 'ow much 'e should carry—dam-me, I think 'e mus' 'ave some sort o' union h'arrangement—an' w'en they loads 'im a bit too much 'e lays down, an' all 'eaven can't move 'im. Any h'efforts to get un h'up again starts the beggar spittin.' But w'ot 'e naws, 'e naws, an' 'e mus' 'ave some spunk any'ow."

Exchange and Miners' Wages

Many miners from British Columbia are reported to be going to the Cœur d'Alene district, in northern Idaho, being attracted first by the high wages, \$5.75 per day, or by the contract system in some of the mines under which an average of \$8 or more per day is made. But high wages are not the only inducement that draws these thrifty Canadians. The disparity between the currency of Canada and that of the United States amounts to between 15 and 20 per cent in favor of the latter, which means that an American dollar has that much greater purchasing power in Canada. Thus the Canadian miner is not only receiving much higher wages than he can get at home, but he also gets the premium on American money, which adds at least \$1 to his daily wage, based upon its value across the line, where he will spend it.

In connection with this it is interesting to note that there is a movement on foot to have Canadian currency accepted at par in Seattle next week for the convenience of delegates from north of the line who will attend the International Mining Convention to be held in that city. But who will pocket the loss? Again, the American traveling through the border country finds, when shopping, that on this side his Canadian money is accepted only at the prevailing discount, with an occasional 1 per cent or so added for luck. But on the other side no one ever mentions the premium on his good American money, unless it be himself.

The Llama's Qualities

Peru's contribution to the world of transportation, the llama, has been described as an unmannerly bearer of burdens, melancholy, churlish, of low intelligence, and requiring great patience. It is nobody's pet. It has four legs, like the Widow Lcary's cow, wherein those

unversed in zoology and ethnology may readily distinguish it from the lamas of Thibet. The llama's carrying powers are great; it can transport its own weight for a day's journey. It is as agile as Mitzi and as frugal in its habits as Russell Sage ever was, making coarse fodder and herbage its food, and drinking little and seldom. It is timid and shy as a debutante. Its gait is most peculiar, its head and neck bobbing forward chickenwise, as it walks, but without rhythm. It prefers the high spots of the Andes, and is unsuited to the heat of the low country. It is short of temper and long on wool, and fights by spitting in its adversary's ear, except when it misses its aim. When it dies it is done for. "Useful as the beast is," said a writer in *Bailey's* some years ago, "he is unpopular with those responsible for the working of the mines. The Indian is an independent man; he begins and leaves off—particularly leaves—working when he feels so inclined. When his inclination is to repose, he affirms that his llamas need rest, drives them off home, and no inducement will persuade him to undertake the short journey. The attitude of the Indian in this matter has been the cause of introducing the overhead wire lines for carrying ore to the smelting works, now so common in South American mining districts."

Industry Rewarded

"We have just learned of an engineer who started poor twenty years ago and has retired with the comfortable fortune of \$50,000," says the *Official Bulletin* of the Colorado Society of Engineers. "This money was acquired through industry, economy, conscientious efforts to give full value, indomitable perseverance and the death of an uncle who left the engineer \$49,999.50."

We Appreciate the Kindly Intention

A former editor of *Engineering and Mining Journal*, now running a personal organ in the West, says that *Engineering and Mining Journal* is tied up to Wall Street, and its metal quotations are therefore worthless. This is pleasant for us. To be publicly rated as a Wall Streeter is nice, even if it doesn't buy shoes for the baby. We feel like the man who was asked to change a ten-dollar bill, and said he couldn't but was thankful for the compliment.

Things Have Changed Since Father Died

The editor in question was responsible for metal quotations in *Engineering and Mining Journal* for years. Therefore we wonder if he intends an accusation or a confession. If the latter, he may be, like us, thankful for the compliment we pay him in making the query. Should he ever fulfil his ambition to become the editor of *Engineering and Mining Journal* again, however, he would be astonished to find how things have changed since his days. We may illustrate with another joke, standard and therefore safe. Olaf Peterson, having struck it rich, commissioned an artist to paint his father's picture. On inquiring, the artist found that the father had died and that there was no existing portrait, but he finally did his best from Olaf's description—yei-low hair, blue eyes, blond mustache. Olaf examined the finished portrait searchingly, then wept: "It is my fodder," he said; "blue eyes, yellow hair, scar on left cheek—it's him all right—but" here he broke down, "My Gott, fodder, how you haf changed!"

Oil Land Leases and Lawsuits

A Recent Decision in a Kentucky Court Increases the Difficulties of Small Operators—A Plan Suggested for the Grouping of Small Tracts Into Larger Areas—Operating on the "Ten-Cent" Lease Basis

BY GEORGE A. LAIRD

Written exclusively for *Engineering and Mining Journal*

UNDOUBTEDLY any suggestions, on the part of an oil-land lessee, of a fixed obligation to be bound to a definite drilling program, would find disapproval among both the operating companies and the "lease grabber." Nevertheless, with the constantly increasing demand for petroleum products, it would seem as if some method of securing development of possibly productive areas might be enforced by the enactment of laws which would protect both the lessor and the bona fide operator and at the same time benefit the industry in general.

The present system of the "land grabber"—a term used to discriminate between the actual operator who develops by drilling and the gambler who secures and holds leases with the hopes that their value may be increased to his benefit at the expense of someone else—is to tie up as many acres as possible, without regard to their merit, often securing leases by misstatements bordering on actual fraud and paying for them a price which, if increased but a few cents per acre, would double his invested capital.

The fact that oil lands are owned largely in fee, makes the application of anything like the Mining Assessment Law impossible, but it should not be impracticable to license lessees or require them to furnish a bond in an amount sufficient to cover the cost of drilling one well on each tract or parcel of land leased, which would make advisable the grouping of lands under a single lease, or the legal limitation of time for which a lease could be held without development.

Many of the so-called development companies are merely promotion companies, which in their way are useful, inasmuch as they are willing to drill, relying on their ability to dispose of the lease while it is being drilled and before the oil sand is reached. In many cases, however, drilling is started by these companies where there is little chance of success, the profits being acquired through the difference in buying and selling price of the tract being drilled or the supposedly increased value of adjoining leases because of their proximity to territory in course of development.

In these days of oil excitement, it is apparently easy for promoters to dispose of property, if it can be stated that it is "now drilling," at a price which covers the cost of the lease, one well, and the profit desired on the transaction. The large operating companies, holders of millions of acres, are not likely to develop all districts in which they hold leases, but they do actually develop far more territory than the lease grabber does, and they do not attempt to make their profits through lease transfers.

All over the country, leases, legal or illegal, have been secured on ridiculous terms, the lessors not knowing whether they were legally bound, or not abiding by their side of the contract. In one district in Kentucky thousands of acres were leased for twenty years by the

payment of a dollar per farm, no drilling agreement and no rental being imposed. Undoubtedly, they are of no legality, but it requires a lawsuit to set such a lease aside, a procedure not relished by the land owner. Many of these leases have been transferred, and some of the territory has been drilled. This does not obviate the fact that the intent of the lessee was not to develop, but the expectations of the lessor, by implication if not by word, were that his land would be drilled. In this one particular case, the lessee became insolvent, and the leases secured by him were sold by his receiver, complicating the cloud on the title of the properties in question even more than is usually the case.

Where a farm of from 300 to 400 acres has been drilled unproductively, the owner could much more easily clear his title by suit for abandonment than he could by a suit to set the lease aside. As most of the drilling has been done on the larger tracts in this particular district, due probably to the fact that their sale was more profitable and equally as easy of accomplishment as the smaller tracts, the smaller land owners, less able to institute legal proceedings, find themselves in the greatest predicament.

Where the leases have been secured at prices ranging from \$1 for a parcel to 10c. per acre, and where values, fictitious or real, have reached \$100 or more per acre, the only hope of the small land owner is in royalties, quite unlikely to accrue if the development is retarded by the prices demanded for purely wildcat leases. Education of the farmer-land owner to the insistence of a drilling clause in his lease, unless his holdings be sufficient to warrant drilling as a unit, will simply retard development. To the uninitiated, the dollar and royalty, with the oratory which goes with them, bring visions not realized after the lease is signed and recorded. With the knowledge that the lease grabber makes his profit without land and without drilling, the land owner who has had his lease set aside by process of law is likely to be unreasonable in his demands when approached for a second lease.

In a decision rendered by Judge J. McKenzie Moss of the Circuit Court (Warren, Allen, Butler, and Edminson counties, Kentucky), on March 13, in the case of Howell and Carr v. the Maverick Oil Co., the suit being based upon the defendant's failure to develop the property of the plaintiffs for oil and gas within a reasonable time after the defendants had received notice from the plaintiffs to develop the property, the court held that the plaintiffs gave the defendants reasonable time, before filing of the suit, to start the work, and that the defendant, by failure to develop the property, forfeited the lease.

The lease held by the defendant was what is known as a "ten-cent lease," or one that carried a rental of 10c. per acre per year, this being simply a nominal rental, the main consideration of the lease being the development of the property.

In other words, the court held that where an oil company is holding a lease, and paying only a nominal rental, it, or the individuals, cannot hold the lease indefinitely by paying said nominal rental against the wishes of the land owner or owners.

This decision will have the effect of retarding development in Kentucky, as the majority of the leases are of the "ten-cent" variety. Nevertheless, they have cost the operators an amount far in excess of this figure. As all parcels of land in the state are of relatively small area, the wildcatter who wishes to secure an area of sufficient extent to warrant drilling will be in the position that, unless he is prepared to drill each individual parcel or tract of land in his holdings, frequently less than 100 acres each, he may forfeit the greater part of his territory by the service of notice to drill by the land owner, whose lease is immediately enhanced in value by the drilling in close proximity and who will undoubtedly take advantage of this decision in order to re-lease his land at a higher figure.

The small operator in Kentucky is now "up in the air." No one wants a lease which will inevitably mean a lawsuit unless drilled within "a reasonable time," supposedly ninety days from the time of issuance of notice on the part of the land owner, and it is improbable that anyone will care to drill 100 acres on a purely wildcat proposition. A licensed agent might have grouped areas large enough to warrant drilling, and, by furnishing a bond for an amount equal to the cost of drilling one well to determine the value of the entire tract, he had something besides a series of lawsuits to transfer to the operator willing to drill one or more wildcat wells, but not willing to start ten or a dozen in unproven and contiguous territory.

It would seem as if many innocent purchasers had acquired something more than oil leases in Kentucky. The decision of Judge Moss, owing to its practically invalidating a written contract, might be reversed by a higher court; nevertheless, many of the small operators of the district in which it was rendered will forfeit their leases and abandon the state rather than await the results of an appeal.

Terms Used in the Oil Fields

For the benefit of many mining men who are as yet unaccustomed to the terminology of the oil fields, definitions of some of the more common terms follow. These are taken largely from one of the monthly reports of the California Mining Bureau.

Blown—A common expression for a well that is being pumped by means of the release of compressed air at a considerable distance below the normal level of the fluid. Such wells are commonly known as "air wells."

Brought In—A well is "brought in," or "comes in," when it begins to produce.

Cased Off—Excluded from a well by means of metal casing.

Collar Shut-Off—An accidental "shut-off," supposed to be occasioned by the accumulation of material between the walls of a well and the casing at, or just above, a collar of the casing.

Contour Lines—These represent level lines along the surface contoured. They are spaced at regular intervals of distance from a level datum plane such as sea level. This use of the contour should not be confused with that in a topographic map, in which the surface contoured is the ground surface. There is, however, a certain similarity. If all the formations above the surface represented by an underground contour map were removed, the underground contour map would then become a topographic map.

Correlate—To determine the stratigraphic relation of formations "logged" in two or more wells.

Diatomaceous—Composed partially of the siliceous skeletons of diatoms.

Edgewater—Water sometimes occurs in the down dip portion of an oil sand. As the oil is drawn off through wells, the water fills the vacancy. Such water is referred to as "edgewater."

Formation Shut-Off—This term is used to denote a special case of a "shut-off." In this form of a "shut-off" the water-tight bond, between the metal casing and the walls of the hole, is effected without the use of cement or lime. It is usually accomplished by seating the casing tightly on or into an impervious stratum of clay, shale, or "shell."

Landed—When a "string of casing" has been permanently placed in a well and allowed to support its own weight, it is said to have been landed.

Logged—Recorded in the log of a well.

Marker—A distinctive stratum that can readily be identified in a majority of the wells while drilling through it, and particularly one of such distinction as to receive mention in the logs of these wells.

Offsetting—The practice of placing wells on one lease directly opposite those on an adjoining one. This protects property lines and prevents drainage of oil to the adjoining property.

Oil String—A "string of casing" used to keep a well open from the point of "shut-off" to and through the formations from which oil is entering the well.

Oil Zone—A series of oil-bearing beds between arbitrarily chosen limits, but usually limited by persistent water sands or zones.

Plugged Off—This describes the condition existing when fluid, encountered in the lower part of a well, has been excluded from a higher part by placing an effective plug in the formation between these two places.

Shell—A term used by drillers in the logs of wells to denote a hard stratum.

Shut-Off—This term ordinarily refers to the exclusion of water encountered in a well from the deeper portion of the well by effecting a water-tight bond between the metal casing and the walls of the hole. It is, however, sometimes used in describing the effectiveness of jobs of plugging to exclude lower waters from the upper portions of a well.

Sidetracked—Whenever a portion of a well is redrilled alongside of casing or other metal, this casing or material is said to be sidetracked.

String of Casing—Any number of joints of oil well casing screwed together and hung, or landed, in a well.

Water String—Special case of the above, applying to a string of casing with which a shut-off has been effected.

Water Zone—A series of strata in which water occurs.

New Oil and Gas Development In Oklahoma

Drilling for oil and gas, according to the Oklahoma Geological Survey, has been done or is now being carried on in every county in Oklahoma, and thirty-six of the counties of the state are to be classed as oil and gas producers. At the present time there are 25,000 wells in the state, producing either oil or gas or both. The extent of the explorations and the intensity of development are greater than they have been at any time in the past.

During the month of December, 1919, a total of 247 new sections were added to the progress development map kept up by the Oklahoma Geological Survey, showing that during this month drilling operations began in that number of sections over the state where operations had not been carried on prior to that time. Sixty per cent of the "wildcat" wells drilled in 1919 proved productive. The producing areas of the state are divided into 150 pools, each of which bears a specific name.

NEWS FROM THE OIL FIELDS

Discuss New Leasing Regulations With Van. H. Manning

American Petroleum Institute and American Mining Institute Representatives From Oil-Producing States Confer

A conference of representative oil and gas men was held at the office of the Director of the Bureau of Mines on April 1, and the operating regulations for the proposed leasing of the oil and gas lands of the public domain, involved in the newly created land-leasing law, were discussed. These regulations, which have been drawn tentatively by the Interior Department, are to be considered thoroughly by the industry before they are finally adopted as the official regulations governing the operation of this important law.

Director Manning of the Bureau of Mines has asked the governors of the states of California, Colorado, Wyoming, Montana, and Louisiana, in which oil and gas are being obtained from the public lands, to send two representatives each to this meeting. The American Petroleum Institute, the Mid-Continent Oil and Gas Men's Association, the American Mining Congress, the American Institute of Mining and Metallurgical Engineers, and the independent Producers' Agency of California are also to be officially represented.

The proposed regulations are to cover drilling, producing, and gaging of oil and gas on the lands leased under this act. They are modeled after the Interior Department regulations now in force in the Osage Reservation, Oklahoma.

Federal Resolutions in House of Interest to Oil Producers

On March 15 a resolution was passed by the House of Representatives authorizing and directing the Attorney General of the United States to begin at once injunction proceedings in the United States against the Standard Oil Co., its affiliated companies, and the U. S. Steel Corporation, together with its associated companies, restraining both companies from taking any steps, either by stock dividends or other devices, to distribute the surplus war profits accumulated in the last six years.

On March 23 the House passed a resolution directing the Attorney General of the United States to investigate the operations of leading concerns marketing petroleum products and report to the House the cause of recent price advances in those products, as well as to report the sources of oil supply for the United States, the profits of the petroleum industry and any combinations in restraint of trade and their effect upon prices of petroleum products.

Progress in Construction of Oil-Shale Plants

According to the latest information, the following summary represents the progress made to date in constructing oil-shale distillation plants:

1. The Catlin plant at Elko, Nev., has been running for several months. Its capacity is not accurately known, but about 15,000 bbl. of shale oil have been produced.

2. The Southern Pacific R. R. Co., under the supervision of Dr. David T. Day, has constructed an oven contain-

ing four retorts of the Henderson type at Elko, Nev. The plant is in operation.

3. The Mount Logan Oil Shale & Refining Co. has a 30-ton Galloupe retort at De Beque, Col. It has been in operation since the middle of 1919.

4. The Oil Shale Mining Co. has had a 10-ton Henderson retort in operation at De Beque, Col., for over a year.

5. Continental Oil Shale Mining & Refining Co. has recently completed a plant in Rio Blanco County, Col., in which the so-called "Colorado Continuous Shale Process" has been installed.

6. The Ute Oil Co., at Watson, Utah, has, within the last two or three months, completed a 100-ton "Wallace" unit. This plant should soon be in operation.

7. The Lackawanna Oil Shale Co. is breaking ground for a 200-ton "Wallace" unit at De Beque, Col.

8. The Grand Valley Oil & Shale Co. is making excavations and building foundations for a 100-ton "Stalman" unit at Grand Valley, Col.

