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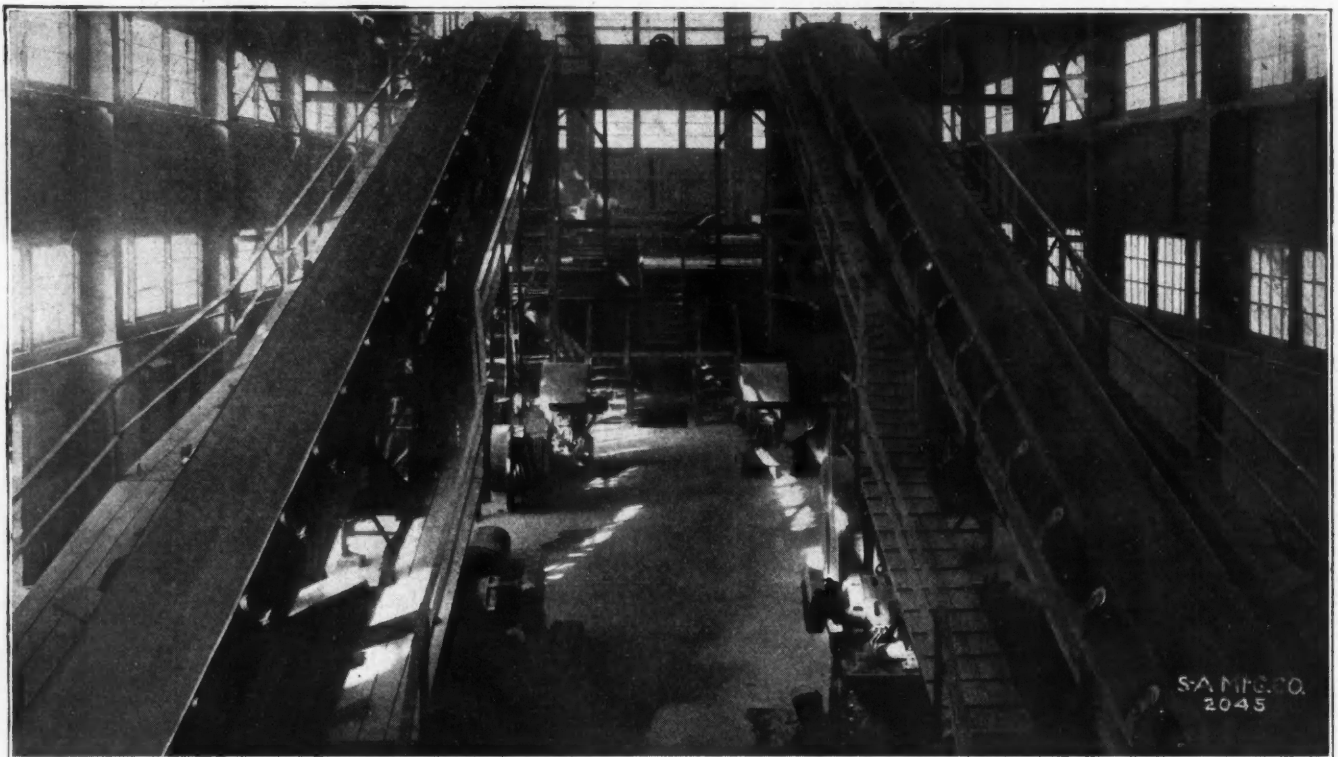


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The Mining Engineering Standard

WE ARE FAR FROM WISHING to terminate the interest in the discussion as to the education of the mining engineer which has been aroused by our phrase "only a correspondence school engineer." There have arisen a number of thoughtful persons who take the view that the mining engineer is born and not educated; and that it makes no difference whether he attends the best mining school, gets his schooling by correspondence, or does not get any schooling at all.

We want to range ourselves once for all against this shallowest of fallacies. Mining engineering is an elevated profession, and must be made so that it will stand as the full peer of the other learned professions, which to date have been medicine, the bar, and the clergy. It does not yet do that; and the main reason is the above-named foolish laxity as to education and qualification. The strict educational and other requirements necessary before a doctor or a lawyer can practice do not eliminate the variations in human nature, or entirely guard us against the incompetent and the shyster: but how much more rankly these would flourish if the educational qualifications were dispensed with! None of our liberal-minded mining men would employ a doctor or a lawyer who had not gone through the prescribed amount of scholastic training; and we know how to appreciate those whose training has been unusually good.

It is recognized, among doctors and lawyers, and by their clients, that certain schools of law and medicine give their students a much more thorough training than do the rest. We must also recognize this very difficulty for the mining engineer. There are, unless we mistake, too many mining engineers, good, bad, and indifferent, in the country today: many of them are out of a job. There are, as we know of a certainty, too many mining geologists in the country. They are, as we happen to know, mostly bad or indifferent; and we wish that more of them were out of a job than is the case. The reason is faulty training. A man takes a summer school course in petroleum geology at some college, and sets up as an oil geologist. Who is there to say him nay?

The Society of Economic Geologists has established a high standard—yet not too rigorous—for membership, and it is safe to say that any economic geologist even fairly well qualified for professional work will soon be found among its members. Outside, however, will still be hundreds of the summer school and correspondence school and no school variety. The Mining and Metallurgical Society of America has a moderately high standard of membership for mining engineers, but there are many equally well qualified who are not members of the society. The American Institute of Mining and Metallurgical Engineers has at present also a moderately high standard; but whereas the first-named society had its standard from the start, and has a uniform grade of membership, the high standard of the latter society was

an afterthought, and was put into effect after most of us had slipped in, in the good old days when about the only qualification was to be free, white, and twenty-one, and have ten dollars.

We hope in the future, for the good of the profession and of mining, that the lines will be more sharply drawn. There are in Washington a type of physicians called "sun-down" doctors—men employed in the Government departments who take their medical course in the evening classes offered in that city. On account of this training, there is a legend that their curative powers come to them only after sundown. Possibly it would be a fair regulation if correspondence school mining engineers should be restricted in their practice to engineering by correspondence.

What and How Many Foreigners Shall We Admit?

THE MINING INDUSTRY is one of the largest employers of unskilled and semi-skilled foreign laborers, and is therefore directly interested in immigration problems. During the war a growing scarcity of this type of worker became manifest, and many employers expected post-war conditions would be worse, considering the expressed intention of many of those whose homes were in southern Europe to return thence as soon as the war was over. This emigration actually did take place to a certain extent. However, when these men saw the generally wretched conditions which obtained in their homeland, they not only showed a disposition to return to America but also persuaded others to come too. Thus, coincident with the present depressed industrial condition of this country, inevitably resulting in a domestic oversupply of the more inefficient workers, we are confronted with vast hordes of foreigners clamoring for admission to our ports.

The Dillingham bill, limiting immigration to the United States, for fifteen months, to 3 per cent of the number of each nationality in the United States, was designed as a restrictive measure, but received a "pocket veto" at the hands of President Wilson. There is likelihood, however, that it will again be offered to President Harding, a fact which has brought out no little opposition to its provisions. It is argued that the bill is opposed to the traditional American policy of affording opportunities to the foreigner and assimilating him into our civilization; that it will prevent relatives of foreign-born residents from coming to this country, and will thereby encourage emigration of trained workers; that it will discriminate against certain nationalities which have only recently begun coming to this country in numbers; and that it will cause a great deal of international misunderstanding. Inasmuch as the legislation is intended to cover only a fifteen-month period, it would seem that no serious objection could be

made on the basis of most of these points. Misunderstanding of the law and its motives, however, would no doubt last longer than this, and possibly the principal objection to the legislation can be made on this ground.

It is regrettable that some intelligent selection cannot be made of those wishing to come to the United States. Since the war we have been forced to take immigrants of the lowest character, diseased mentally, morally and physically, who have swamped our immigration facilities at Ellis Island and elsewhere. Typhus fever has developed in many immigrants after admission, and we know not how many political and social trouble-makers have taken advantage of our hospitality. Intelligent selection should not only keep such classes out, but should take some cognizance of the demands of our industries. Employers could assist materially by a close co-operation with the Government in indicating in which lines assimilation can best be made. Then can our immigration be regarded with the old sense of satisfaction, rather than as a menace.

Our Champions in Mexico

A NEW ORGANIZATION to look after the rights of American citizens in Mexico has been formed under the name of the American Association of Mexico, with headquarters in New York. Its purpose, as announced in its circular, is to work "for the settlement of the difficulties between the Mexican government and American citizens, for a redress of past wrongs, and for a restoration of rights under which Americans became the dominating influence in the development of Mexico's resources and in the promotion of the welfare of her people." The organizers further promise that this association will seek to combat all propoganda to the effect that Mexico's problems have been solved, to make the proper representations to the Government at Washington, and to co-operate with the Government and its officials in securing an adjustment of international difficulties.

One such association, already in existence, namely the National Association for the Protection of American Rights in Mexico, should be enough, if it were really on the job and if the State Department really needed the aid of such an auxiliary. The name of the latter association has become familiar, but if it has accomplished anything the fact is not so well known. In short, the National Association has successfully hidden its light under a bushel, despite spending a large sum on publicity.

But all is not to be harmony between the two associations. The American Association, just organized, says that its principal reason for organizing is that the National Association is not a national association at all, but an instrument of the oil companies that have financed it and directed its policy. "The Americans who have formed the American Association of Mexico," it accuses, "have endeavored for more than a year to induce the so-called National Association to champion the rights of all Americans in Mexico, to announce a policy and to fight for this policy in the open. Having failed to secure such action, they have adopted the alternative of organizing an association that will represent all Americans in Mexico without regard to the nature or amount of their investments." Of the more than 4,000 members of the National Association, 3,800 have no voice in its direction, the circular asserts.

There may have been need of a private association to

champion the cause of Americans in Mexico, when they had a cause, during the last eight years. Whether the need still exists remains to be seen. Perhaps our new Government at Washington intends to protect its nationals and their rights abroad. But surely two such organizations vying with each other as champions of American rights in Mexico will not be productive of good results, even though one be sincere and the other selfish or hypocritical. What can be accomplished depends on the State Department, and if this be efficient the need of private associations, whether their names be long or short, will disappear.

Petroleum and the Colombian Treaty

"Senators Find Americans Own Colombian Oil—Government Report Shows Extensive Holdings—Fact To Be Utilized To Justify Opposition to Treaty—Selfish Interest Charged—Pittsburgh Concern, Later Merged With Standard, Controls Big Concession."

THE ABOVE is an accurate copy of a "scare head" in the *New York Tribune* of a recent date, covering a point of interest in regard to the pending Colombian treaty. To those like ourselves, who have made some study of the foreign mineral problem, and the advisable and even necessary foreign mining policy which the United States should pursue, such headlines give a shock, as we realize that neither the Senate nor the Press is as yet fully emancipated from provincialism and ignorance, and the dissemination of injurious error.

Certain Senators, it appears, have unearthed some apparently damning evidence to the effect that certain oil lands in Colombia are controlled by American capital. "Therefore," they reason, "there are Americans who would be benefited by the establishment of more cordial relations between the United States and Colombia. Ah ha! According to the vote-bidding Congressional tradition and the subscriber-bidding journalistic tradition, here is the best of all reasons why the treaty should not be passed! When the Great American People find out that American petroleum interests would be benefited by the handshake between the two countries, it will demand that the breach shall be widened, and we—the certain Senators—shall be praised for having dug up the damning evidence."

The trail of evidence which the Senators have dug up, according to the dispatch, was not deeply buried. In fact, it consisted of a published report of the Bureau of Foreign and Domestic Commerce, whose object it is to encourage American commerce and industry abroad, as is the object of the State Department, the executive functions of the Government in general, and every clear-thinking American, even if he be Senator or journalist.

It has been the aim of the intelligent element in the national Government for some years now to extend American ownership of petroleum production throughout the world. The campaign of England and of France (as a dissatisfied side-partner) for the maximum possession of the world's petroleum resources has been governmentally conducted for years, the government working in close co-operation with the great petroleum-producing companies. This campaign has determined many of England's political moves during the war and after. Our State Department and our Bureau of Mines and our Bureau of Foreign and Domestic Commerce have become more and more exercised over this policy of "grab and exclude," which, taking advantage of the traditional American attitude of hostility toward "spe-

cial interests," has threatened to leave the United States short of the most essential mineral product in the world, within a decade or two.

What the opposition Senators allege as a reason against ratifying the treaty is an overwhelming argument in favor of confirming it at once. They would find this out if they would stop to investigate. There will, of course, by our system (the best the world has yet devised) always be an uninformed and wild-eyed element in the Government; and this element will be far more noticeable in the legislative branch than elsewhere. Positions in the executive departments are filled with considerations only of special fitness for the place; but the Congressman or Senator is often shot on unexpectedly to Congress because he has made a convincing roar about going to clean up the graft when he gets to Washington, and that he will get a big special appropriation out of the pork barrel for his district or state.

Foreign trade is one thing and foreign mining another; although they are perhaps not unremotely related. We will not touch upon the former: it seems to have champions enough. But foreign mining is misunderstood, underrated, abused. A good many politicians still hold the view that an American dollar invested in Colombia is a Colombian dollar, and, therefore, not to be protected: if anything, to be injured, as an evidence of the utterest lack of interest. England, however, holds that an English pound invested in Colombia is an English pound, and therefore, to be protected; if she had not had this policy she would not be the power she is.

Nor shall we fulfil our destiny to protect ourselves, to withstand invasion, to work out our ideals of humanity, without a governmental policy to aid those adventurers who go to foreign shores to provide for our country that which she does not have in sufficient abundance. Most critical among these things are mineral supplies, which are hidden treasures, and do not grow. Of these the most necessary is petroleum, and our Government should aid in every way the securing by American capital of all the foreign petroleum which is possible.

The Secretary of State (Colby) recently served notice on the British and French governments that the United States Government would not stand for the partition of Mesopotamian oil between England and France, to the exclusion of American interests; and it is understood that the present Secretary (Hughes) will continue the same policy. How much more important is it for American capital to secure petroleum in the Western Hemisphere! Our Senators and our journalists, if they were only moderately enlightened, far from being shocked at the discovery (the fact of its being news to them shows their need of schooling in matters of common knowledge), should be shocked if they discovered that any but American and Colombian capital controlled the oil of Colombia!

We hope that some Elementary School in Foreign Mining Policy may be established for certain Senators and the like. We must believe, of course, that the great majority of the Senate, and of the Press, are better informed. The American Mining Congress has decided to establish a Foreign Mining Division, in the capable hands of Mr. Henry C. Morris; and one of the features of its work will be educational. The Mining and Metallurgical Society of America also has formed a strong committee on Foreign Mining Policy, under the chairmanship of Dr. C. K. Leith, and through this committee the views and influence of the mining engineer will doubtless become effectual.

Introducing Heterophemy

WE SUPPOSE it was heterophemy, which is defined by Webster as the unconscious saying of words other than those intended, that was responsible for the early press dispatch stating that the U. S. Supreme Court had upheld the decision of the Court of Appeals in the Conkling-Silver King Coalition lawsuit, when the truth was that the decision had been reversed. The judgment of the latter court for \$570,000, awarded the Conkling for ore taken from ground claimed by both mining companies, was set aside. He laughs best who laughs last, and the Coalition may, for a while at least, enjoy itself. But apparently the lawyers laugh all the time where mining litigation is concerned. This case which has dragged so long is once more back where it started, except for the fact that in the meantime two decisions have been handed down, one reversing the other and demonstrating the mathematical truism that one minus one is naught.

But to turn from blasphemy to heterophemy, the description of the disputed ground as given in the patent said one thing, whereas it really meant another. That is, there was a discrepancy between the length of the Conkling claim as given in the patent and as marked by the location posts. The Conkling company claimed the ore-bearing ground according to the patent, and the Coalition based its claim on the position of the location posts. To determine this question of the priority of patent over location the Government intervened in the last suit, and it was ruled, to quote our correspondent, that the size of a claim is determined from the survey as marked by the location posts, and not by the figures as given in the patent when there is variance between the two. Thus another point of the mining law is decided, and, having contributed to this end, the Conkling company will not regret the expenses its suit entailed, and the Silver King Coalition will count well spent the money required to defend the property which the decision of the court just handed down has held to be its own.

Aiding the Unemployed Miner

AN EXAMPLE of practical welfare work that benefited the community in more ways than one has recently been afforded in the zinc-lead district of Oklahoma. Nowhere else has the mining industry been harder hit by present conditions than there, three-quarters of the mines being closed down. The resultant unemployment has presented a serious problem to the community, though things would have been much worse and the problem of relief more urgent had the winter been more severe.

At Picher, where the need was greatest, a Central Relief Association was organized, with F. C. Wallower, of the Golden Rod Mining & Smelting Co., as chairman. In the three weeks ended March 5 this organization raised over \$2,700, of which the mining companies gave \$1,000 and the employed miners an equal amount by paying 25c. per week each, the balance coming from mine supply houses and individuals. Unemployed miners were given work on the local roads at \$2 per day, in this fashion about \$2,000 being spent by the association by March 5. The resultant improvement in roads is marked, it is said; conditions are made better for the men themselves, and a distressing situation that threatened the welfare of the community is being eased.

WHAT OTHERS THINK

Men vs. Schools and Education

I have been much interested in the discussions of the question of the "Correspondence School Mining Engineer" in several issues of *Engineering and Mining Journal*, and while I have taken work in both the leading resident and correspondence schools, I am inclined to take a different view of the question from some of your correspondents, as well as yourself.

Your illustration of the negro vainly striving at college to assimilate the sciences, battling against an infinitely ancient unfavorable line of ancestry, gives us the starting point in this discussion. Did it ever occur to you that there are many men of the white race battling against the very same unfavorable conditions of pre-natal influences?

The man as he came into this world represents the sum total of his line of ancestry, and it must be admitted that man is born and not manufactured at any particular college or university; yet this condition of man is graduated on a scale from zero to the highest order of intelligence. The point on the scale at which the man under discussion would register is another very important point in our discussion, and the fact that our presentation of this problem tends to one of the whole scale makes it very difficult of solution.

The fact that we can count many failures in both classes of schools is nothing against either method of instruction. The fault is with the man. We all know that some of the greatest men the world has ever produced had the advantages of neither, which almost amounts to a demonstration of this statement.

It is perfectly true that each man succeeds in this life according to his natural ability and proclivities for any particular line of work, and, taking a given sample of man, it would naturally follow that the most favorable circumstances in which he might be placed to acquire knowledge would give the greatest results in the quickest possible time.

Now, as to the proposition of schools, both resident and correspondence, it might be said that as time passes on they are getting closer together. Many of the leading universities of the country have within the last few years extended their work by adding correspondence courses to their regular curriculum, and the student taking these correspondence courses is given credit for the same as though he had been present at the time the work was taken. There have been 290 high schools, colleges, and technical schools of the United States, Canada, and many foreign countries that have adopted the books of one single correspondence school, not mentioning the fact that the same set of books have been accepted by the United States Government for the use of sailors and marines. This certainly speaks something in favor of the correspondence methods, and I have had many students in resident colleges inform me that they have got better ideas from the use of these books than from any other set of books in college work, including the lectures as presented by some very learned college professors.

It is an evident fact that the correspondence school method has come to stay, and we will gain nothing by trying to underrate it. We must admit that it is reach-

ing many men who would never acquire the knowledge they do without it.

You state in your last editorial that "The recognition of the schooling as an essential part of education—which is axiomatic—may be easily and logically followed further, to the recognition that the highest example of the regular mining schools turns out, as a class, men who will be, in the end, better mining engineers than those who attend inferior schools."

Your statement is more dogmatic than axiomatic, for the simple reason that neither superior or inferior schools ever produced great men, or men of any kind.

Inverness, Fla.

STRAUSS L. LLOYD.

Engineering vs. Surgery

I have read in Dec. 25 issue of *Engineering and Mining Journal* your editorial "Lennine and Wahington B. Vanderlip" and am somewhat surprised at the statement that Mr. Vanderlip is only a "correspondence engineer." This would infuriate that one who gains his knowledge through that method of teaching is not a desirable member of the profession, and in fact, that seems very narrow, and one that we would not look for from a publication of the standing of the E. & M. J.

If a man has the knowledge and ability to follow and line of work and get results, does it matter where he acquired that knowledge? And is it a guarantee because a man has a "sheepskin" form one of the many institutions of learning that he is capable? There are many graduates in the various lines that are not able to make a living in the line that they chose, or circumstances threw them in when the time of choosing an education arrived.

It would seem to me that the results that are obtained, rather than the school attended should be used in judging a man's capabilities.

If a man were to make a million dollars by mining iron, would we say that the money was no good because he did not happen to make it mining gold, or some other metal that we were engaged in the production of?

Again if a physician was called on to attend a case of smallpox, and he learned from the patient that it was contracted, in a pool room, would the physician say that it was not smallpox because it was not contracted in a commercial club, or some other gathering.

Let us be fair minded enough to judge a man by his works.

J. F. INGLIS.

The question raised in this and other correspondence is treated editorially in this issue and was thus discussed in the March 5 number. We should not call in a physician who had only taken a correspondence course in medicine and surgery.—EDITOR.

Concerning Engineering Societies Publications

Referring to my letter printed in *Engineering and Mining Journal* of March 12, the words "engineering foundation" in the last paragraph should have been spelled with lower-case initials. I was referring to engineering foundations in general, and not to the Engineering Foundation of which Charles F. Rand is president.

DONALD M. LIDDELL.

New York.



TIMBER STATION AT 2,800-FT. LEVEL OF SPECULATOR MINE, BUTTE, MONT.

The Application of Cement Mixtures by Machinery

Summary of Properties and Examples of Use of "Gunite" in the Mining and Metallurgical Industry—Fireproofing of Underground Timber and Surface Structures—Prevention of "Slabbing" by Sealing Rock Surfaces and Obviating Action by Air and Moisture

BY GEORGE J. YOUNG

Written for *Engineering and Mining Journal*

THE INTRODUCTION and general acceptance by the mining industry of tools or appliances constructed for specific purposes has been in progress since systematic mining began. The acetylene lamp, the oxygen helmet, the stoper, the hand-held drilling machine, the acetylene torch, and the arc-welding apparatus have won widespread acceptance, and their use excites no special interest. Most mining men can remember when they were introduced.

The invention of a new appliance and the prospect of its acceptance are, however, of considerable interest. During the last six years the cement-gun method of placing cement-sand mixtures in different structures has proved useful in mining operations, both below and above ground. It may fairly be said that it has won a place in the tool rack of the miner as well as in that of the repair and construction workers. More than thirty mining and metallurgical companies have placed this equipment in the hands of their operating crews. The Anaconda Copper Mining Co. is making extensive use of "gunite" for fireproofing mine shafts in the Butte district.

The name "gunite," although first used as a trade name by the manufacturers of the cement gun, has now received general acceptance. There is no equivalent single word to convey the idea of mixtures of fine sand and cement pneumatically deposited in place. As compared with concrete, in kind of mixtures, method of placing, and physical properties, there are many differences. The nearest analogue is "cement plaster." Although there are similarities, there are also differences. Cement plaster is mixed wet and troweled on. Vertical walls and ceiling work entail a considerable amount of skill and muscular exertion. Floor work is more easily done. In wall and ceiling work, troweling is impracticable unless the surface is an approximate plane. The practical difficulty in most plastering or "layer work" has been to secure a close enough bond to the wall or other surface to prevent peeling or flaking off. Mainly because of poor bonds and excessive hand labor, the use of thin layers or coatings of plastic sand-cement mixtures has not found application in mining, where it was obvious that they would be useful.

George S. Rice, of the U. S. Bureau of Mines, used

the cement gun in 1914 to place a coating of "gunite" over the walls of an explosion chamber in the Bureau's experimental mine at Bruceton, near Pittsburgh. This same authority advocated the use of a coating of cement as a preventive of "slacking" of the walls of mine openings, and, as ordinary methods of applying such a coating were impracticable for reasons already stated, the proposed method did not meet general acceptance. The advent of the cement gun has brought about a change in practice, however, as by its use a compact, closely adhering layer can be placed upon irregular surfaces.



CEMENT-TREATED TIMBER IN A CROSSCUT

About six years ago coal mining engineers became convinced that there were important advantages in the use of "gunite," and since then there has been steady increase in its application in the coal-mining field. In a paper presented to the Coal Mining Institute on Dec. 6, 1917, Mr. Rice described the utility of "gunite" in coal mines.¹ In the various applications, in widely different fields, descriptions have appeared in sufficient number to make possible a fairly accurate summary of the properties of this material, its use, and an analysis of cost details.

The cement gun has been described so many times that it is unnecessary to describe it here. By the use of this appliance a uniform stream of sand, thoroughly mixed with a given proportion of cement in suspension in air under pressure, passes through a rubber hose and is discharged through a nozzle, in which a uniform

flow of water is admitted, upon the surface that it is desired to coat. The flow of water is so adjusted that there is just sufficient to wet all the particles and hydrate the cement. The velocity of travel of the mixture in the hose is sufficient to prevent any settlement. The nozzle discharge velocity is high, one writer stating that it reaches 300 ft. per second.

WATER PRESSURE SHOULD BE GREATER THAN THAT OF AIR

It is obvious that the wetted mixture is driven by impact into place and that a dense layer necessarily results. A certain amount of the sand grains rebound, the proportion being variously stated as ranging from 10 to 20 per cent. Both the flow of the mixture and the water must be constant or as nearly so as practicable. It is recommended that the water be delivered under a pressure 20 lb. in excess of the air pressure, which ranges from 40 to 75 lb. This is necessary, so that the water can overcome the air pressure within, as it enters within and not without the nozzle.

The proportion of rebound material diminishes from a maximum at the start of placing a layer to a minimum as the layer reaches a limit thickness. The skin adhering to a wall or other surface has a proportionally greater amount of cement than the outer part of the layer, due to the rebound rejection being greater. The sand which rebounds is stated to be remarkably clean, or free from adhering cement. The first or skin layer is thus of greater plasticity and serves as a bed to receive the stream of material.

In placing a layer upon a floor there is no particular limit to the thickness, but, except in special instances—as, for example, waterproofing—there is no advantage in using "gunite" for floor work, as the ordinary methods are cheaper and more simple of application. For wall work there is a limit to the thickness of the layer, as thick layers show a tendency to slough off before the cement sets. In work of this kind several successive layers are placed until the desired thickness has been attained. In roof work, the tendency to slough is even more marked, and a greater number of successive layers is necessary. There is also a greater proportion of rebound material on roof work, and on the whole this kind of work is much more difficult than wall work. Reinforcement is used in probably the majority of applications, and where this is done the first layer on wall work can be built out to a thickness of 1½ in. (including the reinforcement) and an additional layer of ½ in. applied, making a 2-in. layer in all. This was done in the construction of a flume by "gunite" described by Stephen E. Kieffer. The flume side walls were 4 ft. in height.

DRY MIXTURES AND DRY AIR NECESSARY

The compressed air should be dry and the sand used in "gunite" should comply with the specifications for sand used in concrete. The usual maximum size limitation is one-quarter inch. Clean, dry² sand free from humus, and screened, is necessary. Mr. Kieffer, in describing the construction of the flume mentioned before, found it necessary to slightly moisten the sand under excessively dry and hot weather conditions before charging it into the gun.

²"Dry" is used in a relative sense. There should be a low moisture content, as it is difficult to wet the mixture thoroughly if the sand is excessively dry. The sand should be dry enough not to adhere in clots. About 6 per cent moisture is stated to be sufficient.

¹Reprinted in *Engineering and Mining Journal*, Vol. 105, p. 625.

I have not found any description of the cement used, but the presumption is that the usual kinds employed in concrete work suffice, although it would appear to me that a quick-setting cement would be highly desirable. It is necessary to screen the cement before use. The proportions of cement and sand vary. The extreme ratio is 1:5. Mixtures of 1:3, 1:3½, 1:4 and 1:4½ have been used. E. M. Norris states that for coatings of ¾ in. or less in thickness a mixture of 1:3 was most satisfactory. Mr. Rice states that a 1:3 mixture, due to the rebound material, approximated a 1:2½ when in place. For a 1:4½ mixture, one bag of cement (1 cu.ft.) is stated to be sufficient for 32 sq.ft. of "gunite," 1 in. thick; for a 1:3 mixture the area is 22 sq.ft., 1 in. thick. Approximately 1 cu.yd. of mixture will equal 0.6 cu.yd. "gunite." The amount of free air per minute is estimated at 110 cu.ft. for the N-0 machine, 150 for the N-1, and 225 for the N-2, the three sizes of machines manufactured.

The important characteristics of "gunite" are its compactness and high degree of imperviousness. Mr. Rice quotes Westinghouse, Church, Kerr & Co., to the effect that "gunite" is superior to hand-made products of the same kind. Tensile and compressive strength are exceeded by "gunite." The surface permeability is $\frac{1}{10}$ to $\frac{1}{20}$ as much water per hour as similar hand-made surfaces. Hand-made mortars absorb 1.4 to 5.3 times as much as "gunite"-made mortars. The proportion of voids is from 52 to 72 per cent of that of the hand-made product, and adhesion is 27 per cent better. Many applications of "gunite" have demonstrated its adhesive qualities and its imperviousness to both air and water.

MACHINE-PLACED STRONGER THAN HAND-PLACED MORTAR

Byron C. Collier presented a comprehensive paper on the application and uses of the cement gun before the Municipal Engineers of the City of New York, Dec. 23, 1918. Respecting the most advantageous mixtures he said that 1:2½ is most suitable for work demanding high water-resisting qualities, and 1:3 for ordinary conditions. There was no advantage in using an aggregate in excess of ¼-in. size if a well-graded mixture is used. Tests made with ordinary river sand in which no attempt at grading was made gave excellent satisfaction. As a result of tests he states that it is a safe assumption that 1:2½ "gunite" will have an ultimate compressive strength of 4,500 lb. per sq.in.; 1:3, 4,000 lb. per sq.in. Compared to this a 1:3 gravel concrete averaged on tests 3,038 lb. per sq.in. Between hand-placed concrete and "gunite," the "gunite" proved to be in almost every case 30 per cent stronger than the concrete.

Experimental research has been made upon the properties of reinforced "gunite" slabs for roof and floor construction, and various reports have been published in which data for their design may be found. It is not the purpose of this article to go into the applicability of "gunite" for building operations, but rather to limit its scope to those applications peculiar to the metal-mining industry. Nevertheless, the engineer who specializes in mine building and smelter construction will find it worth while to investigate the advantages that may accrue from its use in this field.

Three sizes of machines are made, commercially designated as the N-0, N-1, and N-2. The cubic contents of the three sizes are, respectively, 3, 4, and 5 cu.ft. of dry, loose material. The respective weights

are 900, 1,400, and 1,475 lb., complete with standard equipment. The sizes of the material, air, and water hose are respectively 1 in., ¾ in., and ½ in.; 1½ in., 1¼ in., ½ in., and 1⅓ in., 1¼ in., ½ in. for the three sizes. A variety of nozzles and tips are provided for specific purposes. I find, in several descriptions, that a 1½-in. material hose has been used. It is highly desirable to place the machines as close to the work to be done as possible. In using a 50-ft. hose length, the capacity of the machine was increased 15 per cent as compared with a 100-ft. hose length. The limiting distance has been stated to be 500 ft., but 200 ft. would be better. E. M. Norris found in shaft work that with air pressures of 75 lb. the nozzle could be satisfactorily used at 200 ft. above and 75 ft. below the gun. These are given as maximum vertical distances.