Leases on 28,000 acres of prospective oil land in western part of Tehama County, Cal., have been closed by I. O. Jillson and William H. McEwen, of Redding, Cal. The leases are for long periods of years, and the land owners will receive a royalty of one-eighth of all oil found. Development will start as soon as the geologists have selected the most favorable place for the first well.

Production of California Oil Fields in February

February production of California oil fields, according to the *Standard Oil Bulletin*, was 274,026 bbl. per day, an increase of 939 bbl. daily as compared with January. February shipments were 304,120 bbl. per day, an increase of 3,010 bbl. daily as compared with January. Stocks were decreased 872,704 bbl. during the month. Thirty-four new wells were completed in February with an initial daily production of 13,825 bbl. Details of fields

TABLE I. SUMMARY OF DEVELOPMENTS AND PRODUCTION FOR ALL CALIFORNIA FIELDS FOR FEBRUARY

Field	New Rigs	Drilling	Wells		Producing	Productive per Day
			Completed During Month	Abandoned During Month		
Kern River	7	24	3		2,083	20,565
McKittrick	2	7			348	7,347
Midway-Sunset	13	67	9	2	2,370	90,214
Lost Hills-Belridge	1	18	1		569	11,540
Coalinga	8	34	10	2	1,242	43,503
Lompoc and Santa Maria	2	24			385	16,505
Ventura County and Newhall	3	43		1	492	5,744
Los Angeles and Salt Lake		1			666	3,739
Whittier-Fullerton	24	149	11		904	74,647
Summerland					142	147
Watsonville					5	75
Totals	60	367	34	5	9,206	274,026
Total crude oil stocks, February 29, 1920					28,738,921	bbl.
Total shipments from fields, February, 1920					8,819,468	bbl.

are given in Table I and prices in Table II.

Effective March 17, 1920, the following are the current prices offered by Standard Oil Co. for crude oil at the well in San Joaquin Valley and Whittier-Fullerton fields:

TABLE II. CRUDE OIL PRICES AT THE WELL

	Per Bbl.
14° to and including 17.9° gravity	\$1.48
18° to and including 18.9° gravity	1.49
19° to and including 19.9° gravity	1.51
20° to and including 20.9° gravity	1.54
21° to and including 21.9° gravity	1.58
22° to and including 22.9° gravity	1.63
23° to and including 23.9° gravity	1.69
24° to and including 24.9° gravity	1.76
25° to and including 25.9° gravity	1.84
26° to and including 26.9° gravity	1.93
and for each increase in gravity of one (1) full degree above 26.0° gravity, up to and inclusive of 34.9° gravity, ten (10) cents per barrel additional	
35° gravity and above	\$2.83

Difficulty in Securing Oil Bids Ascribed by Navy to Speculation

Failure on the part of the Navy and the Shipping Board to receive bids to cover their fuel-oil requirements has aroused great additional interest on the part of Congress and Government departments in the oil situation. It is the opinion at the Navy Department that speculation has something to do with the present difficulty in securing bids, but it is admitted that there is much to justify the producers in their hesitancy to make contracts. Some readjustment is expected in the near future.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

The Inside of the Earth Although Rigid as Steel, It Betrays Fluidity Through Its Earthquake Phenomena

Walter D. Lambert, of the U. S. Coast and Geodetic Survey, recently reviewed our knowledge of the condition of the earth's interior and presented the results in a paper before the Maryland-Virginia-District of Columbia Section of the Mathematical Association of America. He stated that the view that the interior is hot and fluid is not wholly unsound. First, as to heat. As far down as borings have been made into the earth, the temperature increases with depth at variable rates from place to place, but 1 deg. C. for each thirty-five meters, or 1 deg. F. for each sixty feet, may be taken as a fair mean.

The discovery of radium and of the great amount of heat given out by even a minute quantity of it suggests the possibility that the heat applied by radium may exceed the heat radiated into space, so that the earth may be gaining instead of losing heat.

What the temperature of the interior is we cannot say. If the rate of increase of 1 deg. C. for each thirty-five meters should hold good clear to the center, the temperature there would be 180,000 deg. C. Such a temperature does not agree with present ideas. Men of science do not talk of a solar temperature of millions of degrees, as did their predecessors of a generation or two ago. They are content to accept a solar temperature of a few thousand degrees, and our estimates of terrestrial temperatures must be correspondingly lowered. It is almost certain, however, that the temperature is high enough to melt rock under the surface conditions of pressure, but the increased pressure may raise the melting point so much that no actual liquefaction occurs. Volcanoes are supposed to be isolated "pockets" of molten matter unconnected with any central reservoir.

As far as the fluidity is concerned, if the earth be not fluid, it acts in some ways as if it were. It seems improbable that a gravitating body the size of the earth and composed of any species of matter with which we are acquainted should sufficiently resist as a whole the long-continued action of the stresses that would arise from any great departure from the conditions of fluid equilibrium. The flow of rock may resemble that of ice in a glacier, which is a process of rupture followed by reunion under pressure. The theory of fluidity, at all events, has served us well in the past, and is probably valid, if we understand it in the above sense, that for large stresses, long continued, the earth acts on the whole like a fluid body.

The rock on the surface is directly accessible. The extremes of rock density are about 3.3 and 2.1; the mean for the earth's surface as a whole may be put at 2.6 to 2.8. We can judge of the density below the levels accessible to us only by the mechanical effects of the matter of these inaccessible regions. One mechanical effect is the attraction, and from this the mean density of the whole mass of the earth comes out at 5.5 or 5.6.

As the surface density is less than the mean density, somewhere below the surface the density must exceed the mean. Just how that density is distributed from center to surface is a matter of hypothesis. Legendre's law of densities, and others like it, assume a continuous change of density from surface to center, as of chemically homogeneous matter under pressure. Wiechert assumes that the central portion or nucleus of the earth is of different material from the outer portion of the shell, and that there is an abrupt change in passing from nucleus to shell. The nucleus is supposed to be of metal, chiefly iron, and the shell of rock.

The first real evidence that the earth acts like an elastic solid rather than like a mass of fluid—at least in respect to forces acting over a short time only—came from the tide. From the observations of the long-period tides in various parts of the world, Kelvin deduced a rigidity probably between that of glass and that of steel.

From observations at three observatories the focus, or point of origin, of an earthquake can be determined, and from the observed time that a tremor takes to travel from the focus to the point of observation some interesting conclusions may be drawn as to the rigidity of the earth. To deduce rigidity from earthquake data we must make certain assumptions, but it may be said that all results point to a rigidity increasing with the depth from that of rock at the surface to a value exceeding that of steel and perhaps three or four times as great.

It should be noted that, owing to the scantiness of data, for a distance from the focus greater than 13,000 km., the information derived from earthquake data is limited to an outer shell whose thickness is about one-half the earth's radius. This scantiness beyond 13,000 km. or even smaller distances, has long seemed to need some explanation beyond that of mere distance, and in this connection attention may be drawn to Knott's recent paper, which is one of unusual interest. He suggests as a possible explanation that the central core of the earth, with a radius equal to perhaps 0.4 that of the earth, may be non-rigid or nearly so, but highly incompressible.

Significance of Research for Mining and Metallurgy

Walter Douglas, president of the Phelps Dodge Corporation, recently wrote as follows:¹

"The extreme importance of industrial research in the successful conduct of great mining and metallurgical enterprises can be appreciated when it is realized that upon the development of certain scientific methods depends the commercial success of the production of metals from ores formerly regarded as valueless. The efforts of producers are directed toward economical means of extracting coal and metalliferous ores with the least possible loss consistent with safety to the miner, and the concentration and beneficiation of the raw material in such manner as to obtain the highest extraction of the valuable content. To this end, scientific investigation and experimentation are essential, and nearly all great, forward steps in industrial and technical advancement have originated in the research departments of the large producing companies.

"At this time, with foreign sources of supply of certain important elements curtailed through shortage of vessels, it is of special importance that means be devised to furnish certain substitutes or to utilize our own raw materials through the invention or perfection of processes by which production of commercial grades can be made available. Never before have the departments of industrial research assumed such importance to the basic industries of this country as they do today, and if we are to make ourselves independent of materials for which we have in the past relied on Germany, we must enlarge and elaborate our departments of research and investigation to an extent considered in the past as unnecessary and unjustified."

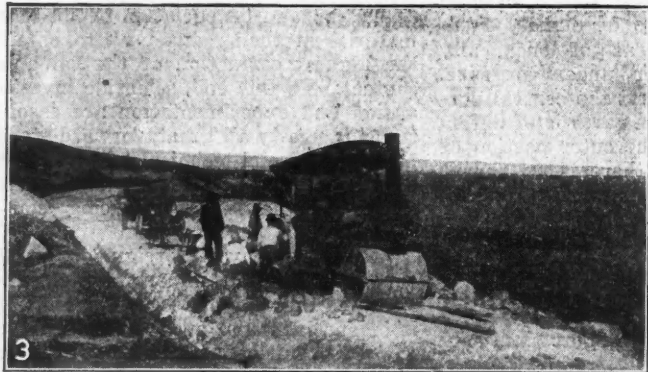
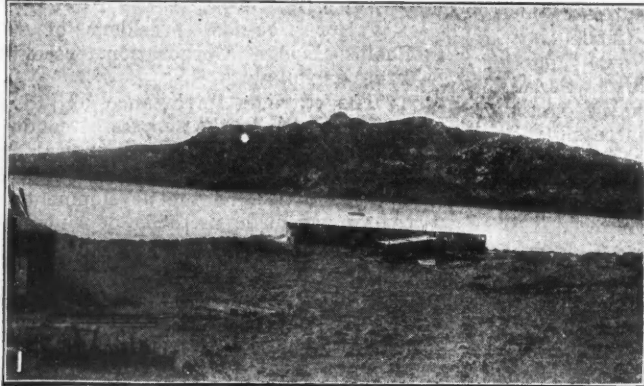
Bureau of Mines Engineers Meet in Salt Lake City

Siliceous dust as it affects disease, the effect of ventilation in metal mines, and high temperature and humidity in deep mining were the principal subjects discussed recently at a meeting of U. S. Bureau of Mines engineers in Salt Lake City. A study of these problems has been in progress for several years by the Bureau, and now it is intended to carry the work forward more intensively. Plans for the campaign were laid at the Salt Lake City meeting. Dr. R. R. Sayers, chief surgeon of the Bureau, and C. L. Colburn, assistant to the chief mining engineer, represented the Washington office.

¹Bulletin, National Research Council, Washington, October, 1919, Vol. 1, Part 1, No. 1, p. 19.

THE MINING NEWS

LEADING EVENTS



1. STAFF HEADQUARTERS OF VANADIUM CORPORATION OF AMERICA AT JUMASHA, PERU, ON SHORE OF LAKE PUN RUN. THIS LAKE IS NAVIGABLE AND IS 1,700 FT. HIGHER THAN LAKE TITICACA. 2. ORE SHED AT RICRAN, WHERE ORE IS DELIVERED TO CERRO DE PASCO RY. 3. BUILDING MOTOR-TRUCK ROAD BETWEEN CASA LAGUNA AND RICRAN. THE STEAM ROLLER IS IN A HOLE. 4. BRIDGE BUILDING ALONG ROUTE OF MOTOR ROAD

WEEKLY RÉSUMÉ

Aside from the activities of the Vanadium Corporation in Peru, the week's news notes that the Mining Corporation of Canada is included in the recent Flin Flon deal. The O. B. U. has caused a strike of minor importance at Cobalt. In Utah, the proposal of the Utah Light & Power Co. to increase its rates is being contested in court. The partly finished Government sulphuric acid plant at Cuba City, Wis., has been taken over by the National Zinc Separating Co. Thomas W. Lawson, author of "Frenzied Finance" was arrested in Boston for illegally advertising stock for sale and was released on bail.

At Washington, the new war-minerals relief bill has been reported favorably to the House. Mining societies are to be asked to criticize a newly drafted bill for revising the Federal mining laws. Bills to forbid destruction of gold and silver coinage and to put a tariff on antimony have been introduced, and the Government-patent bill has passed the Senate. Less conspicuous are the facts that at Jerome, Ariz., Gadsden Copper has stopped diamond drilling and has pulled its pumps; that Arizona Copper is suing the Coronado Mining Co. for debt; and that Anaconda is preparing to operate its Great Falls ferromanganese plant at capacity. In British Columbia, the Consolidated M. & S. Co.'s Rock Candy property and the Hedley Gold Mining Co. have resumed. Dale L. Pitt has been appointed manager of the Premier mine.

Vanadium Corporation of America Improving Minasragra Property in Peru

Narrow-Gage Railroad and Motor Trucks Will Supplant Llamas for Transporting Ore to Shipping Point—Reduction Plant at Jumasha Planned

Work is being done by the Vanadium Corporation of America to do away with the use of llamas for transporting ore between its mine at Minasragra, Peru, in the Department of Junin, and the railroad shipping point at Ricran on the Cerro de Pasco Railway. At present the ore, after being calcined at the mine, is carried by these pack animals over a stretch 12 kilometers long to a point overlooking Lake Pun Run, thence down the steep declivity to Jumasha 800 or 900 ft. below on the shore of the lake. Here it is transferred to a barge and ferried 13 kilometers across the lake to Casa Laguna, where the sacks are again loaded on llamas and, after another tedious haul of 25 kilometers, delivered to the company's ore-shed at Ricran.

Motor trucks will soon replace the llamas over the stretch from Casa Laguna to Ricran. A ballasted highway,

10 meters wide, has been under construction for some time between these points and is almost completed. A narrow-gage (30-in.) railroad, using 40-lb. rails, is also to be built between the mine at Minasragra to the escarpment overlooking Jumasha, thus making unnecessary the use of llamas at the beginning of the haul as well. At a recent meeting of the board of directors in New York, J. Leonard Replogle, president of the corporation, announced that a contract had been let to the Foundation Company for the immediate construction of this 12-kilometer length of railroad.

Over the stretch between Casa Laguna and Ricran, across the lake, the company has been using a Yuba caterpillar tractor with King trailers, in the course of building the motor road referred to above. As soon as this construction work is completed, Moreland

trucks will be used for hauling ore. These have been found especially adapted for work at this altitude, having been designed for the purpose. At Minasragra the elevation is a little less than 16,000 ft. Lake Pun Run is 14,200 ft. above the sea.

Staff headquarters are maintained by the Vanadium Corporation at Jumasha on the shore of Lake Pun Run, nearest the mine. At present, engineers of the construction company are engaged in re-surveying the corporation's holdings at this point, which has been selected for the site of a treatment plant which it is proposed to erect. At this plant a product will be made that will run 85 to 90 per cent vanadium oxide, which will be shipped to the com-

per cent V_2O_5 , this being raised to 35-40 per cent upon calcining. As thus far determined, the orebody has a maximum width of about 40 ft., though the limits have never been definitely proved. It is anticipated that in the future modern mining machinery will be installed at the mine for the purpose of working the deeper and narrower portions of the deposit.

From Ricran the sacked calcined patronite ore is shipped via the Cerro de Pasco Railway 108 kilometers to Oroya, whence it continues over the Central Railroad of Peru to seaboard at Callao. It is at Oroya that the Cerro de Pasco Copper Corporation has just broken ground for its proposed 2,500-ton smelter that is to supplant the one

total capacity will be considerably increased.

The chief uses of vanadium may be listed as follows: It is used for high-speed tool steels in amounts varying from 1 to 2 per cent and for machine tools; also, extensively in automobile construction for springs, transmission parts, axles, crank shafts, connecting rods, steering knuckles and levers, and for ball and roller bearings. It is used for locomotive frames, axles, connecting rods, piston rods, valve parts, and springs; for hammer piston rods, pneumatic tools, metal cutting saws and edge tools; for crank shafts and line and tail shafts of warships; for torpedo air flasks; airplane engine construction and fittings; and for thin armor for



OPEN CUT AT MINASRAGRA, DEPARTMENT OF JUNIN, PERU, WHERE THE VANADIUM CORPORATION OF AMERICA GETS ITS ORE

pany's reduction works at Bridgeville, Pa. The engineers have also to determine the best point for locating a hydro-electric plant capable of furnishing 20,000 kw., for operating the proposed treatment plant. At present it seems probable that this power plant will be situated about 25 miles from Jumasha.

At the mine the ore, which is a clean patronite, is extracted in open-cut workings. It is fairly soft and is given a preliminary crushing with sledges, after which it is calcined before being shipped by llama to Jumasha. It is packed in sacks weighing from 110 to 125 lb. each and averaging 117 lb. Incidentally, it is interesting to note that the llama is very sensitive to overloading, and will sit down in its tracks, if its customary load is exceeded, until the excess is removed. In the past, the ore that has been taken out has run from 20 to 25

at La Fundicion. Oroya is 12,200 ft. above the sea. After leaving this junction point, the Central of Peru climbs the cordillera, reaching the summit at Mt. Ticlio, 15,685 ft. high, from there descending to the Pacific. From Callao, the patronite ore is shipped by water to the United States, being consigned to the Vanadium Corporation's plant at Bridgeville, Pa., near Pittsburgh.