From a number of descriptions of actual work, I have selected six and have summarized each as follows:

I. Waterproofing a Reservoir; *Engineering News-Record*, Nov. 25, 1920, p. 1043. Four guns were used. A 2-in. reinforced layer was placed. Mixture, 1:3. Gravelly sand of ½ in. maximum size was used; about one bag of cement to from 14 to 15 sq.ft.; gage pressure, 80-85 lb. per sq.in. at compressors; 30 lb. at gun nozzles; maximum hose length 200 ft.; reinforcement two layers of wire mesh in which sheets were placed at right angles; reinforcement amounting to 0.3 per cent. Four guns placed 8,000 sq.ft. of 2-in. lining per day of 8½ hours; or at the rate of 2,000 sq.ft. per gun (333½ cu.ft. per day per machine). The cost was 49c. per sq.ft. The greater part was floor work, with some sloping sides.

II. M. S. Sloman described in *Coal Age*, Dec. 26, 1918, p. 1158 (article originally printed in *Mine and Quarry*), the coating of a coal mine slope with "gunite." The surface was first cleaned and scaled. No reinforcement was used and the coating averaged ½ in. in thickness, 1:3 mixture. Timbers were covered with ½-in. wire mesh. The slope was 12 x 12 x 6,250 ft. The total cost was \$7,488.58, or 30c. per sq.yd. (3.3c. per sq.ft.). A 900-ft. section of this slope required 13½ 8-hour shifts for a working crew of eight men; 2,376 sq.ft., or approximately 100 cu.ft., was averaged per shift. Materials required were 540 sacks cement at 60c. and 1,620 sacks sand at 12c. per sack. The working crew comprised one mechanic, one engineer on hoist, one operator on cement gun, two mixers, one nozzle man, one man drying sand, and the part time of one man hauling sand. No mention is made of power cost.

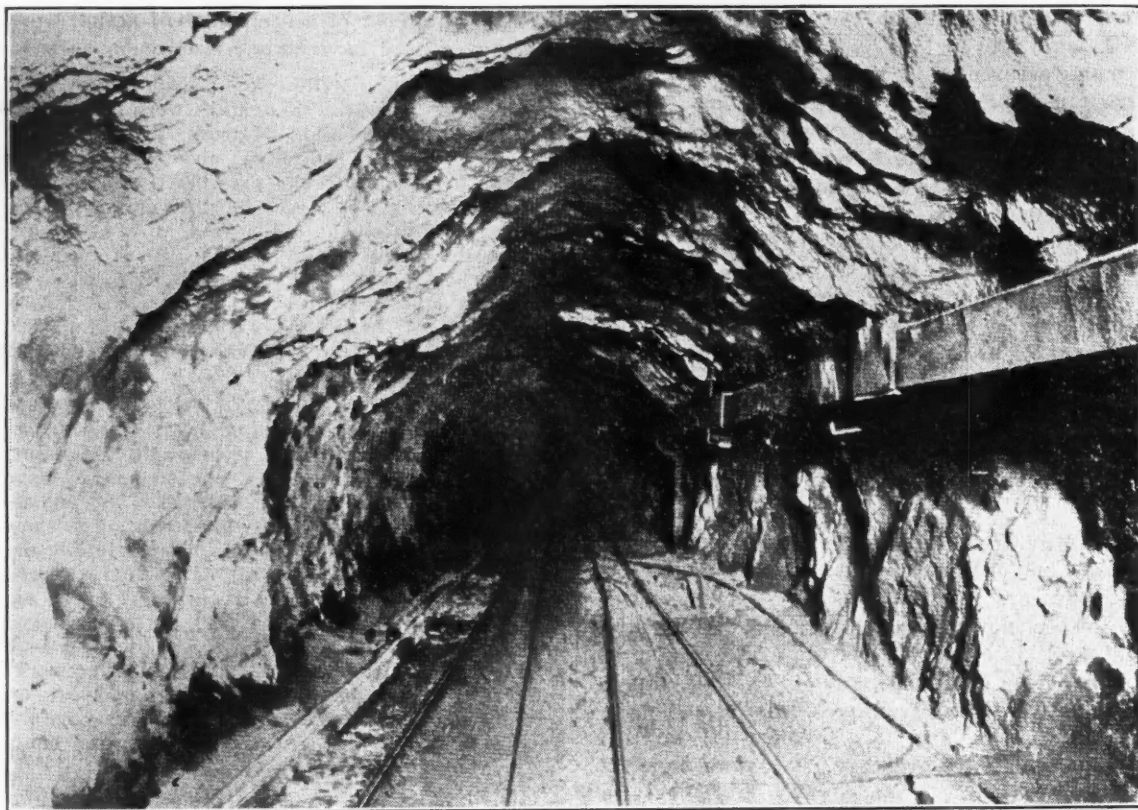
III. E. M. Norris described the fireproofing of the mine shafts of the Anaconda Copper Mining Co., in Butte, before the A. I. M. E., in September, 1918. In this work, "gunite" was placed as a coating on the shaft timbers and lagging after lathing them with 27-gage diamond mesh metal lath, 24 x 96 in. In placing the lathing material 225 sq.ft. per man per 8-hour shift was the labor ratio and a gun crew placed "gunite" on 800 to 1,200 sq.ft. in an 8-hour shift. The coating was applied in two successive layers each ¼ in. thick, and the finished thickness was presumably ½ in. For "guniting" 2,000 ft. of four-compartment shaft, 175,465 sq.ft. of surface covered required 6,102 sacks of cement, 1,500 tons of sand, 165,495 sq.ft. of lathing, 2,600 lb. nails and staples and 94 days' time for an average of 54 men employed, including superintendence and all surface labor connected with the job. On the basis of a square foot of lining, the quantities for this work are 5.2 lb. cement, 17.1 lb. sand, 0.015 lb. nails and staples, 0.94 sq.ft. lathing, and 0.23 man-hours. Two cement guns were employed, and each crew consisted of four men, two feeding the gun and two at the nozzle. Nozzlemen worked from staging and were provided with rubber gloves, safety goggles and respirators. The surface to be coated was washed off thoroughly with water sprays, and "gunite" was applied in two

*Goggles appear to be necessary where operators are inexperienced. It would appear that their use would be desirable on overhead or closely confined work.

successive layers each $\frac{3}{4}$ in. thick. After the coating had become firm, it was sprinkled often enough to keep it damp for several days. The cost of the work was not given.

IV. Stephen Royce described the use of "gunite" at the Cary "A" shaft at Hurley, Wis. This is a steel, five-compartment shaft with the steel sets blocked in place with wooden blocking and lagging of 3-in. tamarack planks wedged into the flanges of the I-beams. "Gunite" was applied to fireproof the lathing and wooden blocking and to protect the lagging from decay by keeping it from contact with air; also to prevent corrosion of shaft sets and waterproof the shaft. The surface to be covered was cleaned thoroughly. This was done partly with water under heavy compressed air pressure, partly by sand blasting, and partly by chipping the rust and accumulated coating from the steel. Reinforcement consisted of No. 7, A. S. & W. Co.'s triangular-mesh reinforcing wire for the side walls. This

on an extensive scale. There were no air blasts nor big caves, but ground that had been barred for loose would again become dangerous, frequently in a few days. "This finally became so serious that it was realized that the expense of timbering, with the probable continuous upkeep cost, might jeopardize the success of the entire plan." The plan referred to in the quotation provided for the duplication of the surface layout of a mine at the 81st level, excepting rock crushers and air compressors; a hoist to reach an additional depth of 3,000 ft., and an electric haulage system three miles long. Supplies were to be delivered through No. 12 shaft at the south end of the Calumet & Hecla property, and the copper rock was to be hoisted through the vertical Red Jacket shaft, 5,000 ft. deep. Work was begun on the project in January, 1918. A careful study of the "slabbing" resulted in the conclusion that it was not due to rock movement but rather to the action of air and



(From the M. C. M. Alumnus)

A DRIFT IN THE CALUMET & HECLA AFTER "GUNNING"

was stapled directly to the I-beams and to the lagging at intervals. To keep the wire mesh about one-eighth of an inch away from the surface to be covered was accomplished by stapling the reinforcing wire on with nails underneath it. The I-beams, before the cement was applied, were covered with $1\frac{1}{2}$ -in. mesh chicken wire, clamped on with wire clamps. The total area of wall surface was 14,260.9 sq.ft.; of steel covered 3,749.96 sq.ft., or a combined total of 18,010 sq.ft. The materials required were sand, 102.5 cu.yd.; cement, 173 bbl.; reinforcing, 14,260.9 sq.ft., and chicken wire, 3,750 sq. ft. Linear feet of shaft was 263.13. The work required one foreman and six men for thirty-two working days. The cost was given as \$9.30 per linear foot of shaft. As the area per linear foot equaled 68.4 sq.ft., the per-square-foot cost is found by calculation to be 13.6c. The thickness of the coating was given as $1\frac{1}{2}$ in. The "gunite" was applied in from one to three coats.

V. In the Michigan College of Mines *Alumnus* for December, 1920, John Knox and Ocha Potter describe the use of "gunite" upon the 81st level of the Calumet & Hecla conglomerate mine. In driving a main haulageway in the foot wall in a barren amygdaloid vein, "slabbing" began

moisture. Drawing upon the experience in coal mining, where similar problems had been solved by the application of "gunite," experiments were made upon several hundred feet in February, 1919. "Slabbing" stopped at once, and the "gunite" layer remained unbroken. After an interval of several months, the "gunite," which had been put on in one coat, dropped off in a few places where the original coat had been too thick to set properly and its weight had pulled it away slightly from the rock surface, thus leaving small air spaces. These formed blisters, and small slabs of "gunite" fell, exposing the rock surface again. The difficulty was overcome by putting on two thin coats, usually one coat on one shift, followed by another coat on the succeeding shift. By Dec. 4, 1920, 8,772 ft. had been coated with "gunite." Trouble from "slabbing" in a section of No. 4 shaft of the North Kearsage mine was remedied by "gunning." As a result of this work, the engineers in charge are of the opinion that hundreds of thousands of feet of mine openings should be "gunned" instead of timbered.

The detail given is as follows: "The 'gunite' mixture used consisted of 1:2 $\frac{1}{2}$; sand was screened through $\frac{3}{8}$ -in. mesh; air pressure, 65 lb., and water pressure, 40-50 lb. Four men were employed on each shift on 'gun' work, two charg-

¹Lake Superior Mining Institute, Sept. 6, 1916.

ing the gun and two men who alternated at the nozzle. These men did their own barring and trimming and applied one coat of 'gunite' over a length of 50 ft. of 9 ft. x 12 ft. tunnel, or an average of 6½ linear feet per man per shift for a double coat. The average thickness of one coat varied from ¼ in. to ½ in. on a smooth rock surface. For two coats the thickness was from ½ in. to ¾ in. Crevices and hollow spots were filled, and at these points the thickness of coat varied materially. About 28,000 lb. of 'gunite' mixture is used to complete 100 ft. of tunnel. Approximately 20 per cent of the sand rebounded from the rock and fell to the floor. This was, of course, wasted. Wire mesh reinforcing was tried at first but was very expensive, difficult to apply, wasteful of 'gunite' and finally found to be entirely unnecessary. It proved convenient to dry and mix the sand and cement on surface and to bring it to the operators in packages, each of which contained a full charge for the gun. However, when this plan was followed, it became necessary to add a very small quantity of water when mixing, to prevent a separation of sand and cement during transit."

VI. E. Court Eaton described, in the *Engineering News-Record* of Aug. 21, 1919, the construction by "gunite" of a six-mile flume: "The flume is 5.75 ft. wide at the bottom, 4 ft. deep, laid on a grade of 5 ft. per mile. It is of reinforced 'gunite' construction, with 2-in. side walls, the whole surmounted by a 4 x 6 in. rectangular beam, the beams on each side being tied together with ¾-in. bars. The forms consisted of 1-in. tongued-and-grooved flooring, kept thoroughly oiled, braced with 2 x 2-in. bracing. A set of 700 ft. of forms, with slight repairs, lasted the whole job. The side walls were shot on in two layers, the first being 1½ in. thick, up to the reinforcement. After about fifteen minutes the final ½ in. was applied. The reinforcement was held the required distance from the inside face with spacing bars. These bars were removed as sufficient concrete had been shot on to insure the mesh having its proper position in the structure.

"An attempt was made to 'gunite' the 4 by 6-in. beam on the top without forms, but it was found that unless this were done in several layers, with sufficient time interval to allow partial settling, the mass was so heavy that it sagged forward and broke away. Small forms were placed above the side walls immediately after they had been completed, and the rebound from 'guniting,' which had been caught on canvas, was used in pouring these beams. Ten per cent of cement was added to this material before placing.

"For the most part, the flume was constructed during hot weather, with temperature from 100 deg. to 125 deg. F. Immediately after the construction of a section of side wall, burlap was hung from the beam over the sides, and the walls were then kept thoroughly wetted for twenty-four hours. After this period, the flume was kept filled with water. The mix was 1 part cement to 4½ parts of sand, with lime in the proportion of 10 per cent of the cement added.

"The average rate of progress was 140 linear feet per day, with a construction crew as follows:

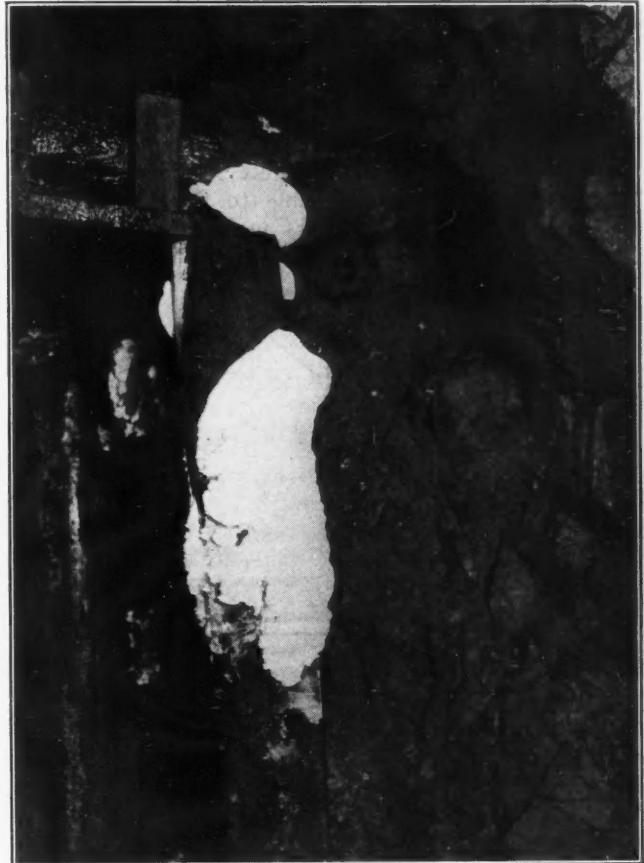
1 Foreman.....	\$5 00
1 Nozzleman.....	5 00
1 Nozzleman's assistant.....	3 00
1 Compressor operator.....	5 00
1 Laborer shoveling sand.....	2 75
1 Laborer screening.....	2 75
4 Laborers mixing and turning over at \$2.75.....	11 00
10 Laborers finishing grade and wrecking forms at \$2.75.....	27 50
3 Carpenters setting forms at \$4.....	12 00
4 Men placing steel at \$2.75.....	11 00
Total per day.....	\$85 00

"Assuming ten men for mixing and placing the 'gunite,' an average of 31.9 sq.ft. per man-hour, or 399 cu.ft. 'gunite' per day, was placed per day."