At the Bridgeville plant, vanadium has hitherto been produced by the aluminum reduction process; recently, however, an electric furnace capable of producing about 75,000 lb. per month was installed for re-treating the slag from the dump of the reduction plant, which carried considerable vanadium. It is expected that by June 1 a second electric furnace of the same capacity will be installed. Ultimately, with both electric furnaces in operation, as well as the aluminum reduction plant, the

tanks, cars, and trucks. It is also used for machine-gun barrels, rifles and heavy guns, and in making cast-iron parts of gas and oil engines; in short, wherever a steel of high physical properties and of ability to stand great fatigue and heavy duty is required.

The deposit at Minasragra has been worked by the American Vanadium Co. since 1905 and until Sept. 15 last year, when the assets and business of the company were taken over by the newly organized Vanadium Corporation of America. The officers of the new company are J. Leonard Replogle, president; Col. M. G. Baker, vice-president; L. K. Diffendeifer, treasurer, and E. F. Nickerson, secretary, and its offices are at 120 Broadway, New York. The company recently declared its initial quarterly dividend of \$1.50 per share on 373,334 shares outstanding, the total amount being \$560,001.

Minasragra for some time prior to 1919 continued to supply over half the world's requirements of vanadium, the only other producer of importance being the Primos Chemical Co. Early in 1919, the Primos company's plant at Vanadium, Col., was burned down, and Minasragra, drawn upon to make up the shortage thus caused, produced over 90 per cent of the vanadium consumed in the United States. On Jan. 1 of this year the Primos Chemical Co. was purchased by the Vanadium Corporation of America, the latter acquiring the former's reduction plant at Primos, Pa., and vanadium, molybdenum, and tungsten mines and concentration plants in Colorado.

Mining Corporation of Canada in Flin Flon Deal

It is announced from The Pas, Man., that the Mining Corporation of Canada is associated with Col. W. B. Thompson, of New York, in the Flin Flon deal. In *Engineering and Mining Journal* of March 13 it was stated that W. J. Judson and C. F. Ayers, together with a certain mining company, were associated in this deal and it is now made known that the company referred to is the one named. Work on the property has been already begun.

Thomas W. Lawson Charged with Advertising Stock Illegally

Charged with illegally advertising mining stock, Thomas W. Lawson, author of "Frenzied Finance," surrendered himself to the police in Boston on March 25. He entered a plea of not guilty and was released under \$2,500 bail after being arraigned in the Municipal Court. Lawson was specifically charged with having advertised, as an officer and agent of the Manhattan Union Mining Co., the approaching increase in price of a certain mining stock, without first filing with the Commissioner of Corporations a statement of the company's financial condition in the preceding year. His case was continued until April 6.

By the attack on Amalgamated Copper contained in "Frenzied Finance," which was published in 1905, Lawson caused a sensational decrease in the price of that stock. It was also Lawson, who raised the cry that over \$60,000,000 had been made in Wall Street through a tip as to the nature of President Wilson's peace note of December, 1916. These charges he could not prove before the House Rules Committee.

Canada Copper's Greenwood Plant for Sale

The Canada Copper Corp., Ltd., Allenby, B. C., announces that it is dismantling the old copper smelter which it has been operating at Greenwood, B. C., for some years, and that the entire equipment of the old smelter and of the mines there is offered for sale. This does not refer to the works at Allenby and Copper Mountain.

Fight Proposed Increase in Utah Power Co.'s Rates

Contracts With Many Companies Still Have Long To Run—Test Case Before State Supreme Court

Permission to increase power rates has been applied for by the Utah Power & Light Co., and the matter has been taken up by the Public Utilities Commission. A great many of the power users of Utah, including the mining and smelting interests, are operating under old contracts with this company, some of which have from ten to twenty-five years still to run. The question at issue is whether these contracts can be abrogated or modified by the Public Utilities Commission to allow for increased rates. Most of the contracts were made before the establishment of the commission in 1917. A test case has been brought by two of the large cement companies and was heard by the State Supreme Court on March 18. The cement companies sought to restrain the commission in regard to any change or interference with their power contracts. The court now has the case under advisement. This case will be of direct interest to the mining industry in Utah, as, altogether, there are fifty-seven holders of special contracts, and the State Supreme Court will decide whether or not to prohibit the commission from further action. If they are restrained, as seems probable, the present contracts will stand.

The Utah Copper Co. is stated to be estimating costs with a view to installing its own power plant for supplying its requirements at the concentrators at Garfield, Utah, and for the mines at Bingham. A 60,000-kw. plant (80,000 hp.) is mentioned. This would be a steam turbine plant, condensing, with the most modern apparatus for steam-driven equipment.

It appears doubtful if any increases under existing contracts will be allowed.

One Big Union Causes Strike at Cobalt

The influence of the One Big Union, which recently started to organize in Cobalt, Ont., is beginning to be felt. Recently several members of the O. B. U. were discharged from the McKinley-Darragh. It is understood that they were let go for sabotage and not because of their affiliation with the union, although it is a question as to what extent the new organization was responsible for their actions. Upon the refusal of the management to reinstate these men, about fifty-seven miners struck. The mill, however, is able to run to capacity, and the striking employees are gradually being replaced. This hasty and ill-advised strike will be of no benefit to the O. B. U., which is, perhaps, a matter for congratulation.

Industrial cranes have been sold on the Mesabi Range to the Cleveland-Cliffs Iron Co. and Butler Bros., who are operating iron mines.

Wisconsin To Have Acid Plant at Cuba City

National Zinc Separating Co. Will Complete Project Started by Government

Official announcement was made on March 24 that the National Zinc Separating Co., whose main office is at Platteville, Wis., has purchased from the Government the acid plant begun in July, 1918, at Cuba City for the manufacture of 20 per cent oleum. The plant was 75 per cent completed when work was ordered discontinued in November, 1918. It is estimated that it will be completed and ready for production June 1. The product to be made is what is commonly termed fuming gas, known commercially as 20 per cent oleum, from which various grades of sulphuric acid are diluted. The plant's output will be one tank car per day at the start. The bulk of the blende concentrates roasted at the National Roaster at Cuba City, as elsewhere in this district, assay 20 to 40 per cent zinc and 10 to 30 per cent iron sulphide. The sulphur fumes from the iron content, formerly wasted in the old process of roasting, and the iron roaster tailings, assaying 30 to 35 per cent sulphur, heretofore sold and shipped to outside plants, will be used.

Nevada Court Holds Valid Discovery Essential Before Location

An injunction which has tied up work for seven years on valuable placer claims at Copper Canyon, 22 miles south of Battle Mountain, Nev., was dissolved by a decision of the U. S. Supreme Court on March 15. This final decision reverses the U. S. Circuit Court of Appeals, which in turn had reversed the U. S. District Court at Carson City. The plaintiffs in the case, who have now won the claims in dispute, are George A. Cole, Ed. Malley, Gilbert Ross, George B. Thatcher and William Forman, and the defendant is Joseph Ralph. The plaintiffs worked the claims for eight days before they were enjoined, and according to Thatcher, took out \$3,000 in that time.

In discussing the decision, Thatcher, who was formerly attorney-general of Nevada, said it was important because it recognizes the absolute necessity of first making a discovery of mineral rock or gravel before any location can be made—that is, that nothing can dispense with the necessity of first making a valid discovery. The Circuit Court of Appeals, in reversing the District Court, held that the statute of limitations, if it had run, would take the place of discovery and all other acts of location.

Recent Production Reports

Granby Consolidated produced 2,180,000 lb. copper in February, against 1,975,439 in January.

United Verde Extension produced 2,977,898 lb. copper in February against 3,676,312 in January.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

McFadden Would Forbid Destruction of Gold and Silver Coins

Causes Loss to Government, in View of Minting Cost—Should Also Protect Foreign Coinage

In an effort to prohibit the destruction of gold and subsidiary silver coins, Representative Louis W. McFadden of Pennsylvania, has introduced legislation looking to that end. In explaining this bill Mr. McFadden said:

"It is estimated that gold coin in the amount of from three and one-half to ten million dollars is being destroyed in the United States annually for other than monetary purposes. The smaller consumers of gold in the manufactures and the arts, unable to purchase less than \$5,000 in gold bullion at one time from the Mint, find it more economical to destroy gold coin and thereby also gain the copper content. This constitutes a depletion of the gold reserve by other than monetary uses, and, therefore, should be prohibited.

"When the bullion price of silver is \$1.37 per oz., it becomes profitable to convert coin into bullion. Aside from the apparent need for maintaining our present coinage circulation, in order to conduct the large volume of domestic business, this destruction of gold and silver coin is a tremendous economic waste to the Government, as is evidenced by the following costs of mintage, which are reported by the United States Mint: The average cost of manufacturing gold coins per thousand dollars is as follows: Double eagles, \$2.82; half eagles, \$3.11; eagles, \$1.95; and quarter eagles, \$4.29. Gold coins were manufactured in 1913 and 1915, but none has been minted since. The cost of manufacturing them now probably would not be less than double the costs of 1915, as above. The average cost of manufacturing silver coins per thousand dollars is as follows: Half dollars, \$13.97; quarter dollars, \$15.96; and dimes, \$17.98.

"We have by law made certain coins of foreign countries current in the United States. Much of this coin is now in circulation. Inasmuch as Great Britain, Canada and France have already adopted laws to prohibit the destruction of their own coin, it is a matter of international financial ethics for the United States to pass a law which would similarly protect their coin from destruction in this country. In return, if such a law were passed, it is probable that those countries would also pass laws to protect our coin in circulation abroad. . . . To lower the content of our subsidiary silver coins by decoin-ing and reminting, it is estimated would take some two years, while this law will immediately become operative."

Revision of Metal Mining Laws Asked in New Bill

Draft Prepared by James R. Jones To Be Submitted to Mining Societies for Approval

A bill providing for the revision of the metal mining laws has been drafted by the committee of consulting engineers of the U. S. Bureau of Mines, which was appointed for that purpose three years ago and which has been working in co-operation with a committee of the Mining and Metallurgical Society of America. The bill is based on a referendum from various mining societies and was prepared by James R. Jones, one of the law officers of the Bureau of Mines and secretary of the committee. The draft of the bill is to be sent out to the mining societies which participated in the original referendum, so that any changes that may be desired may be indicated.

Government Patent Bill Passed by Senate

Provision for reimbursing Government employees who may develop inventions in the course of their duties is provided in a bill which has just passed the Senate. The Federal Trade Commission is authorized to administer any such patent rights for the benefit of the public. A portion of the royalties which may be obtained is to go to the inventor. The President is empowered to determine the percentage of the returns which is to go to the employee.

The question of handling important discoveries and inventions by Government employees has been a much mooted one for years. The present bill is an attempt at a solution.

New War-Minerals Bill Reported Favorably to House

Commission Erred in Interpreting Intent of Act, Committee Holds—Prompt Discussion Unlikely

The Committee on Mines and Mining of the House of Representatives has reported favorably to the House the bill recently drafted by the committee providing for review by the Court of Claims of awards made under the War-Minerals Relief Act. The committee at the same time expressed an opinion that the War-Minerals Relief Commission erred in its interpretation of the intent of the act under which it was operating. The committee calls attention to the fact that the relief law directs the Secretary of the Interior to "adjust, liquidate, and pay such net losses . . . and shall make adjustments and payments in each case, as he shall determine to be just and equitable . . . it shall appear to the satisfaction of the said Secretary that the expenditures so made, or the obligations so incurred by the claimant were made in good faith for and upon property which contained either manganese, chrome, pyrites, or tungsten in sufficient quantities as to be of commercial importance . . . that moneys were invested and obligations were incurred . . . in a legitimate attempt to produce . . . for the needs of the nation for the prosecution of the war, and that no profits of any kind shall be included in the allowance of any of such claims, and that no investment for merely speculative purposes shall be recognized in any manner."

It is contended by the committee that the language is clear and that the act has not been administered by the War-Minerals Relief Commission in accord-

STATUS OF PENDING MINING LEGISLATION

Bills That Have Reached Committee Stage

Subject of Bill	Bill No.	Author	Present Status
Silver in coins	H. R. 11,226	McFadden	Before House Committee
Met. Min. on Ind. Res.	S. 287	Ashurst	On Senate Calendar
Timber for mining purposes	S. No. 1	Pittman	Passed Senate Oct. 3, before House Committee
Anti-dumping	H. R. 10,918	Fordney	Passed House Dec. 9, before Senate Committee
Laboratory glassware	H. R. 7,785	Bacharach	Passed House Aug. 2, on Senate Calendar
Magnesite	H. R. 5,218	Hadley	Passed House Aug. 7, on Senate Calendar
Tungsten	H. R. 4,437	Timberlake	Passed House Aug. 21, on Senate Calendar
Zinc	H. R. 6,238	McPherson	Passed House Sept. 2, ordered reported favorably
War Minerals Relief	H. R. 13,091	Garland	Reported favorably to the House March 25.

ance with the interpretation given to similar provisions in other laws. The committee cites various court decisions in which the interpretation and application of the same principle is set forth.

Another point made by the committee is that claimants for relief in connection with liquidation of War Department contracts, who are provided for under the same act, have recourse to the Court of Claims. The opinion is expressed that the war-minerals claimants should be placed on equal footing with the War Department claimants.

Another argument used in favor of the bill just reported is that it provides means of disposing finally of the claims which otherwise might be presented to Congress as private claims. The experience has been that these private claims are delayed for long periods. It is regarded as advisable to settle the claims by a quicker method so that all the evidence may be available, which is often not the case when Congress gets around to the consideration of private claims.

No arrangements have been made for the consideration of the bill on the floor of the House, and in view of the present legislative situation it may be some time before the bill can be taken up for discussion.

Tariff on Antimony Proposed

Antimony, as regulus ore metal and matte containing antimony, but not containing more than 10 per cent of lead, is to be dutiable at 10 per cent ad valorem if Congress should pass a bill introduced by Representative Watson,

of Pennsylvania. The bill also provides for a 25 per cent ad valorem duty on antimony oxide and a duty of 7c. per lb. and 45 per cent ad valorem on various antimony salts.

Tungsten Tariff Urged for Protection and Revenue

The report made by the Senate Committee on Finance in urging the passage of the tungsten tariff bill, reads in part as follows:

"The report of the United States Tariff Commission states that 'the United States has a sufficient supply for many years to come.'

"The destructive competition which American producers are helpless to meet comes from the ores of Asia. The costs of domestic production were proved from certified statements to average \$13 per unit. The foreign costs were showed to be from \$2 to \$4 per unit; and foreign ores are being sold in New York at from \$6 to \$7.50 per unit. Large quantities, aggregating about 50,000 units per month, are being imported, duty free, and none is being produced now in the United States.

"The difference in costs are not due alone to the discrepancy in high wages paid our American miners (from \$4.65 to \$6.50 per day) and the pittance paid Asiatic coolies (from 20c. to 50c. per day), but the physical character of the deposits is different. Most foreign ores are recovered from rich surface deposits, that require little or no equipment, while American ores are recovered from veins or lodes of hard rock. Expensive

mine equipment is required and large costly mills are necessary, as the ore has to be crushed and concentrated.

"It has been shown that the tungsten mining industry is in a critical condition. Unless prompt action is taken it will be destroyed. Every mine in the United States is closed down, and, without the duty asked for, cannot reopen. The industry which proved of such vital importance during the war will fall in decay, and it cannot be rehabilitated, and the country will be left to the mercy of Asiatic production to supply a material as necessary in our industrial peace program as it is essential in war.

"At the present time tungsten-bearing ores of all kinds are on the free list. With the placing of a duty on such ores it is necessary to place a compensatory duty on imports of refined tungsten products and alloy steels, and the rate named in the bill provides that compensation.

"From the showing made it is perfectly evident that this industry should be protected. Without a healthy tungsten industry the United States will be completely at the mercy of hostile nations, which could instantly cut off supplies. The production of war material would be paralyzed.

"Your committee believes a duty should be placed upon tungsten-bearing ores for two reasons: First, the protection it would afford to this country, and, second, the revenue that would be derived from a duty upon such ores as may be imported.

"We therefore recommend the passage of the bill, H. R. 4437, as amended by your committee."

NEWS BY MINING DISTRICTS

ARIZONA

Gadsden Stops Drilling and Pulls Pumps—Arizona Copper Sues Coronado—Mohave County Operations

Jerome—Gadsden is quitting. Diamond drilling has been stopped on the 1,200 level, pumps are being pulled and trackage is being taken to the surface.

No. 3 shaft of the United Verde, heretofore the principal operating shaft of the property, is to be abandoned, being in the way of the steam shovel operations on the 500 level, from the surface of that level on the hillside. It will be succeeded by No. 6, which is to be complete before the end of the year. It was raised 15 x 15 ft. from the 1,950 to the 400, under contract finished last month, and is now being concreted for its full depth, work that will take six months more. It will have a 13 x 8-ft. compartment in which will be a double-deck cage that will accommodate 96 men. The balance of the shaft space will be taken up by the counterbalance, a manway and pipe and electrical conduits. The hoist, an electric Nord-

berg, will be on the 500 level, in a reinforced-concrete chamber 44 x 45 and 26 ft. high, 2,000 ft. distant from the 500 level portal. The men will be taken on electric cars to the change house, in the open, 2,500 ft. distant from the shaft. No. 6 later will be sunk to 2,400 ft. depth. No. 5 shaft is nearly complete to 2,500 ft.

Clifton—The Arizona Copper Co., Ltd., has entered suit in the Greenlee County Superior Court against the Coronado Mining Co., alleging a debt of \$40,815, accrued within the last ten years in the payment by the plaintiff of taxes and general expenses on the property of the defendant corporation. The same plaintiff also has sued to quit title on the Comet Lode mining claims, purchased from the state on account of non-payment of taxes by former owners.