DIFFICULTIES OF ADHESION TO WET SURFACES

Stephen Royce says: "If the cement can once be applied and can harden, no amount of water will make any difficulty thereafter, but there are considerable difficulties in making the coating stick to a wet surface. In coating a wet shaft for a large southern Illinois

coal company, water was diverted from a wet point in the shaft to the sump below by means of permanent drains. Sometimes bleeder pipes are introduced into wet strata and later sealed after the concrete lining has hardened. In some cases it was necessary to drill through the wooden lagging and with iron rods clear the mud which sometimes accumulates, and so allow the water to drain down to a lower point in the shaft. In some places a waterproof felt sheathing was placed between the cement and wood of the shaft lining; the water drains down between the felt and lagging, and the outer surface is kept dry for the application of the



FUNGUS GROWTH ON UNDERGROUND TIMBER

cement coating. This felt, being waterproof and rot-proof, and being completely incased between the cement and wood, is a perfectly solid part of the shaft lining."

In Bulletin 114 of the Cement Gun Co., Inc., attention is called to the desirability, where "gunite" is applied to wood surfaces, of covering the wood with paper prior to attaching the reinforcing mesh; otherwise not only does the wood tend to absorb the moisture from the "gunite" prior to its getting a set, but also the wood shrinks away from the "gunite" as its accustomed moisture is excluded. Tar paper is used for this purpose, and is drawn tight and firmly fastened. E. M. Norris, in describing the work at Butte, says that "Experiments were made to determine whether reinforcing material was necessary to hold the concrete to the timber and, if so, what kind of material was best. It was found that if the timbers were wet down thoroughly the concrete would stick without reinforcement, but subsequent distortion of the timbers caused the concrete coating to shell off in large slabs."

For an effective seal on rock surfaces "gunite" must

be well applied and excess water avoided, as otherwise the skin of "gunite" will not be impervious and slow action may ensue, with subsequent flaking off of the layer. It is obvious, also, that rock surfaces must be clean and free from loose, weak portions. "Gunite" is not effective where ground is on the move. In no sense is it a support of the ground. Its only function is to seal the rock surface from atmospheric action. How effective "gunite" is in preventing deterioration of timbers by rotting where they are sealed from the air by a protecting layer of reinforced "gunite" remains to be seen. Superficially it would appear that dry rot would be retarded if not entirely stopped. There is, however, no specific information on this point.

COST ANALYSIS

In the examples given, details of cost such as are available have been presented, and are incomplete, in that power and replacements are usually omitted. In the cement gun itself the gaskets for the cone valves require replacement from time to time, as does the outlet-valve body liner. Liners are used for the nozzles. Compressed air and water hose are subject to the

3. "Guniting": Labor, power, water, cement, sand, lubricants.
4. Wear and replacement of liners, gaskets, hose, gun parts.
5. Tearing down, cleaning up and removal of apparatus.

H. V. Croll has given me the cost data shown in the table. In this example "gunite" was used to prevent the walls of a mine "tunnel" from slaking.

COST DATA OF PLACING "GUNITE" IN TUNNEL AT UNITED VERDE EXTENSION MINING CO., JEROME, ARIZ.

1 Gun man, also motorman	\$7.00
1 Nozzleman	5.60
1 Man holding lights	5.60
1 Man loading gun	5.60
1 Man cleaning roof	5.60
3 Men mixing at \$5.60	16.80
Total labor	\$46.20
Cement, 77 bags at \$1	77.00
Sand, 9 cu. yd. at \$1	9.00
Air and supplies	10.00
Superintendence	5.00
Total	\$147.20

3,750 sq. ft. at \$147.20 = 4c. per sq. ft.
 Above crew placed 125 running feet of tunnel in one 8-hour shift, equivalent to 3,750 sq. ft.; average thickness 1/2 in.

SUMMARY OF USES IN MINING

In underground mining, in order of importance, "gunite" is used for fireproofing shaft and station structures where timber is extensively employed; for surfacing rock surfaces that are susceptible to disintegration due to the action of air and moisture; for making air-tight timber stoppings and brattices and making leak-proof sumps and water bulkheads. A minor although important use is in the protection of steel plate and girder construction underground from corrosion produced by damp air. It is problematical whether "gunite" affords any more than temporary protection where acid waters come in contact with such structures.

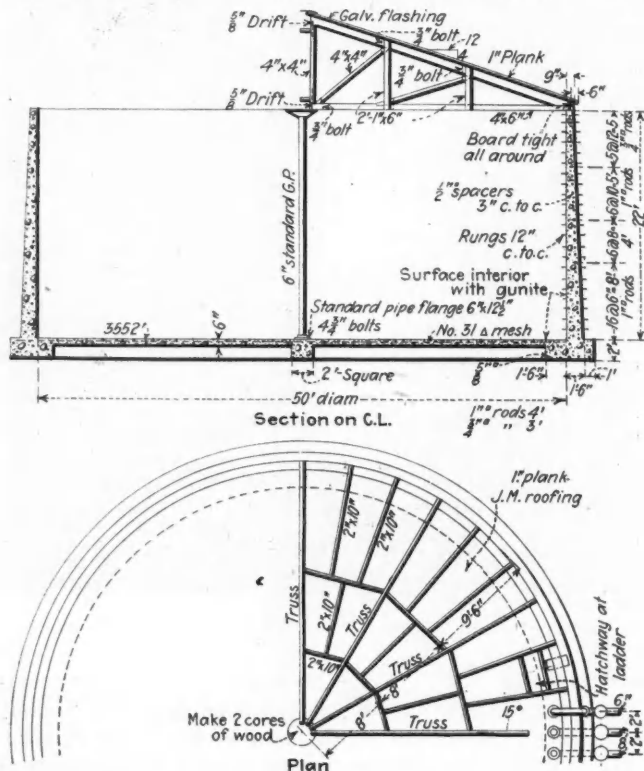
The most extensive use of "gunite" for fireproofing shafts has been made by the Anaconda Copper Mining Co., at Butte, Mont. According to H. J. Rahilly, mine fire superintendent of the Anaconda, "places that are most susceptible to fire, such as working shafts, stations, crosscuts, and drifts having high-tension wires in them, motor, fan and transformer stations, oil houses and powder magazines, are covered with 'gunite' or cement mortar, so as to make it difficult for a fire to start."

Mr. Rahilly, in the *Anode*, describes the construction of brattices: "These brattices are made of 1-in. boards covered with metal lath and coated with 'gunite,' or they are made of burlap over which 1-in. mesh chicken wire is stretched, and then 'gunited.'"

At the Butte & Superior mines "gunite" has been used in covering the timbered stations and approaches to the stations on various levels. In some cases it has been applied to the rock itself. Generally it has been successful, although in some applications it is not absolutely perfect.

E. E. Whitely, superintendent of mines of the Calumet & Arizona Mining Co., at Bisbee, states that "gunite" has been used to seal air from drifts that tend to air slake. For this purpose a coating 1/2 in. to 3/4 in. thick is used. The surface was first washed down and the "gunite" applied in two coats. The gun was also used in the construction of bulkheads in raises and to make ordinary bulkheads airtight. In starting to sink the junction shaft deeper, the sump on the bottom level was made waterproof by a 2-in. layer of "gunite."

N. B. Braly, general manager of the North Butte Mining Co., says with regard to the use of a cement



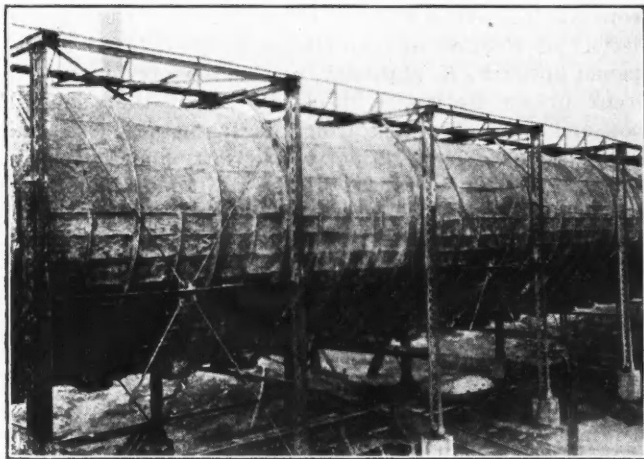
"GUNITE" SURFACED WATER TANK AT UNITED VERDE EXTENSION MINING CO., CLEMENCEAU, ARIZ.

wear which comes from frequent handling, and would require replacement no more frequently than drill hose. The material hose is subjected to considerable wear. Estimates of its life range from four to six months with continuous use. Nozzle liners last eight days and cost 80c. for renewal. I am reliably informed that the upkeep cost on the work in the Anaconda properties at Butte amounted to 50c. per eight-hour shift per machine operated.

The elements of cost of a single job in summary are:

1. Assembly of machine, compressed air and water piping, materials, mixing apparatus.
2. Preparatory cleaning of surfaces, placing wire reinforcing, staging.

gun at this property: "Results show that material hose will last from sixty to ninety days, compressed-air hose about twelve months, and water hose about twelve months. We have found that the most efficient way to operate the 'gunite' machine on big jobs is with three men. On smaller work two men are sufficient, as the man operating the machine can also dump in the 'gunite.' The only difficulty in operating the machine is that the rubber outlet valve will last only from fourteen to eighteen days. This hose is tapped and is 9 in. long. We find that the 'gunite' machine will fail only when the compressed air is wet; it must have dry air to operate properly. The repairs are small. In 'guniting' with 50-ft. material hose, 5 to 7 lb. of



REPAIR OF FLUE BY "GUNITE" AT U. S. SMELTING, REFINING & MINING CO., MIDVALE, UTAH

compressed air is best; with 100-ft. material hose, 10 to 12 lb., and for overhead or shaft work, 15 to 18 lb. of compressed air."

In surface plants, "gunite" has found a number of applications. Apart from its use in building and in fireproofing of cribbing and roofing, it has also been used in the construction of large settling tanks and for water tanks. A 50 x 22-ft. water tank was constructed by the United Verde Extension Mining Co. at Clemenceau. For waterproofing ditches and reservoirs "gunite" is especially valuable. For flume construction in placer mining operations where wood is unobtainable or high in cost, the application of "gunite" might well be considered.

At the Butte & Superior, in Butte, Charles Bocking, manager, informs me that "gunite" fireproofing on surface structures such as coal bins has remained in place, in some cases, for about three years, with no sign of cracking or coming off.

At the Midvale plant of the United States Smelting, Refining & Mining Co. a large balloon flue showed signs of failure due to corrosion. It was covered with chicken-wire netting and "gunited." The result was to considerably prolong the life of the flue. At the El Paso Smelting Works an acid-proof mortar was applied to the interior of the roaster flue by means of the cement gun—a $\frac{3}{4}$ -in. layer of mortar consisting of 50 per cent siliceous tailing, 35 per cent siliceous clay and 15 per cent cement. An examination made recently, about three years after the lining had been put into place, showed the flue to be in good condition. R. S. Moore, chief engineer, informs me, however, that the

acid action is not severe in this flue and that no serious trouble from acid action on the brickwork of the roaster flues, even where unprotected, has been noted. The cost of this lining was less than for coating an ordinary wall with "gunite."

Steel beams and other structural parts free from vibration or not subjected to repeated loads can be protected from corrosion by a thin layer of "gunite" $\frac{1}{8}$ in. to $\frac{1}{4}$ in. thick. There are usually a number of places in and about smelters where such use could be made. Mr. Croll called my attention to a limited use of "gunite" lining for small tanks holding acid solutions. He mentioned one case in which a 2-in. lining of "gunite" had been applied on a tank which was used to hold an 8 per cent sulphuric-acid solution. The lining had been in use for 2½ years without serious deterioration.

In building construction at the plant of the Southern Gypsum Co., at North Holstein, Va., the hoist house, machine shop, and stock room were constructed of wooden framing with galvanized metal on the outside. Gypsum plaster, reinforced by chicken-wire netting, was put on with a cement gun as an interior lining. It would thus appear that clay mixtures and gypsum plaster can be applied by the cement gun more readily than by hand work.

Sharp Decline in Quicksilver Production in 1920

Preliminary figures showing the production of quicksilver in the United States in 1920, according to the U. S. Geological Survey, give a total of 13,070 flasks (75 lb. each), compared with 21,348 flasks in 1919. Of this output 9,366 flasks is credited to California, 3,601 flasks to Texas, 79 flasks to Nevada, and 24 flasks to Oregon. So far as is known neither Idaho nor Arizona produced any quicksilver.

In California ten mines were reported as productive; in Texas, two; and in Nevada and Oregon one each. In California the New Idria, Cloverdale, New Guadalupe, Oceanic, Carson, and Oat Hill mines were closed during the later part of the year, most of them with the expectation that work will be resumed when the conditions for mining and marketing quicksilver have improved. The largest producer, the New Idria, lost its reduction plant and a considerable quantity of quicksilver by fire on June 20. Operations were resumed at about half capacity in September, but ceased entirely in November. In Texas the Chisos mine has been continuously productive, but the Big Bend was closed on the first of November. In Oregon the War Eagle Mining Co. reports the completion of a twenty-five-ton Scott furnace, which will not be placed in operation, however, under existing conditions.

The year 1920 was a discouraging one to quicksilver mine operators, who had to face a decline in prices consequent upon a decreased demand for their product and found little relief from the prevailing high cost of labor and supplies. Such demand as there was for the metal was met from surplus stocks accumulated during the war, from quicksilver originally sold abroad but subsequently resold in this country, and, in addition, from imports.

The average price of quicksilver in 1920 per flask of 75 lb. at New York was \$81.123. The highest monthly average price was in April, \$102.192; the lowest in December, \$49.577.

South American Mining Fields and Practice

Manganese Ore Occurs as Replacement and Alteration of Iron-Bearing Schists in the Bomfim District of Brazil—At Morro da Mina, in Minas Geraes, a System of Mule Training Makes Cheap Transportation Possible

BY W. H. STAYER

Written for *Engineering and Mining Journal*

I HAVE JUST RECEIVED a copy of the work on political and commercial geology edited by J. E. Spurr. I find it fascinating, especially as my experience has taken me to a number of foreign places which he describes. In a friendly way, I wish to add my feeble word to his compilations. Of the need of such a work there can be little argument. I wish it might be expanded into many volumes, to be revised from time to time, like an encyclopedia. I shall try to base my criticisms on my own experience and on knowledge obtained from what I consider reliable sources, which sources I shall give when possible.

PETROLEUM AND OIL SHALE

Brazil is not mentioned under this head. As you will note by F. Lynwood Garrison's article on Brazil in the Jan. 22 number of *Engineering and Mining Journal*, it may be considered as a future factor in oil shales and possibly in oil production. A Rumanian chemist distilled oil from Brazilian shales during the war, and sold his unrefined mixture to users of crude oil for power purposes. I believe he sold his oil in Bahia. He made his own stills, and was immensely pleased with himself and his product when I saw him in the interior of Bahia in 1918. He procured his shales from Maceiô, in the State of Alagoas, he said. I believe that Brazilian oil shales will soon command more attention than they have previously, because of their probable richness and extent. The Standard Oil Co. of Indiana has been in Bolivia for some years and has not been alone. Lewis Emory, Jr., of Bradford, Pa., who owns gold mines and rubber lands, is interested in oil in Peru.