Globe—Miami Copper has started a 1,200-ft. drift from the new No. 5 shaft to cut its orebody. Foundations are being placed for a new crushing plant.

Delayed equipment is arriving for the Iron Cap mill. The railroad from

the shaft to the millsite is about complete and its electric equipment has been delivered. The Iron Cap shaft has passed 1,350 ft. depth. An ore pocket is being placed at 1,300 ft. and another will be provided at 1,500. Shipments are going at the rate of 7,000 tons a month to the Inspiration mill and International smelter.

Phoenix—At the annual meeting of the Kay Copper company here, George W. Long was elected president, S. J. Tribolet, vice-president, and Fred J. Elliott, secretary. All are of Phoenix. Other directors chosen were F. R. Poss and F. W. DeFoe, of New York, representing the interests of the Yawkey estate. The president reported that the mine, 40 miles north of Phoenix, now has exposed copper ore of commercial grade worth \$6,000,000, with several new lenses lately cut by drilling. The main development will be from the going to the Inspiration mill and International smelter.

Production will be started soon by A. J. Porterie from his cinnabar mine, nine miles north of this city. He has

purchased a retort that will handle three tons of ore a day, and has on hand a quantity of the richer ore from new development work. The ore is found in schist stringers. It runs from 1 to 5 per cent in quantity and extends along a contact for fully two miles, within a pass in the hills that are the northern boundary of the Salt River Valley. Development is not over 100 ft. deep on any of the five groups of claims that cover the outcrops.

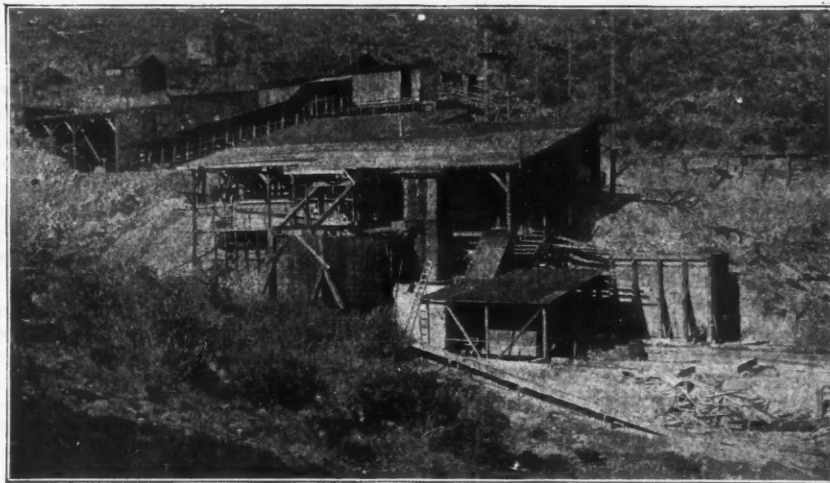
The Chloride District

BY S. FORD EATON

The Chloride Silver Mines Co. is one of the camp's active operators. It owns and works the Diana mine about 1½ miles west of Chloride. Development work is being done from a vertical shaft which is down 360 ft. and is being sunk to the 400 level. Gasoline is now used for power, but installation of electrical equipment is under consideration, the power to be obtained from the Desert Power & Water Co. at Kingman. The main vein on the property is about 18 ft. wide and dips at 80 deg. The shaft cuts the vein at the 250 level and enters the footwall at the 300. On the 200 and 300 levels about 250 ft. of drifting has been done in ore. Results from general sampling of the advancing drift faces averaged \$40 in silver and gold. In places, streaks rich in silver run up to \$400 per ton. An average across the entire 18 ft. of vein on the 300 level gives \$11.35. The ore shows an absence of zinc and is quite amenable to concentration. The plans of the company include sinking to the 400 level, crosscutting to and drifting on the vein at that level and eventually the installation of a mill. D. C. Williams is resident manager. The company's eastern office is at No. 85 Devonshire St., Boston.

Mineral Park—Work has been resumed at the Washington mine. A gang of men has been put to work cleaning up mill shaft and tunnel. Sinking will soon be started.

Activities at the Golden Star mine continue. The new headframe is in place and the hoist house, blacksmith shop and transformer house are completed. The old inclined shaft is being cleaned out and the new vertical shaft is down 35 ft.



MILL AT WASHINGTON MINE, MINERAL PARK, MOHAVE COUNTY, ARIZ.

CALIFORNIA

Natomas Co.'s Report — Kennedy Workings Flooded To Put Out Fire

Natomas—The annual report of the Natomas Co. of California shows a net profit of \$461,483 from dredging on company property. Eleven gold dredges are owned and operated by the company, nine on the American River and two on the Feather River. Cubic yards of material dredged were 20,485,530, the total cost being \$1,313,640, including taxes and insurance. Two rock-crushing plants were operated, one at Fair Oaks and one at Oroville, the combined output being 359,000 tons of crushed rock and 92,000 tons of screened gravel during the year.

Jackson—The fire in the Kennedy mine has proven so persistent that it became necessary to flood the workings. It started in the Argonaut mine adjoining nearly a year ago and ever since has been a serious handicap to operations at both properties. The flooding of the mine will cause a suspension of operations for an indefinite period.

Brandy City—The Yuba Development Co., successors to the Marysville-Nevada Water & Power Co., has completed preparations for extensive hydraulic operations. Recent rains have assured a fair supply of water for this season's work.

COLORADO

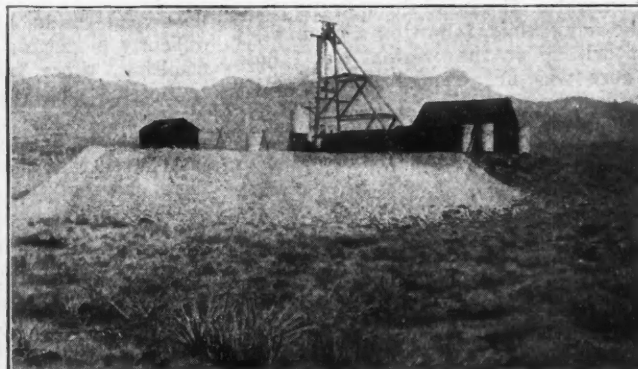
Carnotite Mining Active Around Montrose—Efforts Under Way To Revive Properties in Hahn's Peak District.

Idaho Springs—New equipment has been purchased by the St. George Mines Co. to develop the recently discovered body of silver-lead ore opened up on its property on Douglas Mountain.

Lessees on the La Plata have broken into good silver-lead ore and are storing it for shipment as soon as the roads can be opened up.

Montrose — In anticipation of unprecedented receipts of carnotite ore, the Radium Ore Sampling Co. has enlarged its plant and increased its warehouse facilities. The sampling plant is said to be one of the most complete of its kind and storage facilities are provided for 250 tons of sacked radium ore. Extensive road building by the county is being planned to bring a larger part of the carnotite field tributary to Montrose.

Steamboat Springs—A decided revival of mining activity is in evidence throughout the Hahn's Peak district, about forty miles northwest of Steamboat Springs. In early days ore was freighted to Denver by wagon, and with the advent of the Moffat road an effort was again made to revive the camp, but the low price for metals and the long wagon haul discouraged opera-



LEFT—OLD AND NEW INSTALLATIONS AT GOLDEN STAR MINE, MINERAL PARK, MOHAVE COUNTY, ARIZ. RIGHT—ENGINE ROOM AND HEADFRAME AT DIANA MINE, CHLORIDE, ARIZ.

tions and most of the properties were closed down. The Tom Thumb group, located high on the west slope of Hahn's Peak, was recently transferred to strong interests. This is reputed to have shipped lead carbonates running 60 oz. silver and over 50 per cent lead.

At Columbine, a few miles north of Hahn's Peak, new locations are being made and arrangements perfected to revive old properties. The Master Key Mining Co. announces that it has provided the necessary capital and will begin development work when the condition of the roads permits.

IDAHO

Coeur d'Alene District

Wallace—Patrick Brady, of Wallace, representing a syndicate of Pittsburg, Pa., men, has secured a bond on the Olympia group of twelve claims and the Rose claim, adjoining on the east. The ground is favorably situated, joining the Green Hill Cleveland on the west and the Tamarack & Custer on the north, within a proved mineral zone. A shaft on the Rose claim has been sunk 100 ft. on the vein, showing much low grade lead carbonate ore. Brady has also secured a lease on the Headlight plant and workings, from which he will drive a crosscut across the Green Hill and Cleveland claims into the Rose, cutting the vein at a depth of about 1,200 ft. The bond on the Olympia group is for \$150,000 and on the Rose for \$100,000, payable on or before July 1, 1921.

KANSAS

Joplin-Miami District

Baxter Springs—The Iowa Mining Co., which has a 46-acre lease in Oklahoma two miles south of Baxter Springs, Kan., has purchased a 150-ton mill in the Joplin field and is removing it to its lease. The Iowa lost all its equipment last fall by fire. A new hoist and pump were installed. The shaft has been deepened.

MICHIGAN

Seneca Drilling for Kearsarge Conglomerate—Mohawk Ordering More Storage Battery Locomotives

Calumet—Seneca's diamond drill is now heading for the Kearsarge conglomerate. It passed through the Osceola amygdaloid, following a resumption of drilling on the original No. 1 hole. There was not enough mineralization evident in the Osceola to justify development. The Osceola carries no values in the vicinity of the Mohawk, Ahmeek or Seneca.

The company's work in Gratiot No. 2 shaft is fairly well under way. One party is at work on the 6th level and another at the bottom of the shaft. Others will be started soon. No further shipments of Seneca rock have been made at this time. In the Seneca shaft proper the work of laying concrete skiproads is continuing.

The Keweenaw Copper Co., owned

largely in Duluth, has invested \$219,832 of its total surplus in Anaconda 6 per cent bonds. It also has \$25,200 in United States bonds. The surplus and other quick assets now amount to \$267,241.42, with no bills payable. Thomas F. Cole is the president of the company. The directors are George G. Hartley, of Duluth; Spencer Hill, of Boston; Thomas Hoatson, of Calumet; A. L. Warner, of Duluth, and Charles A. Wright, of Calumet.

Mohawk—Mohawk's most interesting development is in the remarkable stretch of vein matter 40 ft. wide now being opened at the 25th level. This freak showing seems to be opening as rich in copper on the lower level as in those above. The company has ordered more storage battery locomotives, using four of them in development laterals. Trolleys continue in use in the permanent openings. A trolley system has been installed on the 15th level of No. 6.

Kearsarge—Wolverine is not touching its mine pillars. From the 40th level upward the company is working out the old stopes and getting fairly good returns. The output for March was not large, but will get back to normal in April if present improvement continues. In February the flow of mine water from the South Kearsarge gave trouble, but this has been taken care of. The company had to keep bailers at work owing to this, thus interfering with the production of rock.

Other amygdaloids of the Wolverine will be opened in crosscuts. A program of exploration will be carried on east of the shaft. In addition to the crosscuts diamond drilling will also be done.

Iron Country

Menominee Range

Iron River—The Cleveland-Cliffs Iron Co. is preparing to resume at the Spies mine, north of the city, which closed down a year ago when the ore market started to sag. It has considerable ore in stock. Contracts have been made for more than the amount on hand, and some ore will have to come from underground to fill orders received.

Iron Mountain—There is talk of organizing a furnace company here, with M. E. Richards, formerly of the Judson Mining Co., in charge. Negotiations are under way for the purchase of large hardwood tracts, and there will be no difficulty in getting the proper ores for smelting, there being various grades to be had close to the city. Several meetings of men identified with the project have already taken place, and it is believed that the furnace, which will have charcoal iron as a product, will be constructed.

Marquette Range

Palmer—Preparations are being made for resuming operations at the Richmond and Empire mines, both of which will be worked by the M. A. Hanna Co. The Maitland will also resume work at an early date. All of these mines produce low-grade siliceous ores, of which

there is a large tonnage in the Cascade district.

Gogebic Range

Ironwood—Within the last week or ten days the deep winter snows have melted and the mines are preparing for the shipping season. They could start shipping now, but have to wait for the boats, and the harbors are still choked with ice.

Another 400-hp. water-tube boiler has been received at the Pabst mine and will be added to the battery supplying steam to the turbo-generators in "G" power house.

According to the annual report of the Inspector of Mines for Gogebic County, Mich., for the year ended Sept. 30, 1919, which has just been published, there were two open-pit mines and nineteen underground mines in active operation, and two more underground mines where development work was going on. The underground mines mined 5,141,428 tons of ore and employed on the average 6,273 men, of whom 4,424 worked underground and 1,849 on surface. At these mines there were fifteen fatal accidents, three of which occurred on surface, and 320 accidents where the injured was disabled for more than two weeks. The two open-pit mines employed on the average 562 men; the tonnage mined is not given. They had three fatal accidents, and twenty-two were injured who were disabled for more than two weeks.

MONTANA

Butte—C. F. Kelley announces that Anaconda's ferro-manganese plant at Great Falls will be operated at capacity as soon as arrangements for tonnage can be made. One furnace is now in operation and three more will be put in commission immediately. The rod and wire plant is being operated day and night.

NEVADA

Operations at Round Mountain—Blue-stone M. & S. Co. Lost Quarter Million in 1919

Round Mountain—The Round Mountain Mining Co. is carrying on development in the Sunnyside crosscut. Drifting on the vein recently cut by this crosscut at 400-ft. depth is producing satisfactory results. The crosscut is also being extended to cut stringers found on the surface.

The Fairview Development Co. has saved 100 tons of \$25-\$40 ore from development on the 100 level of the main shaft. In a crosscut on the 250 level what appears to be a new vein system has been opened up, and Louis D. Gordon, general manager, believes the find may prove important. Owing to recent snows, the outlook for the placer season is more promising than it was.

Simon District—On receipt of a substantial cash payment and a block of stock, Hector McKinnon has compromised with the Simon Silver and Simon Extension companies as to the ownership of valuable local claims, the companies now having uncontested title.

Goldfield—In addition to work on company account on the 350 level of the Florence mine, ten sets of lessees are busy and one or two of them are in ore, according to F. Sommer-Schmidt, general manager. The company is running two crosscuts on the 350, one to the west and the other southeast, the former to explore the Columbia Mountain fault, and the latter to determine if faulted orebodies were thrown to the east instead of to the west, where most of the exploration work has hitherto been done. The management has so far done 1,200 ft. of development on royalty returns of lessees.

Yerington—The income and profit and loss account for 1919 of the Blue-stone Milling & Smelting Co., as shown by the report of Warwick, Mitchell & Co., chartered accountants, reveals a net loss of \$248,601.03. Income from copper and concentrates was \$493,683.41, and from silver, \$1,230.44.

Pioche—Joe Sandon, who is associated with E. C. D. Marriage, of the Pioche Assay Office, purposes to re-treat 12,000 tons of De Lamar mill-tailings which he owns. These will average \$3 in gold and silver per ton, and a recent test demonstrated the practicability of making a 75 per cent recovery by cyaniding and charcoal precipitation. The tailings are so situated that they can be economically loaded into tanks for treatment. Water for milling has been arranged for.

The Prince Consolidated shaft is now down 565 ft. vertically.

A cyanide unit is to be added to the Tungsten Comet's milling plant.

NEW MEXICO

Mogollon—Preliminary plans are being considered by the Mogollon Mines Co. for the development of water power in Whitewater Canyon for use at the mines.

White Signal—An option has been closed through L. N. Kniffen, manager for the U. S. Smelting, Refining & Mining Co. at Hanover, N. M., for six claims owned by Otto Forster and Jack Grissom, the purchase price being stated at \$175,000, the purchaser to sink a shaft 125 ft. within a year. The property is reported to show bismuth, but was originally located for gold.

Black Hawk—The Black Hawk Con. Mines Co. has installed a 60-hp. gas hoist at Ross No. 1 shaft, which is 300 ft. deep, and is hoisting about 100 tons daily. About five cars of ore a week are being shipped.

Steeple Rock—The Nuggett group has been leased by George F. Utter to Serf, Amme and Lewis, who have started active operations.

UTAH

Park City—Shipments for the week ended March 20 amounted to 1,892 tons, as compared with 2,213 tons the week preceding, bad weather and poor roads being the chief cause of the decrease.

The Silver King Consolidated Mining Co. reports that its Spiro tunnel during 1919 advanced 2,622 ft. at a cost of \$39.87 a ft. as compared with 4,001 ft. in 1918 at a cost of \$30.48 per ft, and as compared with 5,000 ft. in 1917 at a cost of \$21.61 per ft. In 1918 the cost of labor increased 30 per cent and in 1919, 82 per cent. Material advanced 46 per cent in 1918 and 83 in 1919. Work in 1919 was practically suspended for seven weeks during the time of the Park City strike. With about 3,000 ft. more work the tunnel will have reached ground underneath the California-Comstock shaft, and it will be possible, when connections have been completed by raising, to take out ore which can be concentrated in the mill at the portal. The cost of the tunnel work exceeded the income from ore sales even more than was expected, owing to increased costs, and the difference was made up from the sale of treasury stock and short-term 7 per cent notes convertible into stock at \$2 per share. With the tunnel completed, the cost of ore extraction will be lowered.