Many tests have been made on the coal from southern Brazil. This coal is not especially inaccessible. The fault is with the impurities in the coal. Briquetting, pulverizing, washing, picking, and like industrial operations have been tried. The experiments have been done by good men under the observation of graduates of American institutions which own the steamships on which the coal would logically be used, viz., the Loge Brothers, of Rio.

IRON AND MANGANESE ORES IN BRAZIL

There are considerable deposits of iron ore in the State of Bahia, quite like those of Minas Geraes, that have not been mentioned in the technical press, as far as I know. Most of them are in isolated places, and transportation will be difficult.

I consider myself capable of discussing manganese ores to a greater extent than most of your readers, as I mined these ores from Bomfim, Bahia, and from the district of Saude, near by, which has never been mentioned in any technical magazine, as far as I have observed. Most articles dealing with Bahian manganese ores state that manganese mines exist at Nazareth and that manganese ore was shipped from Bomfim during the war.

In 1917 George Lavino, for E. J. Lavino & Co., bought three mines at Nazareth and paid five hundred *dontos de reis* (about \$125,000) cash for them. This was while I was going to Bahia from New York in March, 1917. I looked over these mines, laid out a line of work for reopening them, and then, after many delays, went to the district of Bomfim to take charge of the alleged mines opened up by F. N. Mainetty, an Antwerp ore buyer—a Greek or an Italian, I think. I found that several thousand tons of mixed iron and manganese ore had been mined. After Mainetty had left, and I was in charge, I opened up about fifteen different manganese ore deposits, optioned others, abandoned some, and in a year had fifteen thousand tons of ore piled at the railroad, the railroad overtaxed, and much more ore ready to ship to the railroad when it seemed best. All this from the district of Bomfim, on the railroad from Bahia to Joazeiro.

The ore occurs as a replacement and alteration of iron-bearing schists, like the schists called "itaberite" in Minas Geraes. There is a short range of mountains near Bomfim rising 1,000 ft. abruptly from the nearly level, semi-arid plains below. There are three distinct repetitions of these iron-bearing schists in the Bomfim district, and perhaps three more in the Lamarão district, to the south, which has been little prospected. Still farther to the south and nearer the railroad from Bomfim, past Missão, Lamarão, and now at Jacobina, is the Saude district, from which I mined a lot of fine ore, before the railroad was completed, in 1918. Then comes the Jacobina district, then the Canna Brava, and others. There is a necklace of districts of manganiferous ore probably extending to Goyez and to Minas Geraes.

CLIMATE VARIABLE

There are also manganese districts in Bahia, nearer the coast and connecting Nazareth and Cajoeira with the interior. The climate at Nazareth is very moist, though at Bomfim it is as dry as Nevada.

The manganese mines of Minas Geraes are barely known, even by name, at least to the public. In order of importance they ranked, in 1918, about this way: Morro da Mina, Cocoruto, Santa Mathilda, São Gonsalvo, and the mines at La Fayette and vicinity.

The Morro da Mina had a simple system of mining, top benches, exposed to the weather, with an irregular lot of tunnels for wet weather work, about 200 ft. below the top works. At the top, where the chain of orebodies, hundreds of feet wide and thousands long, was exposed, there were no cars and no rails, save those of the broad-gauge railroad leading to Rio de Janeiro. Perfectly level floors were gradually made, mules and two-wheeled dump carts carrying the broken ore, much of which was soft and none of which was crushed by machinery, to chutes leading to small bins from which the railroad cars could be filled. The carts and mules cost two *milreis* per day, (\$2), the repairs falling to the man who owned them.

Thus a man could earn 50c. for a mule and cart, and many such units were used per human employee, as the mules were trained to form a line of carts that looked like a circus making a one-day jump. They would back up to the ore pile, wait for the cart to be filled, then start off for the procession leading to the ore chutes perhaps five hundred feet away, turn around, let the ore be dumped and start back on the run for another load.

The Morro da Mina mine has probably five million tons of marketable ore, the Cocoruto has shipped 300,000 tons or more and has nearly as much left, and the São Gonsalvo has a record of 200,000 tons, and its future will depend on the cost of mining its caved ground.

The topography and geology of Minas Geraes and the mountains of Bahia suggest Virginia, and the climate, though milder than that of Virginia, and with less rainfall, is similar.

The mines of La Fayette, of Miguel Burnier, and of Ouro Preto are all that are usually described by writers of Brazilian manganese ores. In addition, there are huge deposits in Goyaz, Matto Grosso, and elsewhere in Minas Geraes and Bahia. Thus Brazil can supply the world with manganese, and of varying qualities, including crystalline pyrolusite, which has often been shipped as furnace ore, but has been used to make batteries or in other chemical applications.

CHROMITE IN BAHIA

The chromite deposits of Brazil have not yet been described by any one, being mentioned only by name. I notice Mr. Garrison says in a recent article that he discovered them. No doubt he refers to his examination of them in 1916 for E. J. Lavino & Co. and associates. The deposits are situated in the State of Bahia, about two and a half kilometers west of the station of Santa Luzia. I first saw them in 1917, in May or June, in company with George Lavino and E. J. Huffard. There were two three-foot pits and a lot of black boulders visible in the thick undergrowth of oak, thorny trees, and underbrush, impenetrable save for the irregular paths taken by Mr. Garrison, which were visible.

I ordered a fifty-foot swath cut along the probable line of the ore and later another at right angles to the first. Finally all the growth over an area of half a square kilometer was cut off. I dug thirty-two pits and extracted 10,000 tons of ore before I knew the extent of the deposits. Suffice it to say I ran two inclines, mined over 30,000 tons of 38 to 47 per cent chromic oxide in the form of chromite, and left over double that in the mine for the future.

The mine, which was leased by E. J. Lavino & Co. from Newman & Co., an American firm of New York and Brazil, was known for years as "Pedras Pretas," or black rocks. Coronel Leopoldino Leitão, an agent of Newman in the hide business, sent the rocks to Newman, who sent them to his brother in New York, who had them analyzed, finding chromite. There are at least two other localities in Bahia that show chromite, and one of these should yield to development.

It cost \$2 to mine the ore and put it on cars, \$2 to pay Newman, and a scattering expense for freight, export tax, and ocean carriage, making the ore cost \$20 to \$25 per ton in New York, f.a.s., or f.o.b., or f.o.g.—meaning free of graft.

As to the geology of the chromite, I collected a set of specimens and made several cross sections, and they

have not been delivered to me as yet, as they are among my private effects which were delayed in Bahia. There is little serpentine near the chromite. The chromite is in three stages of alteration or replacement. One stage is chromite, another disseminated chromite in silica, and another a chromite-hornblende combination, which is hard and of variable composition. Bands of segregated material lie along the line of weakness evident in the complex of granites, gneisses, and other materials that are common in the vicinity. These materials include serpentine, quartz, hornblende rocks, and iron ore (indicated on surface). Quartz is perhaps equal in quantity to the hornblende rocks. There is some kaolinization, but it is more marked along a later fracture, also mineralized, and at an angle of seventy degrees or so with the line of the chromite deposits first mentioned. There is much more chromite in this segregated district than anything else. One hundred feet or so under the original surface the orebodies are nearly one hundred feet thick and contain 80 per cent ore at least. It is chromite, mixed chromite and hornblende, and disseminated chromite. The surface near the chromite deposit is only slightly elevated, the slope being eight degrees. The prospecting was like looking for ore in a wooded cow pasture.

There are countless cliffs of titaniferous iron along the coast in Brazil, not yet visited by many Americans, and still open for location, I think.

Copper occurs in several known districts in the north of Brazil, but there are no operations for its recovery at this time. I opened up four pits in the Carahyba mines, seventy-six kilometers west of Angico, between Bomfim and Joazeiro. I took out four thousand tons of 4 per cent ore and piled it neatly and precisely near the pit. Several dozen pits two meters square and four meters deep were dug at the intersection of hundred meter squares. The copper occurs along a northeast line and can be found at points 100 miles apart. I should like to prospect the whole belt. It is a nearly arid country, slightly wooded. A valuable fibre was shipped from this section during the war.

There are a few graphite deposits, slightly worked, in Bahia. They are not far from Santa Luzia, where the chromite occurs. There are several places in Bahia and more in Minas Geraes where commercial mica is found, in several colors. Muscovite is not as common, in my experience there, as other forms.

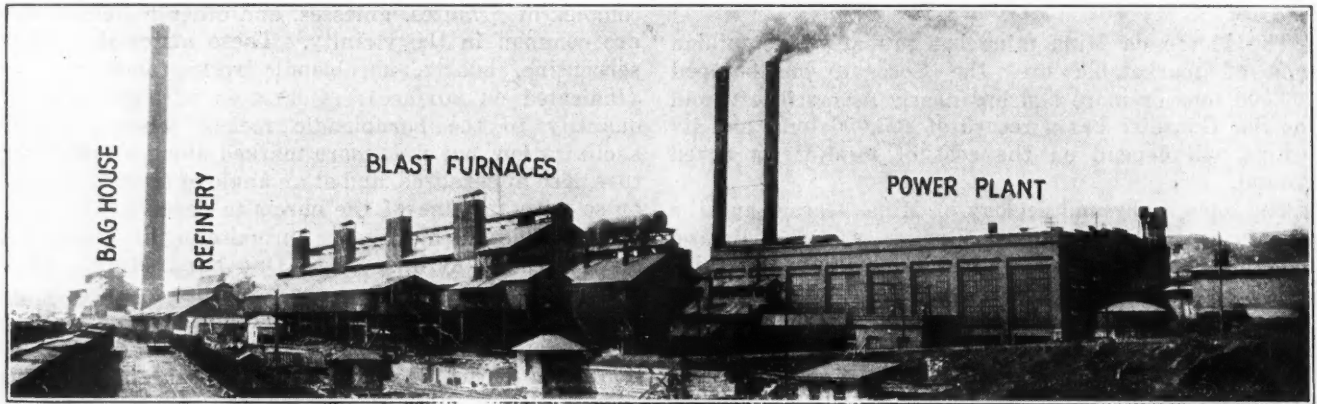
Bahia has a number of nitrate deposits, usually very small and with potassium nitrate rather than sodium nitrate. We made gunpowder from it for our mining purposes, when dynamite became too high in price.

I notice that "Political and Commercial Geology" keeps off Ecuador. The South American Mines Co. owns the South American Development Co., which operates the only gold lode mines in Ecuador. The company makes money and has only one possible rival, an adjacent property controlled by Frenchmen.

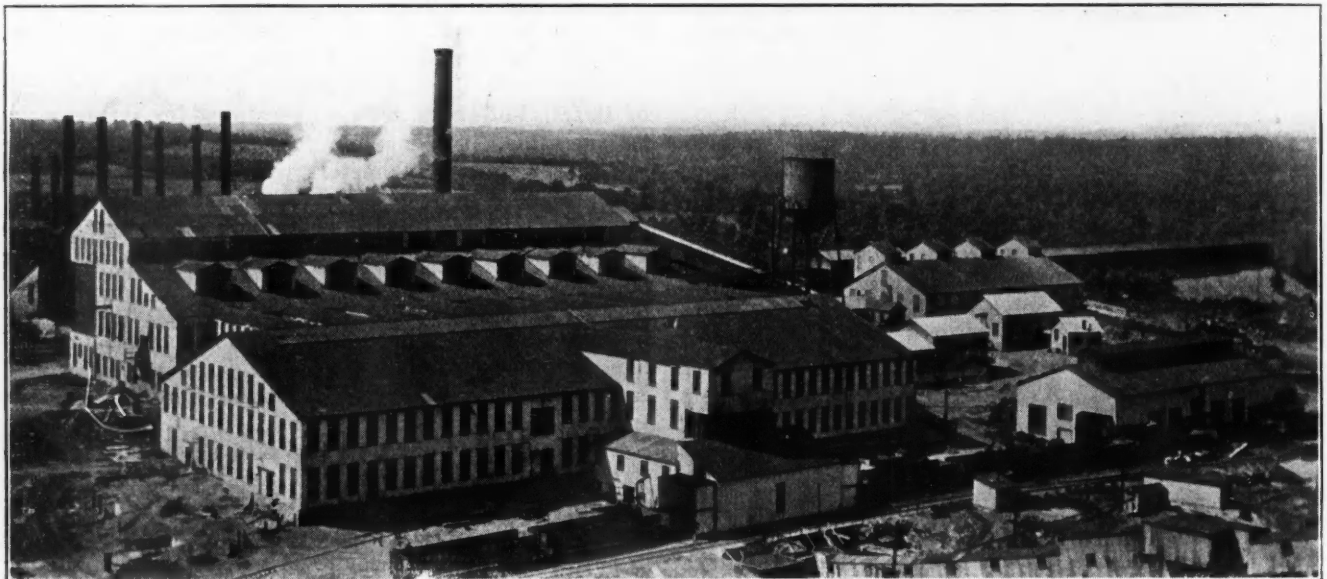
Queensland's Gold-Mining Activities

Gold was naturally the first of the minerals to be exploited in Queensland, Australia, according to Trade Commissioner Ferrin in *Commerce Reports*, and its production showed an accelerating increase from 111,589 fine ounces in 1868, the first year in which it exceeded 100,000 ounces, to 676,027 fine ounces in 1900, since which time production has been steadily declining, and at present is under 150,000 ounces.

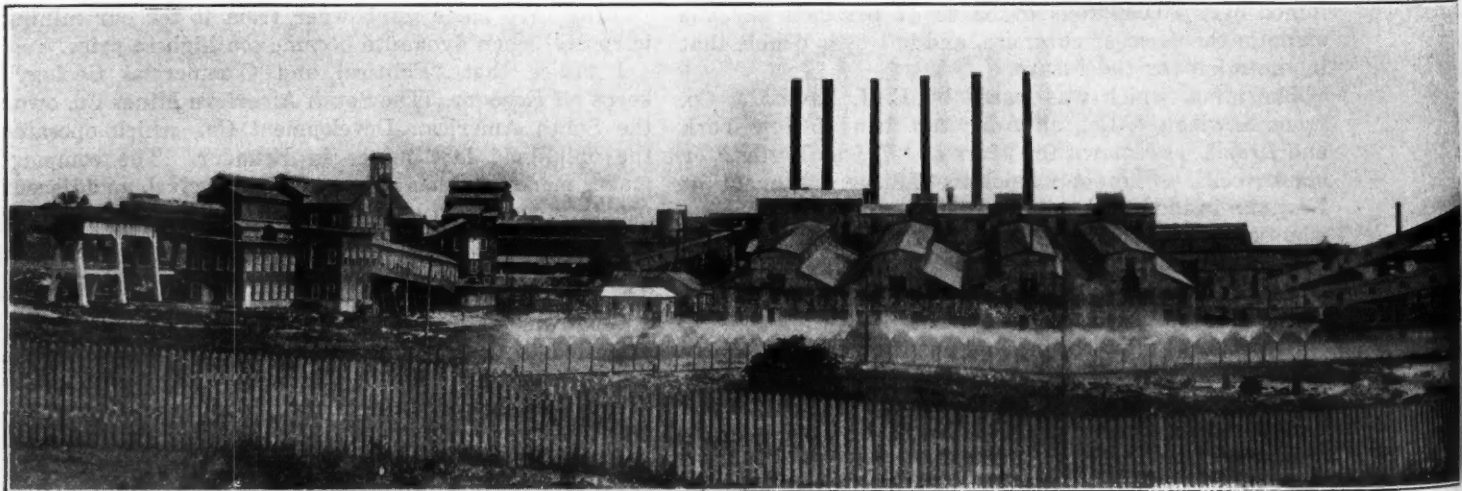
Lead Mills and Smelters in Southeast Missouri



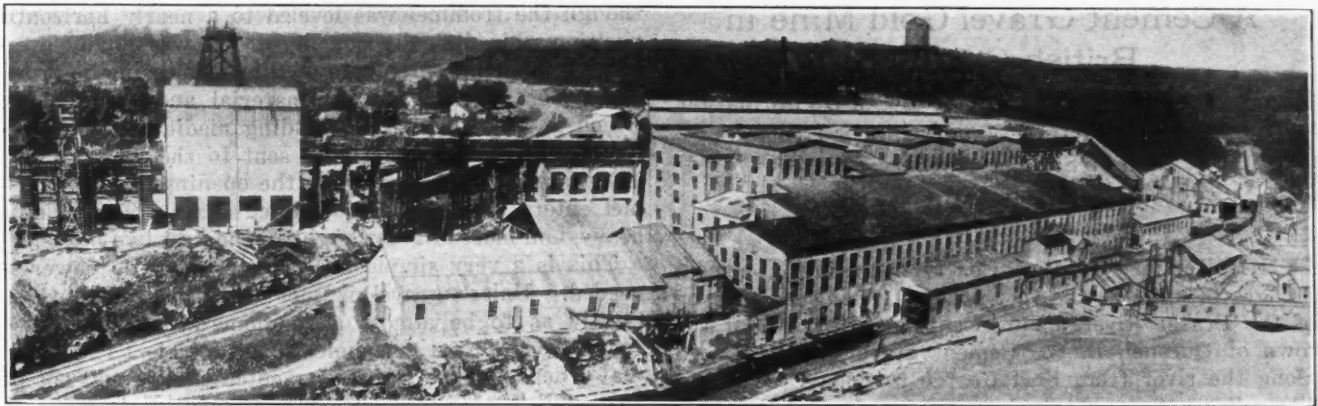
HERCULANEUM SMELTER OF ST. JOSEPH LEAD CO. AT HERCULANEUM, MO.



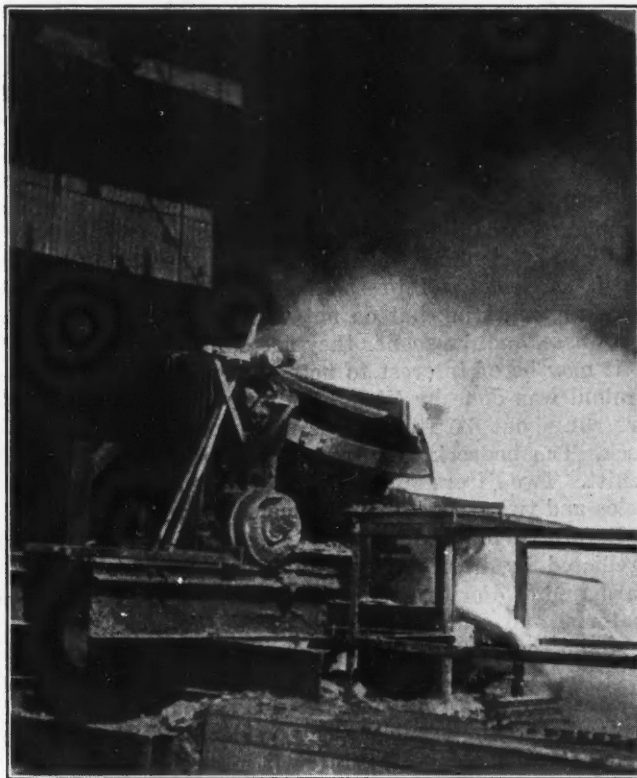
NO. 4 MILL (5,000 TONS' CAPACITY) OF FEDERAL LEAD CO., NEAR FLAT RIVER, MO.



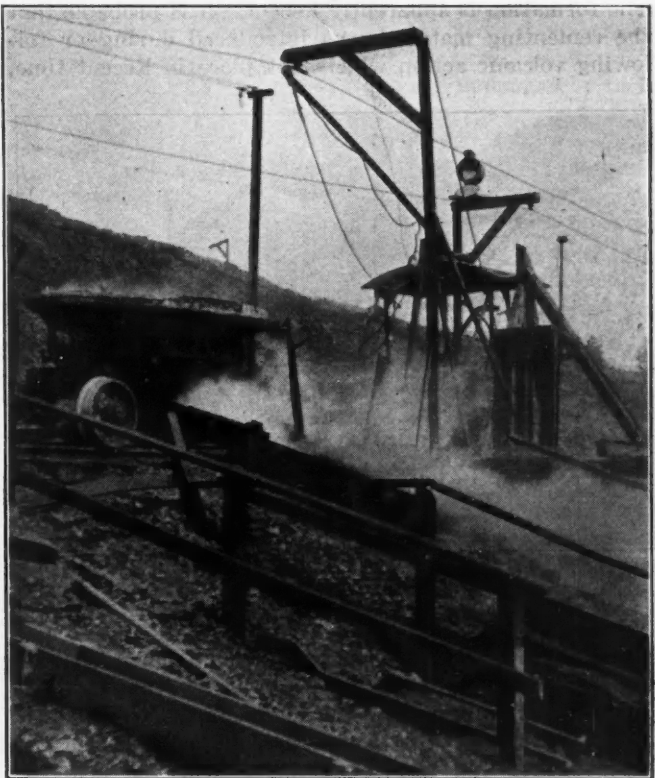
THE 3,000-TON MILL OF ST. LOUIS SMELTING AND



NO. 3 MILL (5,000 TONS' CAPACITY) OF ST. JOSEPH LEAD CO., NEAR ELVINS, MO.

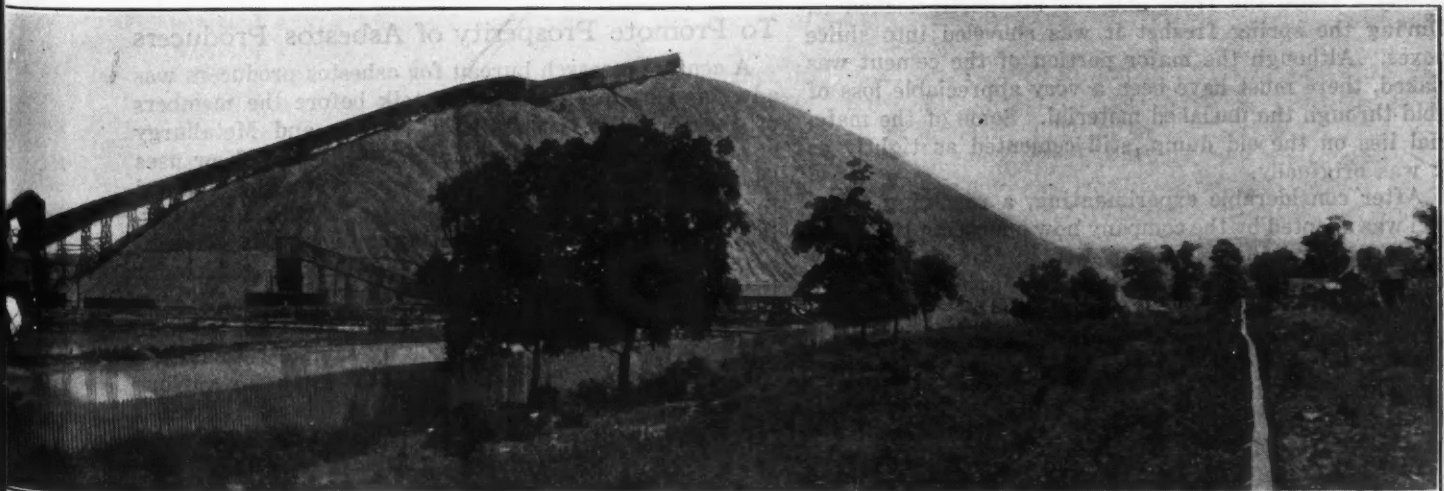


MATTE SINTERING



SLAG SINTERING

AT HERCULANEUM SMELTER OF ST. JOSEPH LEAD CO., HERCULANEUM, MO.



REFINING WORKS OF NATIONAL LEAD CO., ST. FRANCOIS, MO.

A Cement Gravel Gold Mine in British Columbia

Trommel and Spray Sufficient To Break Up Formation, Releasing Metal—Waugh Clipper Drills Give Satisfactory Service

BY DONALD D. FRASER

Written for *Engineering and Mining Journal*

THE Tertiary Mining Co. is operating a cement gravel mine at the foot of the Cottonwood Canyon of the Fraser River about twenty miles north of the town of Quesnel, B. C. Cement gravel can be traced along the river from Fort George to Soda Creek, over 120 miles. As one travels up the Cottonwood River, also, cement gravel can be seen exposed for a number of miles. The binding material is, in part at least, lime. The formation is apparently Recent. It is probable that the cementing material was introduced during or following volcanic action which took place in Recent time.



MILL BUILDING, TERTIARY MINING CO., NEAR QUESNEL, B. C.

The mine is situated on an old channel which cuts across the Fraser River in a southerly direction. At the point of intersection the channel is nearly 200 ft. wide. Years ago it is said that Chinamen worked the exposed face and ran coyote holes near the bedrock. Afterward it was held by two white men, who made good wages drifting. They did their mining in the winter and dumped the gravel near the mouth of the tunnel. There the frost and the air partly slaked it. During the spring freshet it was shoveled into sluice boxes. Although the major portion of the cement was slaked, there must have been a very appreciable loss of gold through the unslaked material. Some of the material lies on the old dump, still cemented as tightly as it was originally.

After considerable experimenting, a revolving trommel was adopted by the company now operating the mine. It is a machine 16 ft. long and 4 ft. in diameter built up of $\frac{1}{2}$ -in. boiler plate and punched with $\frac{3}{4}$ -in. holes. A spray pipe was installed along its axis of rotation. The gravel is dumped from the mine cars into a receiving bin, from which it is fed to the revolving trommel. As the material works through the trommel, its own grinding action scours the boulders as clean as possible. The water from the spray pipe keeps the boulders washed clean.

At first some trouble was experienced because the material passed too quickly through the trommel. Even

though the trommel was leveled to a nearly horizontal position, this difficulty continued. It was finally overcome by placing three sets of 8-in. baffles in the trommel. These held back the material and made a bed which gave an increased grinding medium. The boulders from the machine were sent to the waste dump. The material washed through the openings in the trommel enters a line of 12-in. sluice boxes. The gold is heavy, and most of it is caught in the first two boxes.

This is a very simple flow sheet, and little power is needed. Unless gravel is met which is cemented so tightly as to be almost a conglomerate, this method should be the most economical one possible. It may be that a deposit is so tightly cemented that it will not be amenable to this method. The alternative is a stamp mill, which will cost more to install and be more expensive to maintain.

I have seen a ball mill used in connection with a Blake crusher. On the face of it, this is absurd. Anyone who has had anything to do with a ball mill knows what will happen when it is fed with a large percentage of extremely hard oversize. The oversize builds up in the mill, gradually cutting down its capacity. It seems almost that no amount of grinding will reduce this oversize. It must be dumped out of the mill. The boulders found in a placer mine are the remnants of material washed by the stream and are naturally very hard. When fed into the ball mill they make good grinding material, but do not work through. Boulders are waste, and the sooner they are eliminated the better.

It may be of interest to note that the drilling underground was done by Waugh Clipper drills. The drifts are run about 6.5 ft. high, of which one foot is in bedrock. The bedrock is a greatly decomposed micaceous schist. Two lifters are put into the bedrock; two breast holes and two uppers in the cemented gravel.

Before giving the machine drills a trial, failure was predicted by nearly all. The boulders are extremely hard, and of diorite, granite and quartz, and the binding material and sediment are brittle and friable. It was thought that the drill would "run" between the boulders and that it would be impossible to keep a hole. The first trial proved that the drills would work satisfactorily. Some trouble was experienced, but no more than is usually expected in rock mines where fissures are prevalent. As the sediment around the boulders is heavy, considerable water is required to keep the holes clean.

To Promote Prosperity of Asbestos Producers

A central research bureau for asbestos producers was advocated by J. G. Ross in a talk before the members of the Canadian Institute of Mining and Metallurgy at the Montreal meeting (March 2-4, 1921). New uses should be investigated and publicity campaigns planned to market the contemplated increase in production during the coming year. Such a bureau could also investigate milling methods and establish definite grades for the product. At present, crude No. 1 and No. 2 are the only grades which can be easily defined; the mill stocks vary, and sales are made by sample rather than by specification. There is also a tendency for various mills to adopt a common method of treatment, which often results in inefficiency, because the best method to use on one type of rock is likely to require considerable modification in operations on rock of a different nature.

Prominent Mining Engineers

C. V. Corless

WHEN THE TIME CAME for decision as to what line should run at the top of this page, some doubt entered our mind. Is Mr. Corless a mining engineer or a metallurgical engineer, or does he belong in some of the newer classes such as "human" engineers or educational engineers? He qualifies for any of these titles, but we thought that "mining engineer" was the most all-embracing. Mr. Corless is another one of those Canadians: he was born on an Ontario farm in 1868, and has spent most of his life in his native country. His early years of manhood were occupied in teaching in preparatory schools, where he gained a reputation for his work in natural science, particularly biology. At the age of thirty, however, he had become convinced that progress along the lines which he had been following, and the fruition of his desires, required a separate income, which he did not command. No doubt feeling, therefore, as so many of us have, that digging gold out of the ground was a good way to acquire it, he decided on a course in mining and metallurgy at McGill University, in Montreal.

In 1902, he was graduated with high honors, including a medal and a fellowship, and received the degree of B.Sc. in Mining.

In Canada, the summer vacations are longer than in this country, and the mining students almost invariably spend this time in practical work. One summer, Mr. Corless worked under W. A. Carlyle at the Le Roi mine at Rossland, B. C.; another was spent in the coal mines of Crow's Nest Pass; and his last "vacation" was spent in an inspection trip, with other students of his class, of the mines and metallurgical works of British Columbia, and in the preparation of a thesis on the geology and ore deposits of southern British Columbia. The year 1903 was devoted to graduate work under the Dawson fellowship, which he had received, the subject of his research being "Free Fall of Bodies in Water," a topic of great importance in the concentration and classification of ore pulps. For this work he won a Master's degree.

After leaving the university, Mr. Corless held his

first position for only ten days. This was not because he was fired, however. The work he had accepted had been the inspection of railroad shops, and when he had the opportunity of examining some coal properties he lost no times in turning to his chosen profession.

Many of our readers have heard the story of the man who was hired to kill some beavers which were damaging his employer's property. Joe had been on the job for some days with gun in hand, when friend Bill happened by to keep him company. Bill's bright eyes soon saw a beaver, but Joe was unmoved. "There he is, Joe; why don't you shoot?" he asked. "What do you think I am, Bill?" he replied, "that's the last beaver; and if I kill him I'm out of a job." Now, Mr. Corless, when he went to the given spot in British Columbia, had no trouble in deciding that coal was present, for he could see it; also that the seam was not workable, for that was equally evident. However, he lost no time in reporting his conclusions, and in a few days was again out of a job. This state of affairs was soon remedied, however, when he was offered an assistantship in the



C. V. CORLESS

mining department of McGill. This was not exceedingly remunerative, but offered further opportunities for study.

A year later, in 1904, Mr. Corless, through his university friends, was given a position as mine superintendent for the Mond Nickel Co., the world's second largest nickel producer, and his connection with that company has continued to the present day. In 1908, he was made director and manager, and since that time has been actively in charge of hydro-electric development as well as the construction and operation of the Coniston smelter and an experimental flotation mill.

Besides his engineering activities, Mr. Corless has achieved a reputation as an educator and a welfare worker, and has contributed many constructive papers to scientific societies and technical journals on these subjects. The latest honor accorded Mr. Corless is that of the presidency of the Canadian Institute of Mining and Metallurgy, a position which he assumed at the Montreal meeting early in March.