WASHINGTON

Daisy—The Silver Mountain Mining Co., with head offices in Spokane, is completing arrangements for the erection of a 50-ton concentrator at the old Daisy mine four miles east of the town of Daisy. For several years past, the company under the direction of W. H. Seelye has been engaged in developing two parallel quartz veins carrying their principal values in silver. A 1,000-ft. crosscut has been completed.

Index—A crew of 70 men is employed at the Sunset Copper mine in the Cascades. One hundred tons of ore is being handled daily in the mill with good recovery. A winze is being sunk 100 ft. below the present lowest level and a deeper level will soon be opened.

CANADA

British Columbia

Atlin Hydro-magnesite Shipped Abroad
—Rock Candy Mine Resumes Operation

Stewart—Extensive development of the Big Missouri Group is planned for this summer. About 12,500 ft. of diamond drilling will be done on this property and two camps will be maintained throughout the season. While the property contains some rich ore, it is to be operated chiefly for its large low-grade orebodies. If the results of the work, under way and proposed, are satisfactory the erection of a concentrator and the installation of necessary mine equipment will follow.

It is reported that Dale L. Pitt, until recently assistant manager of the Premier mine, in the Salmon River district, has been appointed general manager for the company, and that R. K. Neill, of Spokane and Vancouver, who is retiring, will retain his interest in the mine. Mr. Pitt is quoted as stating that development of the property will be carried on with energy, that a concentrator

will be installed, water power developed and a sawmill erected.

Atlin—For the first time since the war a shipment of hydro-magnesite has been made to England from the Atlin district, B. C. Two hundred tons were brought from the property to Vancouver in 1914, of which only 50 tons reached Great Britain before the opening of hostilities. The remainder has been held since that date and only now is being called for.

Allenby—The Canada Copper Corp. will begin construction work at Allenby and Copper Mountain soon. The grading of the railway will be completed shortly and it will be possible to start tracklaying. The timber for bridges is being framed at Princeton and will be taken to Allenby for distribution.

Trail—The Consolidated M. & S. Co. is paying shippers everything over 5 per cent on the exchange value.

Greenwood—Shipments from the Providence mine continue, two cars, aggregating 75 tons, having been dispatched in March. Most of this came from the 400-ft. level. Development is being done on the 500-ft. level, where there is considerable high-grade ore in sight.

Grand Forks—The Rock Candy property of the Consolidated company has resumed operations. The mill had been closed down for the last few months, although development has continued. Shipments from the decrepitating plant probably will reach about 18 cars a week.

Hedley—The Hedley Gold Mining Co. has resumed operations after several months' inactivity. G. P. Jones, general superintendent, states that the property will be worked to capacity.

Ontario

Porcupine—Dome Mines has declared a dividend of 25c. a share, payable on April 30 to shareholders of record April 1.

The Clifton-Porcupine, operating on a narrow vein a short distance from the Dome, has shipped two tons of ore to Ccbalt, which averaged \$66.45 per ton. The vein is now being opened up on the 200-ft. level.

Kirkland Lake—The report of the Teck-Hughes mine of Kirkland Lake for the year ended Dec. 31 shows that the company treated 18,387 tons, and recovered \$169,590. The mill heads averaged \$10, and the recovery was \$9.20, which leaves a fair margin of profit. The costs have now been reduced to about \$6 per ton. Ore reserves have a gross value of approximately \$1,000,000.

At the Keora the power house has been completed. The mine plant is to be in operation about April 15.

Bourke's Station—The Lake View has purchased a 5-drill compressor and mining plant, to be shipped at once to its claims, where work on the surface is stated to have resulted in an important discovery.

COURT DECISIONS IN MINING CASES

By Wellington Gustin

Judgment for Compensation Sustained

Posted Notices and Rules May Not Determine Workmen's Rights To Recover Damages

The Supreme Court of Kansas was asked to reverse the judgment for compensation obtained by an employee against the Edgar Zinc Co. The plaintiff was engaged in feeding coarse ore into a crusher. Occasionally, a piece of ore, on account of its size, would not go between the rollers, and a long-handled maul was furnished him for the purpose of breaking such pieces. Often, small pieces of iron, which could not be crushed or forced through the rollers, were found in the ore and were jerked out from the rollers by a stick. At the time of the accident a fragment of ore or scrap of iron had become lodged between the rollers and stopped them. The plaintiff picked up a short stick and undertook to pry it out, as he had often done before. The rollers started up, jerking the stick through them and injuring him. He said he used the stick because the maul would not dislodge the iron, and that he had seen others use such a stick.

Immediately in front of his working place the mine superintendent, G. W. Whipple, had posted a notice to shut down the machinery until the rollers were cleared, should they become choked. The plaintiff knew this rule, and the machines could be stopped by means of an electric switch near his working place.

In its opinion, the Supreme Court said, it was not material that plaintiff may have been guilty of a high degree of negligence. Under the English act, and the laws of several states, to warrant a reversal the court must declare as a matter of law that the injuries resulted from a "serious and willful misconduct" of the workman, and, even under the Kansas act, the mere voluntary and intentional omission of a workman to use a guard or protection furnished to him is not necessarily to be regarded as willful (169 Pac. 1087).

Now, the maul appears to have been furnished to break pieces of ore where necessary—to prevent rather than remedy the choking of the rollers, the latter situation being provided for by the direction to shut down the machinery. The fact that the workman used another and less safe instrument than the one furnished, is not equivalent to his refusal to use an available guard or protection against the danger to which his injury was due, said the court.

But the question whether the failure to stop the machinery brought the workman within the exception of the

law was more difficult. The company's rule requiring the machinery to be shut down was a reasonable and proper guard and protection against the risk, in a sense only. For, said the court, if that construction were adopted, it would seem that a recovery would be prevented whenever a workman was injured in consequence of his neglecting to follow a rule adopted by his employer for his benefit. The court concluded this was not the kind of delinquency that was within the mind of the Legislature when it denied a recovery to one who was injured through his willful failure to use a guard.

Recovery against the zinc company was affirmed.

Exclusive Selling Rights

Mining Corporation Liable for Services Accepted by It—May Not Rely on Defense of Ultra Vires

In an action by Chester A. Flanagan against the American Minerals Producing Co. a judgment for the former has been affirmed by the Supreme Court of Washington. From the facts it appears that the company, having an interest in a mineral deposit in Vail, Ore., entered into contract with one Flanagan and one Jacobson, giving them the exclusive selling rights of such mineral. Later, it was found such exclusive sales contract was an obstacle in the way of securing necessary investments in the corporation, and its surrender was solicited and obtained, the two accepting notes as a consideration for the cancellation. The company alleged that subsequently other valuable consideration was paid for this cancellation, thus invalidating the notes, including 25,000 shares of the capital stock of the company.

Flanagan alleged that in an endeavor to finance the company and sell its stock he had expended the sum named in the notes, and he testified he never knew just why the 25,000 shares of stock were issued him. The trial court found that of the hundreds of thousands of shares and dollars talked about in the whole transaction, the actual financial precipitate was about \$500, as Flanagan contended, which he spent for the benefit of the company.

On the company's contention that the notes were ultra vires, the Supreme Court said that where a mining corporation accepted the benefit of plaintiff's services and allowed him to furnish the services of an analytical chemist for testing its ores, and notes were given in payment, the corporation cannot defend on the grounds that the execution of the notes was beyond its power.

Prescriptive Rights and Pipe Lines

Authority Acquired to Lay Line on One Side of Creek Bed Does Not Extend to Other Side of Creek

A suit in equity instituted by the Pure Oil Co. and the Producers & Refiners' Pipe Line Co. against John M. Lowe, of West Virginia, was recently decided in the United States Circuit Court of Appeals, Fourth Circuit. The oil and pipe line companies asked for an injunction to restrain defendant from proceeding, either in law or in equity, to remove, from a creek bed, all pipe lines operated by gravity, maintained by the pipe line company, and to quiet title.

The piping is four inches in diameter and is part of a system twenty miles long, operated for the last seventeen years in piping oil for the public from the field in the vicinity of Jacksonburg to tanks at Pine Grove, in West Virginia, and laid in the bed of the South Fork of Big Fishing Creek, the location of the pipe line in the creek bed enabling the oil to flow by gravity.

The pipe line company claimed the right for the location of its line by prescription which matured by actual possession taken and held adversely to defendant for more than the statutory period of ten years under claim of ownership and right without objection. The evidence showed that it had acquired a prescriptive right by use for more than ten years, maintaining its line on the south side of the stream. This right was upheld by the court. But after this period the company moved its line to the opposite or north side of the stream in an entirely new location. The change, the defendant claimed, materially damaged his property on the north side of the stream. The company contended that its possession by prescription extended from one bank to the other, and that therefore it acquired a right to occupy either side of the stream and any part thereof. The court said, in view of the purpose for which the side of the stream was used, that occupancy of the south side did not inure to the benefits of the pipe line company, so as to vest it with title to the north side; it appearing that the company had not occupied the north side of the stream for a sufficient length of time to acquire a prescriptive right to that side. The company not having acquired a prescriptive right to the north side of the stream, the title of that portion of the premises remained with the grantor. Therefore the suit for injunction brought by the two companies was dismissed, reversing the judgment of the United States District Court.

MEN YOU SHOULD KNOW ABOUT

Julius Kruttschnitt, Jr., is making examinations in Greenlee County, Ariz.

Robert T. Hill has been re-elected president of the Southwestern Geological Society.

James B. Tenny, of Bisbee, has been making examinations in the Tyrone (N. M.) district.

D. C. Jackling has been visiting the Chino Copper Co.'s property at Santa Rita and Hurley, N. M.

M. Motherwell has completed his flotation experiments at the Eighty-five mine, and is now in Douglas, Ariz.

F. Field, mining engineer of Duluth, is visiting the Southwest and spending some time in Globe, Bisbee, and Ajo.

Charles A. Mitke has been in the Clifton-Morenci district on professional work for the Arizona Copper Co.

C. S. Smith, president of the Old Dominion Co., and his brother **J. Waldo Smith**, of New York City, have been visiting the company's mines in Globe.

O. B. Hopkins has resigned his position with the U. S. Geological Survey to enter private employment as an oil geologist.

Victor G. Hills, mining engineer, of Denver, Col., has been engaged as consulting engineer for the old Dolly Varden mine, Mount Bross, Col.

Nelson H. Darton, of the U. S. Geological Survey, has been given leave of absence to undertake private oil investigations in northern Mexico.

C. G. Rice was elected president of the U. S. Smelting & Mining Co. at the quarterly meeting of the directors. He succeeds the late **William G. Sharp**.

R. T. Hancock, of the Nigerian Tin Corp., Ltd., Jos, Northern Nigeria, has left Jos and is to be addressed at 4 Broad Park Ave., Ilfracombe, England.

F. A. Garbutt visited Kingman recently on business connected with a request made by the minority stockholders of the Tennessee mine for a receivership.

George Otis Smith, the Director of the U. S. Geological Survey, has been elected to honorary membership in the American Association of Petroleum Geologists.

John Seward, of Nutley, N. J., is in Washington on mine valuation work for the U. S. Treasury Department in connection with the administration of the income-tax laws.

Stephen R. Capps, of the U. S. Geological Survey staff, has been granted leave of absence for one year to do work for an American oil company in the Black Sea region.

Edward H. Clark, of San Francisco, president of the Homestake Mining Co., Lead, S. D., is returning to California after spending some time in New York City and the East.

E. C. Harder has resigned from the U. S. Geological Survey and left Washington to engage in commercial work. His new address is 1116 Harrison Building, Philadelphia.

A. R. Wilfley was in Globe and Miami recently, superintending tests of a sand pump of his own invention that is being installed at the Old Dominion and Miami mills.

Charles J. Marsh, of the Standard Underground Cable Co., was elected president of the New York Metal Exchange, and **C. Mayer** re-elected its secretary at the recent annual meeting.

I. C. White, **George Otis Smith** and **Ralph Arnold** were among the guests attending the meeting of the Southwestern Geological Society on March 19, at Dallas, Tex.



HARRY J. WOLF

Harry J. Wolf, who has been associate editor on the staff of *Engineering and Mining Journal* since June, 1919, has resigned and will resume general practice as a mining engineer with offices at 42 Broadway, New York City.

Oscar Lachmund, formerly general manager of the Canada Copper Corp., Ltd., and now in private practice at Spokane, will be in New York until the middle of April.

E. W. Shaw and **R. H. Sargent**, of the U. S. Geological Survey, have been granted leave of absence to conduct investigations in South America for an American oil company.

Arthur L. Day, geophysicist, announces a change of address from Corning Glass Works, Corning, N. Y., to the Geophysical Laboratory, Carnegie Institution, of Washington, D. C.

Dale L. Pitt, recently assistant manager of the Premier mine, Salmon River, in the Portland Canal division, has been appointed general manager of that property. Mr. Pitt succeeds **R. K. Neill**, of Spokane, Wash.

M. G. Baker, vice-president of the Vanadium Corporation of America, sails on April 7 for Peru, where he will superintend the construction of the

twelve-mile railway building from the corporation's mines to Lake Pun Run.

Bulkeley Wells, president of the American Mining Congress, recently attended the meeting of gold producers held in Tonopah for devising ways and means to stimulate gold production and securing proper legislation for the relief of gold producers.

James Neil, chief mechanical engineer of the Pennsylvania State Department of Labor and Industry, has accepted a position with the U. S. Bureau of Mines. Mr. Neil is widely known as an boiler expert and is a member of the A. S. M. E. uniform boiler society.

F. A. Wright, president of the Cerbat Silver M. & M. Co., recently passed through Chloride, Ariz., en route to Los Angeles and San Francisco. He will be in California for a fortnight and then return to Chloride for a more complete inspection of the company's interests.

A. W. Ambrose, of the U. S. Bureau of Mines, has been appointed superintendent of the petroleum experiment station of the bureau at Bartlesville, Okla. He succeeds **W. P. Dykema**, who has resigned the position in order to be able to devote more time to the natural-gas investigations of the Bureau.

W. B. Cramer, assistant consulting engineer of the Concentrating Department, Phelps Dodge Corporation, Douglas, Ariz., has just returned from California, where he has been recuperating. A serious automobile accident in the latter part of January confined him to a hospital for a number of weeks during January and March.

Horace V. Winchell, of Minneapolis, and **Fred Searls, Jr.**, of San Francisco, mining geologists, are at Wallace, Idaho, where they are engaged in professional work in connection with the pending apex litigation between the Federal Mining & Smelting Co. and the Hecla Mining Co. Both have been retained by the Hecla company.

H. Lipson Hancock, general manager, Wallaroo Mining & Smelting Co., Ltd., Wallaroo, South Australia, who has been on an extended tour for the last six months, passed through Arizona recently on his way to San Francisco, where he embarked on the S.S. "Sonoma" for Sydney. Mr. Hancock will be remembered as the inventor of the Hancock jig.

William C. Huntington, recently appointed commercial attaché of the United States at Paris, is a graduate of the Columbia University School of Engineering, and was for four years a metallurgist with the U. S. Steel Corporation before taking up foreign study. He is personally familiar with a number of manufacturing plants in Belgium, France and the present occupied territory of western Germany, and was also commercial attaché at Petrograd from 1916 until after the second Russian revolution. He speaks French, German, and Russian, and has been in charge of the Russian Division of the U. S. Bureau of Foreign and Domestic Commerce since November, 1918.

THE MARKET REPORT

Published in part in San Francisco and mailed from there to our Western subscribers as a special service pending the arrival of the *Engineering and Mining Journal*

Silver and Sterling Exchange

March	Sterling Exchange	Silver		March	Sterling Exchange	Silver	
		New York, Cents	London, Pence			New York, Cents	London, Pence
25	385½	124½	72½	29	393	126½	71½
26	390½	125	71	30	385	126½	72½
27	394½	126	71½	31	386½	126½	72½

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.

Daily Prices of Metals in New York

March	Copper		Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.	
25	18.40@18.50	58½@58½	59 @59½	8.90@9.00	8.60@8.65	8.40@8.50	
26	18.50@18.60	59½@60	60½@61	8.90@9.00	8.60@8.65	8.35@8.45	
27	18.60@18.70	60½@60½	61 @61½	8.85@8.95	8.60@8.65	8.35@8.45	
29	18.75@18.85	61½@61½	62½@62½	8.85@8.95	8.60@8.65	8.35@8.40	
30	18.75@18.85	62 @63	62½@63½	8.80@8.90	8.60@8.65	8.40@8.50	
31	18.75@18.85	61½@62½	62½@63	8.80@8.90	8.60@8.65	8.40@8.50	

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 the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point. All prices are in cents per pound.

Copper is commonly sold on terms "delivered," which means that the seller pays the freight from refinery to buyer's destination. The delivery cost varies, and it would be confusing to figure net prices on individual transactions. Consequently, an average deduction is made from the "delivered" price. At present the average cost of delivery from New York refineries is 0.15c. per lb., and that deduction is made to arrive at the New York price. When copper is sold f. o. b. or f. a. s. New York, of course no deduction is made.