CONSULTATION

Metallurgy of Ferro-Uranium

"Will you give me through the pages of *Engineering and Mining Journal* some information relative to the ferro-alloys ferro-uranium and ferro-vanadium? Is it an expensive or difficult process to reduce the above-mentioned minerals to the ferro state? Also, if you have the data at hand, give me the radium content of carnotite, and assuming the radium is in equilibrium with the uranium."

We have no cost data on the reduction of vanadium ores, but the problem has been found rather difficult of solution on account of the high temperature required and the speed with which the reaction must take place. The crude ore runs about 25 per cent V_2O_5 . This is calcined and then smelted in an electric furnace with carbon or silicon as a reducing agent. An older process, though still widely used, employed aluminum as the reducing agent in an open-hearth or crucible furnace. The aluminum, added in the form of shot, is slagged off, the addition of carbonate of soda or fluorspar being made for this purpose.

In the manufacture of ferro-uranium it is necessary to subject the carnotite ore, which is the principal source of uranium, to wet treatment, which has as its object the extraction of radium with uranium oxide, vanadium oxide, or iron vanadate as byproducts. Ferro-uranium was developed as a ferro-alloy more because a large amount of sodium uranate, $Na_2U_2O_7$, accumulated as a byproduct of radium production, than for any special necessity for the use of uranium in alloy-steel manufacture. According to Keeney, as the reduction temperature of uranium oxide by carbon is 1490 deg. C. the electric furnace is the only available means for performing the operation in quantity.

One of the chief chemical considerations in the smelting of ferro-uranium is the strong affinity of uranium for carbon, its tendency to form carbides, and the fact that no fluxing material except fluorspar can be used with sodium uranate, as the addition of lime or silica results in keeping the uranium in the slag, with practically no reduction. In practice, steel turnings, uranium oxide, petroleum coke, and fluorspar are mixed in the proper proportions and charged slowly at a rate dependent upon the size of the furnace and grade of alloy to be made. The reaction involved is a simple reduction, the carbon reducing the uranium, which alloys with the steel turnings to form ferro-uranium. All the ingredients in the charge should be as pure as possible, and especially free of silica.

Standard commercial ferro-uranium contains 35 to 50 per cent uranium and 1.5 to 4 per cent carbon. It is brittle and has a high density.

A large amount of data on the subjects mentioned is given in R. M. Keeney's paper "Manufacture of Ferro-Alloys in the Electric Furnace," which appeared in Vol. 62 of the *Transactions* of the American Institute of Mining Engineers.

The output of uranium and vanadium ores in 1918, the latest figures compiled by the U. S. Geological Survey, amounted to about 18,860 tons, which contained 89.5 tons of uranium (105.5 tons of U_3O_8) and 27.1

grams of radium. This will give an idea of the ratio of radium to uranium in domestic ores as mined. The carnotite ore of Colorado supplies the domestic raw material in this country for the manufacture of ferro-uranium.

Blowing White Metal to Blister

In our issue of Jan. 29, one of our correspondents presented the problem of treating a combined mass of shot copper and high-grade matte in converters, to obtain the usual blister copper product. C. D. Demond, of the Anaconda Copper Mining Co., has been kind enough to contribute the following comment on the problem.

"It is quite out of the question to treat the high-grade reverberatory product, mentioned by the correspondent from Rosita, directly in a converter, because it would not develop enough heat to prevent freezing the charge; and it seems unlikely that any feasible method of preheating the converter can be devised. If a heating material is to be used, and if iron pyrite is available (preferably carrying some copper, in order to make it pay its way), the best practice may be to add this to the reverberatory, first thoroughly mixing it with the rest of the charge. But this would yield a considerable amount of converter slag, carrying so much copper that it would have to be re-treated.

"It is probable that the cheapest and best method will be, as suggested by Patrick Dalton, the long-experienced converter foreman at Anaconda, to skim off the reverberatory slag and then bring the high-grade matte to blister copper by blowing air into it through iron pipes plunged into the bath, while continuing a moderate coal fire in the furnace. After tapping the copper, a fresh ore charge would be introduced. Or, the blowing-up might be done in a special small reverberatory furnace.

"Referring to the 0.2 to 0.3 per cent of copper in reverberatory slag, it would be of a good deal of interest to know the analysis and mineral content of the charge, and the analysis of the slag. Is the ore self-fluxing? If not, what materials go into the reverberatory, in what proportions, in how large pieces, and how thoroughly are they mixed?"

Ninety-nine and One-Half Cent Silver

"We are writing to inquire how you arrive at the quotation of 99½c. for domestic silver. All the smelters are settling for silver at 99½c., and it seems that this is the price agreed upon between the Mint officials and the smelters and refineries on June 16, 1920, as reported in the newspapers the following day. This would mean that producers are to be paid \$1 per oz. for silver, less ½c. for transportation and the difference due to adjustment on the basis of 1,000 fine, as against the commercial 999 fine."

The 99½c. silver quotation made by the Western smelters does not include a ½c. commission charge, which Handy & Harman and possibly other silver dealers compute in effecting sales of silver. As the *Engineering and Mining Journal* accepts Handy & Harman's silver quotations as accurate, the 99½c. quotation is given preference. The price of 99½c. is a buying price for domestic silver at 999 fine, and allows a commission for handling the business and disposing of the silver to the Government on a basis of \$1 per oz. 1,000 fine.

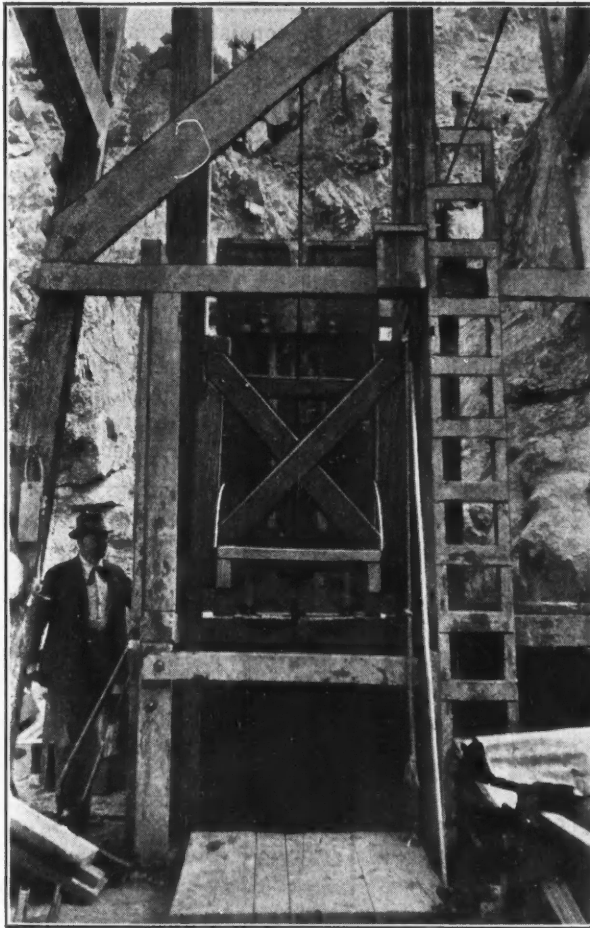
HANDY KNOWLEDGE

Crosshead for Prospecting Shafts

BY LEROY A. PALMER

Written for *Engineering and Mining Journal*

The attached illustration is self-explanatory. It shows a crosshead used in development work which provides a platform on which the men ride instead of on the bucket. The crosshead is about 4 ft. high and



CROSSHEAD WITH HOISTING PLATFORM

the platform is built about a foot from the bottom, projecting about 2 ft. each side of the crosshead proper and well braced to it at top and bottom. This gives standing room for four men and brings the top of the device at a convenient height for them to hold on to while in motion. The photograph was taken at the Big Jim shaft at Oatman, Ariz.

Further Kinks in Surveying

BY J. F. HANST

Written for *Engineering and Mining Journal*

I was much interested in an article which appeared in Vol. 111, No. 9, under the date of Feb. 26, pp. 390 and 391, and entitled "Dodges Useful in Surveying," by H. L. Thackwell. I have a few comments and suggestions to make, particularly on items 1, 6 and 8, which I shall take up under the same headings.

1. How To Get Along Without a Back Flagman

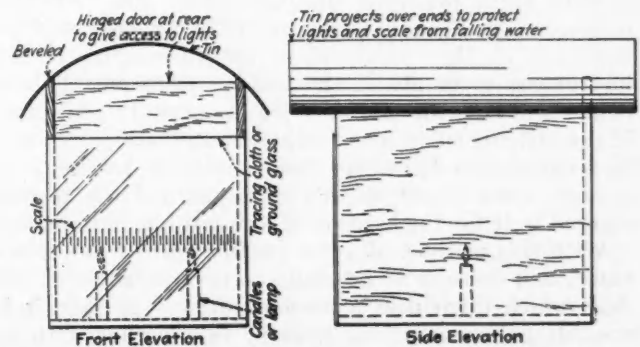
Mr. Thackwell's suggestion is all very well for settled country, but for work in the woods or wild country where it is difficult to see even prominent natural objects, from one station to another, it becomes absolutely useless. The most simple and obvious solution is of course to have the head chainman give the first backsight. When he has given that backsight it is an easy matter to rest a pole across the line and set a backsight by hanging a plumb line from the pole in the correct position, weighting the line with a rock. A piece of white paper strung on the line aids the instrument man to locate it easily. If the country at the backsight is too open to make convenient use of trees or other objects, on which to rest the pole, a rough tripod can be made out of poles, cut from saplings, or from any convenient materials.

Of course, any of these methods slow up the work, but the particular method which I have described, and which I have used on many occasions, is not subject to error, as in Mr. Thackwell's method. It is impossible to triangulate distant objects in relation to a short and comparatively inaccurate base line without introducing serious errors in the work.

6. Sighting Box for Tunnel Work

The apparatus described by Mr. Thackwell is quite ingenious, but it seems to me that it is much more elaborate than necessary. Most mining engineers are accustomed to using stations set in the roof of the tunnel or drift, and not floor stations. When roof stations are used, with the plumb bob hanging from a spad, a square of tracing cloth, held behind the string and illuminated by a light held behind the tracing cloth, is all that is necessary in the performance of the most accurate work.

For shaft plumbing, an apparatus similar to Mr. Thackwell's, but much simpler, is used. This apparatus consists of a box with a door at the rear. At the front of the box is a piece of ground glass or tracing cloth, on which a graduated scale is ruled in ordinary India ink. Two candle stubs, or an acetylene lamp, are placed in the box for illuminating purposes, and the apparatus is placed behind the plumbing wires. A tin "roof" on the box protects the lights from water and permits the escape of smoke and heat. The graduated scale enables the transitman quickly and accurately to bisect the



SIGHTING DEVICE FOR TUNNEL WORK

swing of the plumbing wire. A sketch of this sighting device is appended.

8. Projecting Accurate Lines

Mr. Thackwell's suggestion is all right as far as it goes, but it does not go far enough. It is admitted by all experienced engineers that one of the hardest things which a surveyor has to do is to run a perfectly accurate straight line. As most maps of mine properties today are laid out on a co-ordinate system, some companies, notably the Cleveland Cliffs Iron Co., of Ishpeming, Mich., use the co-ordinate lines as a basis for the actual field work. On this system, the co-ordinate lines are laid out in the field from two main or zero lines, one running due east and west, the other intersecting at the origin of co-ordinates, running due north and south. All stations, then, become expressions of co-ordinates, and are designated thus: N 400 x 800 E, or S 2,400 x 1,200 W. An intermediate or "plus" station, if on a principal line, becomes, for example, N 1,600 x 819.25 W, or similarly S 3,216.49 x 1,200 E. Permanent stations, consisting of 1-in. round iron stakes about 24 in. long, are set on each principal line at every 800-ft. intersection and also at such points on the line that a permanent backsight and foresight may be seen from each permanent station. At intervals of 200 ft. wooden stakes are set to line. Every 800-ft. "iron pin" line or principal co-ordinate line is run complete throughout the entire length of the area it is desired to survey. Intermediate 200-ft. lines are only chopped out wide enough to set whatever stadia stations are necessary to take all of the topography within an 800-ft. square.

In running these long principal lines, extreme accuracy is necessary, as the principal lines must intersect at exactly 90 deg., and measurements must check both ways. All measuring is done at short intervals with "measuring" stakes set on line, and, except on very level ground, all measurements are taken from the head of the transit and the vertical angle read off and noted. Two measurements, one forward and one back, can be taken each time the instrument is set over a measuring stake. This setting need not be particularly accurate, the only requirement being that the transit head is on the line of sight. Measurements are taken with a 200-ft. steel tape graduated to feet and hundredths, and reductions are made on the ground from a table of corrections for all probable vertical angles and distances, or from an ordinary table of cosines.

In projecting the lines ahead, the transit is accurately set up over an "iron pin" or principal station. The vernier is clamped in any position and a direct sight taken on the backsight. The telescope is then reversed on its axis and a point set on line at the foresight. With the telescope still reversed, the plate is unclamped and another sight taken on the backsight. The telescope is now reversed again, bringing it to its normal position, and another point set at the foresight. If the instrument is in absolutely perfect adjustment, these points will coincide and the line is correctly projected. If the instrument is out of adjustment, these points will be separated, and the true line is midway between. A tack or mark is set at this midpoint and the transit sighted in it for the location of any intermediate points.

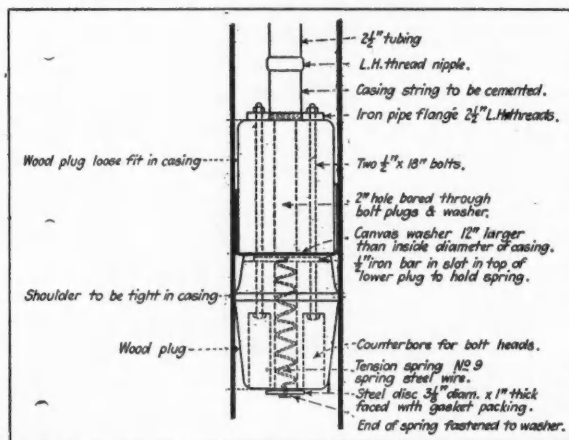
With this method, all errors of the transit are eliminated, and there is no necessity to turn an angle of 180 deg., which introduces a personal error. In fact, it is possible to run very long lines by this method with an absolute minimum of error. It is particularly applicable

to rough country, although, of course, the longer the sights the more accurate will be the work. It is very necessary that the instrument be set exactly over the point at each principal set-up; otherwise, an error is introduced which may or may not be compensating.

Wooden Plug for Placing Cement Through Tubing

An ingenious and inexpensive outfit for placing cement in a well is described by H. B. Thomson, in "Summary of Operations—California Oil Fields," and is illustrated by the accompanying sketch. This device is original with H. S. Williams, superintendent of the Timber Canyon Oil Co., and was successfully used in cementing 9½-in. casing in the company's well No. 3, Sec. 18—4—20, S. B. B. and M., Santa Paula field, Ventura County, Cal. It consists of an upper and lower wooden plug with a canvas washer of large diameter between, and bolted together through an iron pipe flange on top with two long bolts. The pipe flange is threaded with left-hand thread to fit a short nipple having left-hand threads on one end and screwing into a standard threaded string of tubing on the other end.