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 special shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

March	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3 M	Spot	3 M	Spot	3 M
	Spot	3 M							
25	106	109	115	333	335½	40	42	48½	51
26	103½	106½	114	338	339½	40½	41½	48½	51
27
29	104½	107½	113	345	346½	40½	41½	49½	51½
30	107½	110½	115	359	359½	41	43	50	52½
31	107½	110½	116	348	350	43	45	50	53

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

Monthly Average Prices for March

Copper:	
New York Electrolytic....	18.331
London Standard	109.533
London Electrolytic	118.348
Lead:	
New York	9.145
St. Louis	8.894
London	46.054
Silver:	
New York	125.551
London	74.194
Zinc:	
New York	8.881
St. Louis	8.531
London	53.467
Tin:	
99 per cent	61.037
Straits	61.926
London	369.489

Metal Markets

New York, March 31, 1920

The market is characterized this week by a firm rise in copper to 19c. delivered; an advance in tin, which went above 63c. yesterday for spot and future Straits, both of which are quoted at the same figure for the first time in about six months; a slightly weaker tendency on the part of lead; and with zinc fairly steady.

Copper

The firm upward tendency of the market continued during the week, and for the last three days producers have maintained the price of 19c., delivered, or 18.75@18.85c. net at the refinery, at which figure considerable business was reported. Some small lots of metal for prompt delivery could be obtained as

Notice

Special Service of Advance Market Reports

THE market report of the *Engineering and Mining Journal* is prepared Wednesday evening, and the Journal is mailed to its subscribers Friday.

For those who wish earlier information as regards market quotations, we are offering, as a special service, to send them on Wednesday evening collect telegrams covering the price of any metal or metals in which they may be directly interested. The same information will be given to subscribers over the telephone.

We will also mail on Wednesday evenings to subscribers the printed advance sheet of the report.

The charge for this service will be \$50 per year.

low as 18½c., and it is probable that the delivered price of 19c. was raised slightly for certain small third-quarter business. Demand in general continued about the same as last week, and is probably in excess of current production. Most of the business is, of course, for domestic delivery.

John D. Ryan, president of the Copper Export Association, issued some interesting figures regarding the copper production and consumption in the last year, also estimating the stocks of the metal on hand. He believes the current European stocks to be at an absolute minimum, and the domestic reserves no larger than should normally be carried. Government stocks have been exhausted, and the reserves piled up at the refineries are being depleted.

The future of the copper market depends almost entirely upon export business, and should this pick up, a further increase in price is extremely probable. The potential European demand is plainly evident, and only awaits the provision of credit facilities.

Lead

Lead has been quiet, and almost no change occurred during the week. Consumers seem to be well provided for

their current requirements and in no hurry to book future orders. Low prices in London are having their effect here, and the prospect of Mexican lead coming into the market serves as a wet blanket to any tendency to increase prices. The London price has shown a tendency to increase for the last two days and is approaching parity with New York. The A. S. & R. price continues at 9½c. for desilverized lead, but it is safe to say that little if any new business is being booked at this figure.

Zinc

The price of zinc, steady or declining during most of the week, picked up somewhat yesterday and today, particularly in the London market. The price differential between New York and London was too wide to continue indefinitely. A large amount of the new business is being taken by small Western operators, the larger producers apparently not being attracted to any great extent by present prices. High-grade zinc continues firm, and considerable business in both this and brass special is being done. Government stocks still supply a part of this demand.

Tin

The tin market has shown an increasing strength during the last week, and there has been active buying by consumers. Some brands have been scarce, particularly 99 per cent, in which little business has been done, light sales having been made during the last two or three days. On March 30, a good demand for spot and April Straits tin developed, and little if any of the metal is now available under 63c. A rise of £14 in London was largely discounted by a disposition on the part of speculative interests to take profit and by the decline in sterling exchange. Today spot Straits tin is off £11 in London, and the New York quotation is 62½@63c.

Electrolytic tin was quoted as follows: March 25, 59@60½c.; March 26, 61@62c.; March 27, 62@62½; March 29, 62½@63½c.; March 30, 63½@64½c.; March 31, 62½@63c.

Straits tin for future delivery was quoted as follows: March 25, 59½@60c.; March 26, 61@61½c.; March 27, 61½@61¾c.; March 29, 62½@63c.; March 30, 62½@63½c.; March 31, 62½@62¾c.

Gold and Silver

Gold was quoted in London as follows: March 25, 107s. 3d.; March 26, 105s. 8d.; March 27, 105s. 8d.; March 29, 105s.; March 30, 106s. 7d.; March 31, 106s. 2d.

Foreign Exchange—Sterling continued to advance in the early part of the week, due probably to the fact that it was understood the Anglo-French bonds maturing this year were to be retired, and, also, to the fact that gold is being shipped to this country. The amount coming is only a drop in the bucket, however, and its effect is largely sentimental. Yesterday, sterling was weaker, a reaction which was not unexpected, but recovered slightly today.

The fluctuations are affording a fine opportunity for speculators. Outside of sterling, the exchange market showed little change from a week ago. German marks have picked up a little, being worth yesterday 1.39c., compared with 1.24c. a week ago, and Brazilian reis declined from 27½ to 26¾c. Canadian discount rates fell from 9 to about 8 per cent. In units to the dollar, francs and lire were, respectively, 14.87 and 20.62.

Silver—London is comparatively steady. The price in that market would advance materially if it were not for the coin supplies coming over from the continent. China continues to be a buyer, with direct shipments from San Francisco. Reserve in silver coin and bullion in India under date of March 7 was 3,864 lacs.

Mexican dollars at New York: March 25, 94½; March 26, 96; March 27, 96½; March 29, 97½; March 30, 96½; March 31, 96½.

Other Metals

Aluminum—Ingot is quoted at 32½c. to 33c. per lb.; No. 12, 31½c.; sheets, 18 gage and heavier, 44.2c. Open market quotations are: 98-99 per cent virgin metal, 31@32c.; 98-99 per cent remelt, 30½@31½c.; No. 12 remelt, 29@30c.; powdered aluminum, 60@65c. Market firm at current prices.

Antimony—Chinese and Japanese for prompt or March delivery, 10½@11c. per lb. Steady. Domestic market quiet, with ordinary brands quoted at 10½@10¾c.; futures at 11½@12c.

Needle Antimony—The market for Chinese needle antimony in lump form is firm at 8½c. per lb., with a rather quiet demand. Standard powdered needle antimony (200 mesh) is quoted at from 11@12c. per lb., according to quantity.

Bismuth—Up 20c. per lb. to \$2.70 for 500-lb. lots.

Cadmium—Unchanged at \$1.40 @ \$1.50 per lb.

Cerium Metal—There has been no change from the price of \$8@\$9 per lb. in ingot form.

Cobalt—Metallic, per lb., \$2.50@\$3.

Iridium is nominally quoted at \$300; unchanged.

Magnesium—Metallic, 99 per cent or over pure, \$1.60@\$1.85 per lb.

Molybdenum Metal in rod or wire form, 99.9 per cent pure, is still selling at \$32@\$40 per lb., according to gage.

Nickel—Ingot, 43c.; shot, 43c.; electrolytic, 45c. Prices are established over long periods without change.

Palladium Metal—Quoted at \$120@ \$130 per troy oz., 99 per cent pure.

Platinum—Weaker, not much doing, \$130@\$135.

Quicksilver—Increased demand. Market strong, at \$95@\$97 per 75-lb. flask. San Francisco telegraphs \$88@\$95, firm. Demand in New York reported good; cost of metal from England is \$120 at present rate of exchange.

¹Furnished by Foote Mineral Co., Philadelphia, Pa.

Selenium, Black, powdered, amorphous, 99.5 per cent pure, continues to be quoted at \$1.75@\$2 per lb., depending on quantity.

Thallium Metal—Selling at \$18@\$20 per lb., ingot, 99 per cent pure, depending on quantity.

Metallic Ores

Chrome Ore—Quoted 60@85c. per unit for material containing 35-40 per cent Cr₂O₃; and 70c.@\$1.25 per unit for ore running 48 per cent Cr₂O₃ and over.

Iron Ores—Lake Superior ores, per ton delivered at Lower Lake ports, are as follows: Old Range bessemer, \$7.45; Old Range non-bessemer, \$6.70; Mesabi bessemer, \$7.20; Mesabi non-bessemer, \$6.55. Stocks in some furnace yards are low, and consumers will try to accumulate large stocks during the shipping season.

Manganese Ore—Quoted at 75@85c. per unit ore containing 45 per cent Mn and over; chemical ore (MnO₂) quoted at \$80@\$90 per gross ton.

Molybdenite—Quoted at 75@85c. per lb. of contained sulphide for 85 per cent MoS₂.

Tantalum Ore, guaranteed minimum 60 per cent tantalic acid, is still selling at 65@70c. per lb. in ton lots.

Titanium Ores—Ilmenite, 2c. per lb. of 52 per cent TiO₂. Unchanged. Rutile, standard imported Norwegian grade, carrying a minimum of 95 per cent titanium dioxide, in the form of concentrates, is quoted at 11c. per lb.

Uranium Ore (Carnotite)—\$2.75@\$3 per lb. for 96 per cent of the contained oxide (U₃O₈). Ores must contain a minimum of 2 per cent U₃O₈.

Vanadium Ore—\$6 per lb for 99 per cent of the vanadic oxide (V₂O₅) contained.

Tungsten Ore—There was some activity in the market, and several hundred tons were sold at \$6.50 per unit 65 per cent WO₃. Today one seller claimed to be unable to secure \$6.25 per unit; \$6.50 fairly represents the market for the week.

Zinc and Lead Ore Markets

Joplin, Mo., March 27—Zinc blende, per ton, high \$53.90; basis 60 per cent zinc, premium, \$50; Prime Western, \$50@\$47.50; fines and slimes, \$45@\$42.50; calamine, basis 40 per cent zinc, \$35. Average settling prices: Blende, \$51.98; calamine, \$37.53; all zinc ores, \$51.53.

Lead, high \$108.70; basis 80 per cent lead, \$107.50; average settling price, all grades of lead, \$105.51 per ton.

Shipments the week: Blende, 18,554; calamine, 362; lead, 1,621 tons. Value, all ores the week, \$1,150,150.

Shipments three months: Blende, 156,836; calamine, 2,587; lead, 22,178 tons. Value, all ores three months, \$10,560,080.

Less than 5,000 tons of zinc blende was sold this week. Buyers lowered offerings after midweek to \$47.50 basis, and few sellers would accept.

Private ownership of the railroads

has brought enough cars the past two weeks to permit the shipment of 37,380 tons of blende and calamine and 3,950 tons of lead. Smeltermen are loading out ore already purchased, and were not anxious to buy, and these circumstances are given as the reason of lowering offerings. Comparison with the corresponding three months last year shows an increase of 17,140 tons of blende and 3,534 tons of lead, with a decrease of 740 tons of calamine.

Platteville, Wis., March 27—Blende, basis 60 per cent zinc, contract sales represented a nominal base of \$54 per ton for high grade. Lead ore, basis 80 per cent lead, \$105 per ton. Shipments for the week are: Blende, 1,556; calamine, 30; lead, 136; sulphur ore, 70 tons. Year to date: Blende, 19,317; calamine, 960; lead, 1,824; sulphur ore, 209 tons. During the week 1,918 tons blende was shipped to separating plants.

Non-Metallic Minerals

Asbestos—Quoted per short ton f.o.b. Thetford, Broughton and Black Lake mines, Quebec, Canada. Freight rate from mines to Sherbrooke, Quebec, over Quebec Central R.R., 20c. per cwt; from Sherbrooke to New York, 27½c., carload lots. Crude No. 1, \$1,750@ \$2,000; crude No. 2, \$1,100@ \$1,500; spinning fibres, \$500@ \$750; magnesia and compressed sheet fibres, \$250@ \$400; single stock, \$95@ \$150; paper stock, \$60@ \$75; cement stock, \$25@ \$30; floats, \$14@ \$16 per short ton.

Magnesite—Dead burned, for refractory (see Refractories).

Calcined Magnesite—High-grade caustic calcined, in lump form, is selling at \$35@ \$40 per ton in carload lots f.o.b. California points. The price of freshly ground calcined, suitable for the flooring trade, is \$60@ \$65 per ton f.o.b. Eastern points.

Barytes—Market practically at standstill, and demand exceeds output. No price is being quoted on contract goods. Spot market is practically bare of material, and as high as \$40 per ton is being asked for white floated; and the off-color grade is listed at \$25@ \$30 per ton.

Blanc Fixe (Barium Sulphate)—Dry, 4½@ 5½c. per lb.; pulp, \$30@ \$50 per ton f.o.b. New York.

Chalk—English, extra light, 5@ 7c. per lb.; light, 4½@ 6c. per lb.; dense, 4@ 5c. per lb. f.o.b. New York. Unchanged.

Graphite—Present quotations for crucible flake are: 85 per cent carbon content, 7½c. per lb.; 86 per cent, 8c.; 87 per cent, 8½c.; 88 per cent, 9c.; 89 per cent, 9½c.; 90 per cent, 10c.; 91 per cent, 10½c.; 92 per cent, 11c.; over 92 per cent, 12½c. per lb. delivered. Crude Mexican ore quoted at \$32.60 per ton New York; selected amorphous, \$50@ \$60 per ton; Korean, 3½c. per lb., Madagascar, 9c.; Ceylon, 4½@ 16c., according to quality.

Nitrate—Spot quoted at \$3.90 per cwt. and futures \$3.80@ \$3.87½.

Pyrites—Spanish pyrites quoted at 16c. per unit for furnace-size ore, free from fines, c.i.f. Atlantic ports. Domestic pyrite, fine, 16c. per unit. No great quantity is being marketed.

Sulphur—Prices average \$18 per ton for domestic, and \$20 for export, f.o.b. Texas and Louisiana mines. Unchanged.

China Clay (Kaolin)—Imported lump, \$25@ \$35 per ton; imported powdered, \$30@ \$60 per ton; domestic lump, \$10@ \$20 per ton; domestic powdered, \$25@ \$40 per ton f.o.b. New York. Unchanged.

Feldspar—Nominally quoted at \$13.50 @ \$18 f.o.b. New York. Unchanged.

Fluorspar—Gravel, f.o.b. mines, is quoted at \$25 net ton. Nominal prices: Acid grade, lump, \$30@ \$45; acid grade, ground, \$52@ \$57, f.o.b. mines.

Fuller's Earth—Remains firm at \$25 @ \$30 for domestic and \$35@ \$40 for foreign, with little material available at these prices.

Monazite—Product carrying a minimum of 6 per cent thorium oxide, \$42 per unit is quoted, duty paid.

Phosphate Rock—Prices quoted per long ton at port are: 68 per cent tricalcium phosphate, \$6.85; 70 per cent, \$7.35; 74 to 75 per cent, \$10; 75 per cent minimum, \$10.50; 77 per cent minimum, \$12.50. Practically no domestic business, owing to lack of cars. At mines, 74 per cent is quoted at \$9.15 per long ton. No change.

Pumice Stone—Imported, 3@ 6c. per lb.; domestic, 2½c. per lb. Unchanged.

Strontium Ore, guaranteed 90 per cent pure, is selling at \$15@ \$18 per ton, carload lots, with lower prices on large contracts.

Talc—Domestic, \$20@ \$60 per ton; imported, \$60@ \$70 per ton f.o.b. New York.

Zircon—Washed, iron free, continues to be quoted at 10c. per lb. Zirkite—In carload lots, \$90@ \$100 per ton is quoted. Pure white oxide, 99 per cent, is quoted at \$1.15 per lb. in ton lots.

Ferro Alloys

Ferrocobalt—For 15-18 per cent material, \$200@ \$250 f.o.b. Niagara Falls, N. Y. Unchanged.

Ferrocerium—Conditions abroad continue to cause a reduction in price of the American goods, and this alloy is now selling at \$12@ \$15 per lb.

Ferrochrome—6-8 per cent carbon, 20 @ 21c. per lb. of chromium contained; 2-4 per cent carbon, 21@ 22c. per lb. of chromium contained.

Ferromanganese—English, prompt, \$200; last-half delivery, \$175@ \$200; domestic, prompt, \$235@ \$240; and last-half, \$200@ \$225.

Spiegeleisen—Quoted at \$60@ \$65 per gross ton, 16-20 per cent Mn.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, are quoted at \$2.25 @ \$2.75 per lb. of contained metal.

¹Furnished by Foote Mineral Co., Philadelphia, Pa.

Ferrosilicon—\$85@ \$90, 50 per cent delivered, spot and contract. Electrolytic, delivered Pittsburgh Valleys, Cleveland: 50 per cent, \$80; 75 per cent, \$140. Bessemer, f.o.b. Jackson, Ohio, 10 per cent, \$59.50; 11 per cent, \$62.80; 12 per cent, \$66.10.

Ferrotungsten—70-80 per cent W, 90c.@ \$1.10 per lb. W contained.

Ferro-uranium—35-50 per cent U, \$7 per lb. of U contained. Unchanged.

Ferrovandium—30-40 per cent, \$6.50 @ \$7.50 per lb. of V contained.

Metal Products

Copper Sheets—No change in base price of 29½c. per lb. set early in January; wire, quoted 22½c. base price.

Zinc Sheets—\$12.50 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 12c. per lb. Unchanged.

Lead Sheets—Full lead sheets, 12½c.; cut lead sheets, 12½c.

Nickel Silver—18 per cent, 39½c. lb. Unchanged.

Yellow Metal—Dimension sheets, 26½c.; sheathing, 25½c.; rods, ½ to 3 in., 23½c. Unchanged.

Refractories

Chrome Brick—Unchanged at \$70@ \$75 per net ton, f.o.b. Chester, Pa.

Chrome Cements—Unchanged at \$45 @ \$50 per net ton, f.o.b. Chester, Pa.

Clay Brick—First-quality fire clay, \$45@ \$50 per 1,000, f.o.b. Clearfield, Pa.; second quality, \$40@ \$45 per 1,000, f.o.b. Clearfield, Pa.

Magnesite—Dead burned, \$50@ \$55 per net ton, f.o.b. Chester, Pa.; brick, 9 x 4½ x 2½ in., \$80@ \$85 per net ton, f.o.b. Chester, Pa. Unchanged.

Silica Brick—\$50@ \$55 per 1,000, f.o.b. Mt. Union, Pa.

Iron Trade Review

Pittsburgh, March 30, 1920

Pig Iron—The market is almost bare of transactions, except for a few odd lots for prompt shipment, and there is little inquiry. Prices appear to be steady, but this is no indication as to the future, as the furnaces rarely shade prices when consumers show no disposition to buy. We quote: Bessemer, \$42; basic, \$41.50; foundry, \$42, f.o.b. Valley furnaces, freight to Pittsburgh being \$1.40.

Steel—Business in billets has continued quiet, and sheet bars have become less active. Recently one mill covered its regular sheet-bar trade for second quarter at \$60, and it is likely another interest will do the same. The Steel Corporation continues to sell only at \$42. We quote billets at \$65 to \$70, small billets at \$75 to \$80, sheet bars \$70 to \$80, and rods \$65 to \$75.

Coke

New River—Furnace and foundry, \$8 per ton.

Pocahontas—Furnace, \$8 per ton.

Wise County—Furnace, \$7.25 per ton; foundry, \$8.25 per ton.

Connellsville—Furnace, \$6 per ton; foundry, \$7 per ton.

COMPANY REPORTS

New Cornelia Copper Co.

The report of New Cornelia Copper Co. for the year ending Dec. 31, 1918, says that sales of copper during the year amounted to 29,972,106 lb., of which 23,396,590 was delivered. The production of copper for the year was as follows: Electrolytic, 29,640,211 lb.; copper in cement copper shipped, 6,368,952 lb.; copper in ore shipped, 3,500,298 lb.; total, 39,509,461 lb. Operations in January were normal. Early in February orders were received to curtail, and with the exception of a small increase in September, October, and November, production was on a restricted basis for the rest of the year.

Construction of a 500-ton flotation mill to test the sulphide ore was completed, and the mill was put in operation late in August. The mill treated 13,846.8 dry tons of ore. The mill feed averaged 1.275 per cent copper as sulphide, and 0.038 per cent copper as oxide. The tailing averaged 0.203 per cent copper as sulphide, and 0.028 per cent copper as oxide. Dry tons concentrate produced amounted to a total of 937.66. The concentrate assayed 0.075 oz. gold, and 0.729 oz. silver per ton, and 16.219 per cent total copper. The recovery was 83.61 per cent total copper and 85.19 per cent of the sulphide copper. The ratio of concentration was 14.767 to 1.

There was mined and delivered to the crushing plant during the year, 1,542,533 tons of ore, averaging 1.488 per cent copper. There was mined and shipped to Douglas from the high-grade orebody on the Southern claim, 61,292 tons, and 828 tons from the open mine workings, or a total of 62,120 tons, averaging 3.43 per cent copper. This tonnage was mined from the glory hole workings at a depth of 50 ft., and from the underground workings on the 250-ft. level.

There was also mined and delivered to the experimental concentrating plant, 14,024.5 tons of sulphide ore, averaging 1.313 per cent copper. A total of 5,379 ft. of drifting and raising in developing the orebody was accomplished during the year. Of this work, 2,616 ft. was in drifting and developing the low-grade sulphide ores for the experimental concentrating plant. Five diamond-drill holes were completed, and a total of 1,900 ft. was drilled. It is estimated that 1,085,356 tons of sulphide ore was developed, averaging 1.25 per cent copper.

Vindicator Consolidated Gold Mining Co.

The annual report of the Vindicator Consolidated Gold Mining Co. for the year ending Dec. 31, 1919, states that the total development for the year amounted to 7,622 ft., of which 2,082 ft. were driven by lessees. Total development work to date amounts to 268,168 ft.

During the year 1919, a total of 143,400 tons of crude ore was hoisted on company account through both shafts, from which was produced 19,922 tons of shipping product, with a gross value of \$718,136, the marketing charges on which were \$129,251, and the net returns \$588,885. There was hoisted on lessees' account 55,648 tons of crude ore, and shipments from this source totaled 20,722 tons, with a gross value of \$291,065, marketing charges on which were \$104,742, leaving a net value of \$186,323. The company's royalties on lessees' shipments amounted to \$92,525.

The operations of the ferro-alloy plant during the last year have been confined solely to the production of ferro-chromium. The shipments from the Deer Creek chromite mine for the year 1919 amounted to 1,344 tons, of an average value of \$25.50 per ton, or \$35,620.

The expenditures for the year were \$34,855 for mining and haulage. The operating statement shows a net profit for the year of \$7,478, after writing off depreciation and all losses in the operation of the plant.

American Smelting & Refining Co.

The American Smelting & Refining Co., in its twenty-first annual report, for the calendar year ended Dec. 31, 1919, states that the reconstruction period of 1919 probably affected the smelting and refining of metals as seriously as any business carried on in ordinary times of peace.

The close of the war found the company with a reduction in mine production which curtailed the operations of the smelters and ultimately the refineries proportionately, and this great decrease in volume of business tremendously increased the cost of operations per ton treated. The company's mine production during the last six months of the year was about half of that during the first six months. During the period of transition from a large production to a small production it was necessary to reduce the working force and readjust operating methods, which increased the cost of operations. The cessation of demand for the metals locked up the company's liquid capital, and compelled a greatly increased metal carrying cost for a considerable period. Many of the long-time contracts, made prior to or in the early stages of the war, on the basis of pre-war costs, became exceedingly burdensome, owing to the phenomenal increase in wages, cost of fuel and supplies, the tremendously decreased efficiency of labor, and higher freight rates.

MEXICO

The rising price of silver in 1919 turned attention particularly to Mexico, as silver constitutes a large part of the value of Mexican ores, and every effort was made to develop the Mexican output to the greatest possible point. The close of 1919 saw all of the company's smelters in Mexico in operation. Many of the mines were worked throughout the year.

NEW PROPERTIES

The company has realized the desirability of increasing its mining operations, and has conducted an active campaign of search for desirable properties during the year. A substantial interest was purchased in the promising Premier mine, in British Columbia, and options have been taken on several properties in that country. The company also completed the acquisition of over 90 per cent of the Sabinas Coal Co., which owns a large deposit of coking coal situated about a hundred miles south of the Mexican border. The development of this property will enable the company to supply all its Mexican operations with a satisfactory quality of coke at a much lower cost than heretofore.

METAL PRODUCTS

The company produced the following metals and by-products during the period under review:

	1919	1918
Ounces of gold.....	2,191,041	1,994,015
Ounces of silver.....	78,200,298	72,572,506
Ounces of platinum and palladium..	1,824	1,516
Tons lead.....	208,439	260,192
Pounds copper.....	705,676,000	868,540,000
Pounds zinc.....	33,375,301	41,238,000
Pounds nickel.....	662,637	626,085
Pounds tin.....	15,340,000	19,868,000
Pounds sulphuric acid.....	40,362,000	87,338,000
Pounds arsenic.....	9,359,541	7,837,063
Pounds copper sulphate.....	3,675,499	5,164,000
Pounds byproduct metals.....	884,438	1,870,662

The Aluminum Company of America Monopolizes the manufacture of aluminum in the United States and Canada. Plants have been established at Niagara Falls, N. Y.; Massena, N. Y.; Maryville, Tenn.; Badin, N. C., and Shawinigan Falls, Que. The industry is rapidly expanding.

MINING STOCKS

Week Ended March 27, 1920

Stock	Exch.	High	Low	Last	Last Div.	Stock	Exch.	High	Low	Last	Last Div.
COPPER						ZINC					
Adventure	Boston			†75		Am. Z. L. & S.	N. Y.	20	18	19	May '17, 1.00
Ahneck	Boston	71	65	65	Mar. '20, \$ 50	Am. Z. L. & S. pf.	N. Y.	55	53	55	Feb. '20, 1.30
Alaska-B.C.	N. Y. Curb	1 ¹ / ₂	1 ¹ / ₂			Butte C. & Z.	N. Y.	10	9	10	July, '18, .50
Algonah	Boston			†40		Butte & N. Y.	N. Y. Curb				
Allouez	Boston			†34	Mar. '19, 1.00	Butte & Superior	N. Y.	29	25	28	Sept. '17, 1.25
Anaconda	N. Y.	65	61	64	Feb. '20, 1.00	Can. Interst. Cal.	N. Y.	19	17	18	Mar. '20, .50
Ariz. Com'l.	Boston	13	12	13	Oct. '18, .50	Natl. Z. & L.	Boston Curb	*8	*6	†6	May '17, .02
Big Ledge	N. Y. Curb					Success	N. Y. Curb	*7	*6	*7	July '16, .03
Bingham Mines	Boston	6	6	6	Sept. '19, .25	GOLD					
Boston & Ely	Boston Curb			*55		Alaska Gold	N. Y.	2	1	2	
Butte & Bal.	Boston			*30		Alaska Juneau	N. Y.	2	2	2	
Butte & Lond.	Boston Curb	*15	*10	†10		Booth	N. Y. Curb	6	6	6	
Calaveras	Boston Curb			1		Carson Hill	N. Y. Curb	31	23	30	Mar. '20, 10
Calumet & Ariz.	Boston	69	62	69	Mar. '20, 1.00	Cresson Gold	N. Y. Curb			2	
Calumet & Hecla	Boston	355	347	355	Dec. '19, 5.00	Dome Ex.	Toronto	*27	*24	†25	
Calumet & Jerome	N. Y. Curb					Dome Lake	Toronto	*9	*8	*8	
Can. Copper	N. Y. Curb	1	1	1		Dome Mines	N. Y.	12	11	11	Jan. '20, .25
Centennial	Boston	13	13	13	Dec. '18, 1.00	Goldfield Con.	N. Y. Curb	*13	*11	*13	Dec. '19, .05
Cerro de Pasco	N. Y.	56	52	55	Mar. '20, 1.00	Hedley	Boston			4	June '19, 10
Con. Ariz.	N. Y. Curb				Dec. '18, .05	Hollinger	Toronto	6.70	6.50	6.60	Feb. '20, .05
Con. Copper M.	N. Y. Curb					Homestake	N. Y.	56	56	56	Sept. '19, .50
Chile Cop.	N. Y.	19	17	19		Kewanas	N. Y. Curb	*4	*3	*4	
Chino	N. Y.	37	34	37	Mar. '20, .37	Kirkland Lake	Toronto	*72	*66	*67	
Cop. Range	Boston	46	43	46	Mar. '20, .50	McIntyre Porcupine	Toronto	2.15	2.11	2.15	Jan. '20, .05
Crystal	Boston Curb	*31	*30	†31		Silver Pick	N. Y. Curb	*21	*14	*19	Jan. '20, .21
Crystal Cop (old)	Boston Curb	*9	*4	†4		Teok-Hughes	Toronto	*19	*13	*18	
Daly-West	Boston	4	4	4		United Eastern	N. Y. Curb	4	3	3	Jan. '20, .21
Davis-Daly	Boston	12	10	11	Mar. '20, .25	West Dome	Toronto	*10	*8	†9	
East Butte	Boston	16	15	15	Dec. '19, .50	White Caps	N. Y. Curb	18	14	16	
First Nat'l	Boston Curb	1	1	1	Feb. '19, .15	Yukon Gold	Boston Curb	1	1	1	June '18, .02
Franklin	Boston	3	3	3		SILVER					
Gadsden Copper	N. Y. Curb	1	1	1		Adanae	Toronto	*3	*3	*3	
Granby Consol.	N. Y.	49	45	49	May '19, 1.25	Bailey	Toronto	*6	*5	†5	Apr. '16, .05
Greene-Can.	N. Y.	37	33	37	Feb. '19, 1.50	Beaver Con.	Toronto	*64	*60	*62	
Hancock	Boston			5		Coniagas	Toronto	3.25	3.00	†3.00	Nov. '19, 12
Helvetia	Boston	3	3	3		Crown Reserve	Toronto	*36	*32	†36	Jan. '17, .05
Houghton	Boston Curb	*75	*75	†75		Hargraves	Toronto	*4	*3	*3	
Howe Sound	N. Y. Curb	4	3	4	Jan. '20, .05	Kerr Lake	Boston	5	4	4	Sept. '19, 1.00
Indiana	Boston			*75		La Rose	N. Y. Curb				Apr. '18, .02
Inspiration Con.	N. Y.	60	56	59	Jan. '20, 1.50	McKinley-Dar.	N. Y. Curb			61	Jan. '20, .03
Iron Cap	Boston Curb	13	11	†11	Feb. '19, .25	Nipissing	N. Y. Curb	11	10	10	Jan. '20, .50
Isle Royale	Boston	35	32	35	Sept. '19, .50	Ontario Silver	N. Y.	8	8	8	Jan. '19, .50
Jerome Verde	N. Y. Curb					Ophir Silver	N. Y. Curb				
Kennecott	N. Y.	32	30	32	Mar. '20, .50	Peterson Lake	Toronto	*21	*20	*20	Jan. '17, .01
Keweenaw	Boston	1	1	1		Sil. King Ariz.	N. Y. Curb	*4	*4	*4	
Lake Copper	Boston	4	4	4		Temiskaming	Toronto	*46	*41	*45	Jan. '20, .04
La Salle	Boston			2		Trethewey	Toronto	*46	*44	*44	Jan. '19, .05
Magma Chief	N. Y. Curb			1		GOLD AND SILVER					
Magma Copper	N. Y. Curb			38	Jan. '19, .50	Atlanta	N. Y. Curb	*3	*3	*3	
Majestic	Boston Curb	*20	*15	†15		Batopilas	Boston			1	
Mason Valley	N. Y. Curb	3	2	2		Bost. & Mont.	N. Y. Curb	*75	*65	*68	
Mass Con.	Boston	5	5	5	Nov. '17, 1.00	Cashboy	N. Y. Curb	*12	*9	*11	
Mayflower-O. C.	Boston	9	8	9	Feb. '20, 1.00	El Salvador	N. Y. Curb	3	2	3	
Miami	N. Y.	23	23	23	Feb. '20, .50	Goldfield Merger	N. Y. Curb	*3	*2	*3	
Michigan	Boston	6	6	6		Jim Butler	N. Y. Curb	*24	*22	*24	Aug. '18, .07
Mohawk	Boston	68	66	67	Feb. '20, 1.50	Jumbo Extension	N. Y. Curb	*11	*9	*10	June '16, .05
Mother Lode (New)	N. Y. Curb	5	5	5		Louisiana Con.	N. Y. Curb				
Nev. Con.	N. Y.	15	14	15	Mar. '20, .25	McNamara Cr.	N. Y. Curb	*3	*3	*3	
Nixon Nev.	N. Y. Curb	15	15	15		Nev. Packard	Boston Curb	*25	*25	*25	Apr. '19, .02
Nev. Douglas	Boston Curb	*20	*15	†15		Rochester Mines	N. Y. Curb			18	Oct. '18, .02
New Arcadian	Boston	3	3	3		Tonopah-Belmont	N. Y. Curb	2	2	2	Jan. '20, .05
New Baltic	Boston Curb	5	4	†4		Tonopah-Divide	N. Y. Curb	2	2	2	
New Cornelia	Boston	21	21	21	Nov. '18, .25	Tonopah Ex.	N. Y. Curb	2	2	2	Jan. '20, .05
North Butte	Boston	17	16	17	Oct. '18, .25	Tonopah Mining	N. Y. Curb	2	2	2	Oct. '19, .15
North Lake	Boston	*50	*50	*50		West End Con.	N. Y. Curb	*2	*1	*1	Dec. '19, .05
Ohio Copper	N. Y. Curb					SILVER-LEAD					
Oneco	Boston Curb	*100	*60	†60		Caledonia	N. Y. Curb	*36	*33	*34	Jan. '20, .01
Ojibway	Boston			2		Fed. M. & S.	N. Y.	15	15	15	Jan. '09, 1.50
Old Dominion	Boston	33	32	32	Dec. '18, 1.00	Fed. M. & S. pf.	N. Y.	36	34	36	Mar. '20, .75
Osceola	Boston	50	47	48	Mar. '20, .50	Iron Blossom	N. Y. Curb				Jan. '20, .02
Quincy	Boston	58	56	58	Mar. '20, 1.00	Marsh Mines	N. Y. Curb	*18	*16	*17	
Ray Con.	N. Y.	20	18	20	Mar. '20, .25	Rex Con.	N. Y. Curb	*9	*8	*9	
Ray Hercules	N. Y. Curb	1	1	1		Simon S. L.	N. Y. Curb				
St. Mary's M. L.	Boston	50	45	50	Dec. '19, 2.00	Stand. S. L.	N. Y. Curb				Oct. '17, .05
Seneca	Boston	15	15	15		Wilbert	N. Y. Curb	11	9	9	Nov. '17, .10
Shannon	Boston	1	1	1	Nov. '17, .25	NICKEL-COPPER					
Shattuck-Aris	N. Y.	12	11	12	Jan. '20, .25	Internat'l Nickel	N. Y.	24	21	24	Mar. '19, .50
South Lake	Boston	*35	*25	*30		Internat'l Nick. pf	N. Y.			87	Feb. '20, 1.50
South Utah	Boston			*15		QUICKSILVER					
Superior	Boston	5	5	5	Apr. '17, 1.00	New Idria	Boston	6	6	6	Jan. '19, .25
Superior & Boston	Boston	5	4	5		TUNGSTEN					
Tenn. C. & C.	N. Y.	11	10	11	May '18, 1.00	Mojave Tungsten	Boston Curb	*14	*10	†10	
Trinity	Boston	2	1	2		VANADIUM					
Tuolumne	Boston	*85	*75	*85		Vanadium Corp.	N. Y.	70	62	68	
United Verd. Ex.	Boston Curb	*37	*36	†36	Feb. '20, .50	GOLD AND PLATINUM					
Utah Copper	N. Y.	80	74	78	Mar. '20, 1.50	So. Am. G. & P.	N. Y. Curb			8	
Utah Con.	Boston	8	8	8	Sept. '18, .25	MINING, SMELTING AND REFINING					
Utah M. & T.	Boston	2	2	2	Dec. '17, .30	A. S. & R.	N. Y.	70	65	69	Mar. '20, 1.00
Victoria	Boston	2	2	2		A. S. & R., pf.	N. Y.	96	95	95	Mar. '20, 1.75
Winona	Boston	1	1	1		Am. Sm. pf., A.	N. Y.	82	81	82	Jan. '20, 1.50
Wolverine	Boston	20	20	20	Jan. '20, .50	Natl. Lead	N. Y.	85	80	82	Mar. '20, 1.50
						Natl. Lead, pf.	N. Y.	109	108	109	Mar. '20, 1.75
						U. S. Sm. R. & M.	N. Y.	72	66	72	Jan. '20, 1.90
						U. S. Sm. R. & M., pf.	N. Y.	47	47	47	Jan. '20, .87

*Cents per share. †Bid price on Mar. 27.

INDUSTRIAL NEWS

Taylor-Wharton Companies announce the opening of a sales office at 502-503 Denham Building, Denver, Col. O. H. Johnson will act as their special representative there.

The Gold Fields American Development Co., Ltd., New York City, announces that Armor F. Keene, of that company, left New York Feb. 29 on a business trip to Trona, Cal.

The Material Handling Machinery Manufacturers' Association, 35 West 39th St., New York City, held its convention and annual meeting at the Waldorf-Astoria Hotel on Feb. 26 and 27.

Rome Wire Co., Rome N. Y., have authorized an increase of their capital stock to \$4,000,000 of 7 per cent first preferred, and to \$5,650,000 of common stock, par value being \$100 per share in either case.

American Smelting & Refining Co. has placed its sales organization under one of its vice-presidents, J. C. Clendenin, who formerly handled its copper and zinc output. The late E. C. Brush was in charge of the silver and lead sales.

The James Leffel & Co., Springfield, Ohio, manufacturers of turbine water wheels, announce that after Mar. 15, 1920, their Boston office will be removed to Room 610 Compton Building, 161 Devonshire St. This new office will be in charge of A. S. Addison.

R. C. Gosbrow, metallurgical engineer and electrometallurgist, announces the establishment of a consulting office at Room 701 Claus Spreckels Building, San Francisco. He also acts as western representative for Pittsburgh Furnace Co., Milwaukee, Wis.

A. Leschen & Sons Rope Co., St. Louis, Mo., report that they recently completed for the Cia. Beneficiadora de Pachuca, Est. de Hidalgo, Mexico, an aerial tramway four and a half miles long with a capacity of 100 tons of silver ore per hour.

Britannia Wire Rope Co. is a new firm, organized and financed by British capital, to manufacture wire rope on Granville Island, Vancouver. The plans for the factory have been completed and the machinery is already on its way from Great Britain.

Hauck Manufacturing Co., Brooklyn, N. Y., dealing in furnace burners, announce the following removals of their respective service stations: Pittsburgh station to 105 Wood St.; Boston station to 149 Berkeley St., corner Columbus Ave.; Cleveland, Ohio, station to 1106 Walnut Ave.

Stephens-Adamson Mfg. Co., Aurora, Ill., announce the opening of a branch store and assembling shop at 412-414 E. Third St., Los Angeles, Cal. The new branch will carry large stocks of standard "S-A" equipment, including

belt conveyors, bucket elevators, screening and transmission machinery, hoists, car pullers, belting.

Michigan Smelting & Refining Co., at its annual meeting in Detroit elected the following officers; John R. Searles, president and general manager; Norman Sillman, vice-president; Henry Leavitt, secretary-treasurer. Other directors are J. R. Searles, Emory W. Clark, Walter P. Cryslar, Leo M. Butzel, and C. O. Patch.

Mono Corporation of America, 48 Coal and Iron Exchange, Buffalo, N. Y., have purchased the entire stock of Mono apparatus and accessories, including all rights for the manufacture and sale of the various types of automatic analysis apparatus made by F. D. Harger Co., Buffalo, N. Y. Mr. Harger will continue with the new corporation as manager.

Robt. E. McConnell, advises of an arrangement with S. W. Mudd whereby assignments to the investigation of mineral deposits and the examination of mining property may be undertaken by Mr. McConnell for interests in addition to those identified with Messrs. Mudd, Wiseman, and other associates. Mr. McConnell's address is 1208 Hollingsworth Bldg., Los Angeles.

The Blaw-Knox Co., Pittsburgh, announces that it has purchased the C. D. Pruden Co., Baltimore, manufacturers of standardized steel buildings. J. Grier Campbell, purchasing agent of the Blaw-Knox Co., has resigned to become assistant treasurer of the C. D. Pruden Co.; and Wm. S. Boyd has been appointed purchasing agent of the Blaw-Knox Co. Mr. Boyd was formerly of the Page Steel & Wire Co., and the Crucible Steel Co.

The F. C. Austin Machinery Co., Railway Exchange Building, Chicago, Ill., is incorporated to take over the entire earth-loading and cement-working machinery business of the F. C. Austin Co., Inc., Municipal Engineering & Contracting Co., and the Muskegon plants of Linderman Steel & Machine Co. F. C. Austin retires from active management and B. A. Linderman, president of the Linderman company, assumes control. The personnel of the combining companies is retained.

Chemical Catalogue Co., Inc., 1 Madison Ave., New York City, have completed arrangements for the publication of an authoritative compendium of quantitative analytical chemistry. It is planned to include every method given in the chemical literature of a number of languages, systematically listed and broadly grouped into two volumes, Inorganic and Organic respectively. Copious references to the literature and a thorough index under commercial articles as well as under elements and compounds will be features of the work. The Inorganic volume will appear first.

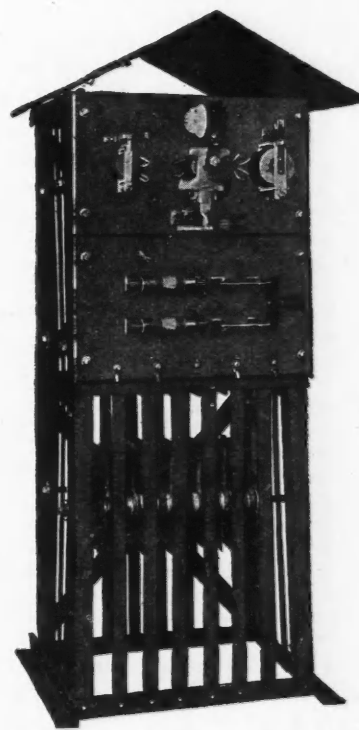
Interstate Drop Forge Co., Milwaukee, Wis., has been organized to manufacture commercial drop forgings for the automotive and machinery industries. Nine acres near the A. O. Smith

plant will be improved immediately, the plans calling for an initial expenditure of \$175,000 for buildings and equipment. Contracts for forge plant, machine shop, hammers and other equipment have been let. William C. Frye, of the Chain Belt Co., is the president, M. McFedries is vice-president and general manager; C. R. Messinger is treasurer; other directors are E. L. Wood, B. Fleeger, and J. M. Olmsted.

New Automatic Charging Panel

For the automatic charging of mine locomotives having Edison storage batteries the new C-H charging panel shown in the illustration has been designed by the Cutler-Hammer Manufacturing Co. It may be connected to a 250 to 275 volt direct-current circuit. The slate panel is supported by a frame having the charging resistance self-contained and the whole is protected by a sheet-metal roof.

The main line contactor, which connects and disconnects the battery from



AUTOMATIC CHARGING PANEL FOR MINE LOCOMOTIVES

the line, is held open by a voltage relay unless the line voltage is sufficient for charging, and the same device opens it if the power fails or the line voltage drops below a predetermined value. When the power is restored after a power failure the main line contactor automatically recloses, and charging is resumed. A shunt trip relay is connected to the ampere-hour meter on the locomotive, and when the battery is fully charged the ampere-hour meter, through this relay, opens the main-line contactor and disconnects the battery from the line. This relay also opens the contactor should the line voltage become too high.

Protecting the Miner's Head Not General in America

An American Cap of Recent Invention Meeting All Essential Requirements

It is an interesting fact that outside of the Michigan copper-mining district, head protection in mines is seldom thought of. The ordinary felt hat and cloth cap, it is true, afford a certain amount of protection to the wearer, but for falling rocks of any size, little can be expected from them. In Freiburg, when that district was active, German miners made use of a visorless cap, something like a polo cap. It was made with a thick felt top and felt of somewhat less thickness on the sides. Though it afforded good head protection, it had the disadvantage of being hot and uncomfortable. In Cornwall, England, the Cornish tin miners invented a hat, shaped like a low-crowned derby, which was light enough to be handy and stiff enough to stop stones up to fist-size. Wherever Cornish miners went, the "hard hat" was used in situations where any considerable amount of "rock fallings" took place in the workings. In the Michigan copper district, the use of the hat is common, but in other mining districts of the United States it is seldom seen.

Conditions which necessitate head protection are not common in coal and metal mines, but occasionally in steep-pitched coal seams and in steep-pitched open stopes where small rocks or tools can fall considerable distances and acquire sufficient momentum to become dangerous, some kind of a protective hat is highly desirable. The latest effort to meet this need is a miner's cap made by the Wagner's Protective Cap Co.' The cap weighs seven ounces. It is stiff enough to admit of a light person standing upon it. A machine bolt, weighing a pound and falling from a height of forty feet, is said to scarcely dent it. It is as light and comfortable as such caps can be made. The visor affords protection to the eyes. The cap is also said to be a non-conductor of heat and electricity. It is water proof and will resist sulphuric acid. It would appear that the manufacturers of this cap have succeeded in incorporating into their design practically all of the essential requirements save the one of cost. The price at which this hat is marketed, cheap enough when considered from the standpoint of safety, is so high that it is doubtful whether miners will purchase it. It is probable that quantity production may lower the present price.

For working in mines generally, drifts contiguous to open stopes, in shafts, in square-set stopes, in construction of buildings, and for mine superintendents, engineers, foremen, surveyors, samplers, shaftsmen, pumpmen and miners, the type of hat described appears to be worth consideration.

1454 Santa Clara Ave., Alameda, Cal.

NEW PATENTS

U. S. patent specifications may be obtained from the Patent Office, Washington, D. C., at 10c. each.

Alumina, Process for the Extraction of, from clay. Harry G. Wildman. (1,326,384; Dec. 30, 1919.)

Ball Mill—Comminuting Apparatus. Oswald Kutsche. (1,332,850; Mar. 2, 1920.)

Barium Oxide—Manufacture of. Herman Fleck. (1,326,332; Dec. 30, 1919.)

Car—Hot-Metal Car. Richard H. Stevens, Philadelphia, Pa. (1,332,772; 1,332,773; Mar. 2, 1920.)

Carrier—Stone Cutting and Handling Apparatus. Edmund C. Morgan. Continuation of application Serial No. 767,140. (1,330,744; Feb. 10, 1920.)

Concentrator—Panning-Movement. William Cottrell. (1,332,863; 1,332,864; Mar. 2, 1920.)

Copper—Process for Hardening Copper. Dewitt T. Beckham, Geneva, Tex. (1,331,479; Feb. 24, 1920.)

Crusher. Lewis Julius Hewes, Oak Park, Ill., assignor to Traylor Engineering & Mfg. Co., Allentown, Pa. (1,329,835; Feb. 3, 1920.)

Crushing—Suction-Nozzle and Material-Separator for Reducing-Machines. Milton F. Williams, assignor to Williams Patent Crusher & Pulverizer Co. (1,327,452; Jan. 6, 1920.)

Crushing-Machine. Peter C. Andersen. (1,328,806; Jan. 27, 1920.)

Drill—Burt L. Worthen. (1,326,245; Dec. 30, 1919.)

Drill—Arthur L. Hawkesworth. (1,328,325; Jan. 20, 1920.)

Drill—Motor Attachment for Drilling-Machines. Frank Jones. (1,330,190; Feb. 10, 1920.)

Drill Bit—Granville A. Humason. (1,326,506; Dec. 30, 1919.)

Drill Bit—Well-Drilling Device. Walter Lee Church. (1,330,736; Feb. 10, 1920.)

Drilling Engine—George H. Gilman, assignor to Sullivan Machinery Co. (1,326,399; Dec. 3, 1919.)

Flotation Apparatus and Process. John M. Callow and Harry P. Corliss, deceased, by Marion P. Corliss, executrix, Pittsburgh, Pa., assignors to Metals Recovery Co., Augusta, Me. (1,331,238; Feb. 17, 1920.)

Furnace—Rotatable Electric Furnace. William K. Booth, Chicago, Ill., assignor, by mesne assignments, to The Booth Electric Furnace Co., Chicago, Ill. (1,332,795; Mar. 2, 1920.)

Furnace—Roasting-Furnace. Henry Alinder, Milwaukee, Wis., assignor to Allis-Chalmers Manufacturing Co., Milwaukee, Wis. (1,332,152; Feb. 24, 1920.)

Furnace—Ring-Furnace. Victor C. Doerschuk, Massena, N. Y., assignor to Aluminum Company of America, Pittsburgh, Pa. (1,330,175; Feb. 10, 1920.)

Furnace—Ring-Furnace. Bartley E. Broadwell, assignor to Aluminum Company of America, Pittsburgh, Pa. (1,330,164; Feb. 10, 1920.)

Furnace-Roof—Construction. Charles E. Bonsor. (1,330,052; Feb. 10, 1920.)

Furnace—Method of Furnace-Heating. William E. Renner. (1,332,684; Mar. 2, 1920.)

Gasoline—Apparatus for Determining the Amount of Gasoline Carried in Casing-Gas. Daniel L. Newton. (1,330,490; Feb. 10, 1920.)

Gasoline—Apparatus for Recovering, from Natural Gases. Andrew B. Cross. (1,327,906; Jan. 13, 1920.)

Gasoline—Apparatus for the Recovery of Gasoline from Casing-Head Gas in Oil-Wells. Walter R. McGinnis, St. Louis, Mo., assignor to Pilsbry-Becker Engineering & Supply Company, St. Louis, Mo. (1,328,680; Jan. 20, 1920.)

Grinding-Mill and Tumbling Comminuting-Body Therefor. Ray C. Newhouse, Milwaukee, Wis., assignor to Allis-Chalmers Manufacturing Co., Milwaukee, Wis. (1,331,964; Feb. 24, 1920.)

Grizzly for Ore Separation. William Ross, Montreal, Quebec. (1,332,305; Mar. 2, 1920.)

Lamp—Miner's Lamp. Alonzo D. Zimmerman. (1,328,553; Jan. 20, 1920.)

Metallurgical Furnace—Samuel S. Amdursky. (1,330,227; Feb. 10, 1920.)

Oil Storage Tank—Protective Means Against Lightning. Frank A. Ford. (1,330,858; Feb. 17, 1920.)

Oil Storage Tank—Fuel-Oil Storage and Heating Tank. James L. Bernard. (1,330,779; Feb. 17, 1920.)

Oil Tanks—Automatic means for draining crude-oil tanks. Thomas S. McCahon, Chicago, Ill. (1,329,983; Feb. 3, 1920.)

Petroleum—Process of Petroleum Reduction. Frederick A. Kormann, assignor to William F. Hull, Brooklyn, N. Y. (1,332,849; Mar. 2, 1920.)

Pumps—Sucker-Rod Attachment to Prevent Sanding up of Well-Pumps. Robert Lee Burns and Fred Freamond Winger, assignors to Standard Oil Co., of California. (1,327,611; Jan. 13, 1920.)

Pump—Oil-Well Pump. Ralph Gregory, assignor to Oil Well Reclamation Co., Chicago, Ill. (1,332,333; Mar. 2, 1920.)

Pump—Deep-Well Pump. Arthur Lee Ligon. (1,332,672; Mar. 2, 1920.)

Well-Rig—Elwood D. Hiatt. (1,332,496; Mar. 2, 1920.)

Well-Drilling Rig. Robert M. Bradford. (1,329,500; Feb. 3, 1920.)

Well-Drilling—Sample-Taking Device [for oil or sulphur wells]. Robert E. Carmichael, Damon, Tex. (1,324,304; Dec. 9, 1919.)

Well—Plug. Erd. V. Crowell. (1,330,430; Feb. 10, 1920.)

Well-drilling—Apparatus for cementing wells. Jean Amedée Hardel, Paris, France. (1,330,023; Feb. 3, 1920.)