Two and one-half inch tubing was used, and a 2-in. hole bored through both plugs and canvas washer. It will be noted that the top plug is somewhat smaller than the outside diameter of the casing, and the shoulder on the lower plug should be a drive fit. A valve was made for the outlet at bottom by facing a flat steel disk with gasket packing, and attaching to a coil spring, No. 9 steel wire being used, and coiled to a diameter to fit the bored hole in the plug. The other end of the



WOODEN PLUG FOR CEMENTING OIL WELL CASING.

wire was attached to a bolt set in a slot in the top of the lower plug.

In placing the cement, the casing is lifted off bottom, and plug run in on the end of tubing string. When the plug passes out of the shoe the canvas washer spreads out, and prevents the return of the plug. With the bottom located in this manner the cement is pumped into the well through the tubing and plug, the valve on bottom preventing its return after the pressure is taken off. When the necessary amount of cement has been placed, as indicated, the tubing is unscrewed and pulled out, the casing lowered to bottom with the plug in place, and the cement allowed to set before drilling out plug.

The outfit, as described, exclusive of tubing, costs altogether \$6.50 to make up, the plugs being turned in a local mill from 10-in. x 10-in blocks at a charge of 60c. each for turning.

THE PETROLEUM INDUSTRY

Oil Possibilities of the Mackenzie—A Warning

THE RECENT PUBLICITY given to the discovery of oil by Imperial Oil, Ltd., near Fort Norman, in northwestern Canada, and to the excitement caused by the strike, has evoked comment¹ that is of much timely interest, warning against undue haste on the part of oil prospectors in acting on the news. Those who participated in the unwise and unprofitable rush to Calgary, Alberta, some years ago, will partly understand the necessity of weighing all facts relative to geology, geography, transportation, climate, and other conditions before acting.

The excitement has been caused by items appearing in the daily press and trade journals, of which the following is a conservative sample:

Chatham, Ont., Oct. 16, 1920.—Reports have reached Edmonton from Port McMurray that an important oil strike has been made by Imperial Oil, Ltd., in the Far North. These reports state that on Aug. 25 the Imperial well at Oil Creek, below Fort Norman, struck a gusher production at 850 ft., estimated between 1,000 and 1,500 bbl. a day, and that when the well came in the oil shot 15 ft. above the top of the derrick.

A report of this sort from an easily accessible region might wisely be investigated by the oil fraternity, with the intention of investing if found favorable. But the fact remains that the majority of such reports have not materialized in anything like the originally reported production. For instance, various wildcat wells in western Texas have been reported with great productions; yet when carefully investigated the production was found less than five barrels per day. Of course, it is far more necessary to consider carefully all factors before accepting similar reports when the locality they concern is 1,200 miles from the nearest railroad and less than 300 miles from the Arctic Ocean.

The facts concerning the Fort Norman well are said to have been stated by C. O. Stillman, president of Imperial Oil, Ltd., as follows:

On Aug. 25, at a depth of 783 ft., oil was encountered, which flowed out of the 6-in. pipe for thirty minutes, when the well was capped and shut in. Any estimate as to the amount of oil this well would produce is only a guess, as there was no tankage available, and an accurate test could not be made.

Mackenzie is one of the three districts known collectively as Northwest Territories. The oil strike that has caused such a stir is in this district, forty-five miles below Fort Norman, on the east bank of Mackenzie River and only a few rods from the river. The nearest railroad point is Fort McMurray, about 1,200 miles distant by river. The scene of the strike is 1,500 miles by the nearest route of travel from Edmonton, Alberta, the nearest city.

Access is mainly by way of either the Athabaska or Peace river to the Slave River, and thence northward via the Slave and Mackenzie rivers. Shallow-

draft boats must be used. Cargo must be unloaded and carried around the rapids at Fort Fitzgerald, if going via Fort McMurray, and around Peace River rapids in addition in traveling via Peace River. The rapids would present a serious obstacle to returning upstream with oil. The rivers are frozen for eight months of the year. Access may also be had via Dawson and the Yukon, but by these routes it is likewise difficult.

Knowledge of the existence of petroleum in the lower Mackenzie region is not new. R. G. McConnell stated many years ago that:

The Devonian rocks throughout the Mackenzie Valley are nearly everywhere more or less petroliferous, and over large areas afford promising indications of the presence of oil in workable quantities. The rock is in several places around the western arm of Great Slave Lake highly charged with bituminous matter and on the north shore tar exudes from the surface and forms springs and pools at several points. (R. G. McConnell, "An Exploration in the Yukon and Mackenzie Basins, N. W. T.," Geol. Survey of Canada Rept., New Series, Vol. 4, Pt. D., pp. 21, 75, 76.)

In 1912 samples of oil were brought to Edmonton from the vicinity of the present Fort Norman well. Alfred W. G. Wilson reviewed these and other evidences in 1915 in Frederick G. Clapp's "Petroleum and Natural Gas Resources of Canada." In that report the statement is made that "the most promising region in the Northwest Territories for the development of a producing field appears to be along the Mackenzie, although the evidence is by no means conclusive." However, little importance was attached to that prospective field compared with the rest of western Canada, as may be judged by the fact that the report allotted only twelve pages to Yukon and the Northwest Territories (including the Mackenzie basin) out of a total of 131 pages describing oil and gas possibilities in western Canada as a whole.

FORT NORMAN GEOLOGICAL CONDITIONS NOT PARTICULARLY FAVORABLE

Notwithstanding the glowing reports received at various times, geological conditions in the Fort Norman region are not entirely favorable. It should be realized by prospectors that to assure a profitable field something more is needed than mere seepages, petroliferous strata, and reports of oil in shallow wells. The strata of the Mackenzie region are in general of Devonian age, and the commercial oil possibilities of the Devonian rocks have by no means been demonstrated. Indeed, in this valley they appear to be underlain at comparatively shallow depth by pre-Cambrian metamorphic or igneous rocks, which are, of course, absolutely unfavorable for oil.

Again, the Fort Norman area appears to lie in the center of a geosyncline or great basin, and for this reason also is not highly favorable for the existence of

¹Abstract of Bulletin No. 6 of The Associated Petroleum Engineers, 120 Broadway, New York. Frederick G. Clapp, chief geologist.

²Canada Department of Mines, Mines Branch, Publication 291, Vol. 2, pp. 255-263.

an important oil field. It is true that certain oil pools in other parts of the world occur on the monoclinical or anticlinal flanks of geosynclines, and many small pools occur in minor monoclines where the rocks are barren of water or devoid of artesian pressure; but the fact remains that few important oil fields have been found in the central portions of geosynclines under conditions such as those that obtain in the Fort Norman area. Some structurally favorable areas do exist; yet even these other conditions, less favorable, may offset the favorableness of structure.

OIL DISSIPATION HAS TAKEN PLACE

The region is several hundred miles northwest of Great Slave Lake, where the seepages exist which were mentioned by McConnell and later explorers. Furthermore, along Athabaska River, between Fort McMurray and Lake Athabaska, a number of wells drilled to depths varying from 100 to 1,200 ft. yielded only small quantities of oil and generally finished in granitic rock. The presence of the "tar sand" outcrops along Athabaska River above Fort McMurray in northern Alberta affords no indication that tar or oil will be found farther north. The reason is that these "tar sands" are in the outcrop of the Dakota formation, of Cretaceous age, which does not reappear in large masses farther north until near the Arctic Ocean, about 200 miles beyond Fort Norman.

The entire Devonian system of rocks between Fort McMurray and the Arctic Ocean may be considered as an outcrop of the formations which are deeply buried farther south. Thus the coming to the surface of Devonian beds in the Mackenzie region has given the oil an opportunity to leak out along outcropping porous strata. In other words, an immense amount of oil has disappeared during the ages since the Devonian was eroded, and there are not to be expected any remaining reservoirs of oil, such, for instance, as those in California and Mexico, where the rocks are far younger geologically and there has been less time for the dissipation of the oil.

It must be recognized, therefore, that, whereas great prospects of oil exist in western Canada, the most favorable regions are not along the Mackenzie but in certain areas which are structurally, stratigraphically, and in other respects favorable at considerable distances from the outcrop of the formation which carries the oil.

A geologic parallel to the Mackenzie conditions may be found in Ontario, where the regions of good surface indications in Devonian rocks on Manitoulin Island and elsewhere are not in regions of oil in commercial quantity. On the contrary, the productive localities of Ontario are farther south, where the deposits are thick enough to have retained oil in quantity throughout the ages.

COMMERCIAL ASPECTS OF FORT NORMAN OIL

Even were the geology favorable, it does not follow that oil development in Mackenzie could be made commercially successful. The localities are many hundreds of miles from the nearest railroad, in a region of deep snow and extreme cold for about two-thirds of the year, and where transportation of supplies is very costly. It is a much more serious matter, for instance, than prospecting for oil in Colombia, South America, for there the great distance from the coast is offset somewhat by the mildness of the climate and the fact that the commercial development of the coun-

try may reasonably be expected to follow oil development.

From Fort McMurray three boats operate as far north as Fort Fitzgerald. They are owned, respectively, by the Hudson's Bay Company, the Northern Trading Company, and Lamson & Hubbard. It is rumored that Lamson & Hubbard are negotiating a sale of their boat to one of the oil companies. Small boats are operated below the rapids. In 1920 the total freight capacity of the three boats mentioned is reported scarcely to have exceeded 300 tons per trip, of which usually only three are made in a season. The boats were generally loaded to capacity with supplies for their owners, and could not possibly handle much drilling material or supplies for oil men. Passenger accommodations this year will be slight, if, indeed, passage can be secured at all. Oil-well supplies used in the district to date have been floated down on scows.

TRANSPORTATION A SERIOUS PROBLEM

The problem of transporting oil out of the Mackenzie region, if oil be discovered in quantity, may be considered a serious aspect of the situation. Northwestern Canada is one of the most difficult of regions in which to build a pipe line. A line for which estimates³ were made some years ago, and covering less than 15 per cent of the necessary distance, was found to involve an expense of nearly \$5,000,000 under conditions then prevailing.

In 1920, it is reported, three trains a week were operated from Edmonton to the crest of the plateau above Peace River Crossing and another train was run from Edmonton to within twenty-three miles of Fort McMurray. However, the roadbeds are bad, and the Fort McMurray line is said to be impassable for months at a time, despite the attractive railroad schedules. With the extension of the railroad northward into the Mackenzie region in future years, interest in prospective oil fields should increase.

In the face of the tremendous uncertainties now existing, there is no sound inducement for prospectors to brave the rigors of the wilderness of the North. Northern Canada is still much more attractive from the standpoint of ore deposits than from that of oil production.

January Production Shows Decrease In Several States

PRODUCTION OF PETROLEUM in the United States during January, 1921, according to the U. S. Geological Survey, amounted to 38,271,000 bbl., which was 690,000 bbl. less than during December, 1920, but was more than four million barrels greater than during January a year ago. Imports, which amounted to 13,193,000 bbl., were the greatest ever recorded in any one month and were 347,000 bbl. more than in December and more than twice those in January, 1920. Estimated consumption of domestic and imported petroleum, the quantity delivered to consumers, chiefly refineries, amounted to 49,651,000 bbl. Stocks of domestic and foreign petroleum were increased by 1,077,000 bbl.

A halt to the long-continued decrease of stocks in California is shown by a reported increase of 331,000 bbl. held in storage in that state. Net stocks of domestic petroleum east of California increased 450,000 bbl., and

³Report on the "Gas Fields of Northern Alberta Available for Supplying Edmonton," by The Associated Geological Engineers.

stocks of Mexican petroleum held by importers in the United States increased 296,000 bbl.

Production decreased in Oklahoma, Kansas, Texas, and West Virginia more than a million barrels and fell off slightly in Ohio, Pennsylvania, and Montana. Increases are reported for the other states. Louisiana in January ranked fourth among the producing states, surpassing Kansas by a small margin, and Kentucky advanced from ninth to seventh place, surpassing West Virginia and Illinois.

The following figures, compiled from company reports, show the quantity of petroleum removed from producing properties. Oil consumed on the leases and net changes in producers' storage are not included except for California. These figures are obtained by annual canvass and will be included in the final statistics of production for the year.

PETROLEUM PRODUCED IN THE UNITED STATES IN DECEMBER, 1920, JANUARY, 1921, AND JANUARY, 1920

State	December, 1920		January, 1921		January, 1920	
	Total	Daily Average	Total	Daily Average	Total	Daily Average
California.....	10,038,000	323,806	10,177,000	328,290	8,488,000	273,807
Central and Northern Texas.....	6,749,000	217,710	6,462,000	208,452	5,778,000	186,387
Coastal Texas.....	2,517,000	81,193	2,616,000	84,387	1,441,000	46,484
Oklahoma.....	8,742,000	282,000	8,299,000	267,710	7,958,000	256,710
Northern Louisiana.....	2,434,000	78,516	2,524,000	81,419	2,400,000	77,419
Coastal Louisiana.....	164,000	5,290	156,000	5,032	167,000	5,387
Kansas.....	3,044,000	88,194	2,664,000	85,935	2,969,000	95,774
Wyoming.....	1,424,000	45,936	1,464,000	47,226	1,169,000	37,710
Kentucky.....	740,000	23,871	905,500	29,210	634,000	20,452
Illinois.....	840,000	27,097	852,000	27,484	887,000	28,613
West Virginia.....	748,000	24,129	645,000	20,806	678,000	21,871
Central and Northern Ohio.....	466,000	15,032	434,000	14,000	396,000	12,774
Northwestern Ohio.....	172,000	5,548	186,000	6,000	135,000	4,355
Pennsylvania.....	624,400	20,142	619,000	19,968	534,000	17,226
Indiana.....	84,000	2,710	95,000	3,065	67,000	2,161
New York.....	79,000	2,549	84,000	2,710	56,000	1,806
Montana.....	86,000	2,774	78,000	2,516	6,000	194
Colorado.....	9,000	290	9,000	290	10,000	322
Tennessee.....	600	19	1,500	48	1,000	32
Totals.....	38,961,000	1,256,806	38,271,000	1,234,548	33,774,000	1,089,484

Oil Boring in the United Kingdom In 1920

The Petroleum Department of the British government, according to *Commerce Reports*, has recently published a statement that in the oil-drilling operations in the United Kingdom during 1920 progress has been satisfactory, considering the great depths which most of the wells have reached, a total of 7,670 ft. having been drilled. Drilling operations are in progress in Derbyshire, North Staffordshire, and in Scotland.

It is stated that six wells have reached a depth of 3,000 ft. or over, one (Ironville No. 2) being 4,006 ft., and three others are approaching that depth. Pending developments of results with Ironville No. 1, Ironville No. 2 was closed down last May. Apedale No. 1 was abandoned in June, 1920, and No. 2 started in September. The latter had reached a depth of 1,350 ft. by the end of the year. The well at Ridgeway was shut down in January, 1920, as large quantities of hot water were met at a depth of 2,890 ft.

At Hardstoft the uniform rate is about one ton per day, or 50 bbl. per week. Total production since the well was brought in, to December 31, 1920, reached 4,575 bbl., or 590 tons. In 1920, production was 2,909 bbl., or 375 tons.

During the year, 500 tons of oil in storage was sold by tender, and this quantity was eventually purchased by the Anglo-American Oil Co. at £22 10s. per ton. By Dec. 31, 325 tons of oil had been transferred for delivery to the company's refinery. The oil is stated to be of exceptionally high grade.

The expenditure in 1920 for oil operations amounted to £126,065.

Federal Reserve Board on Petroleum Price Cuts

In analyzing the February reports of its member banks, the Federal Reserve Board has the following to say in regard to the petroleum situation:

Decreased consumption has resulted in a considerable drop in the price of crude petroleum. At the close of January, Kansas and Oklahoma crude oil was selling at \$2.50 per bbl., a decrease of \$1 per bbl. from the price prevailing at the opening of January, and further cuts in the first part of February reduced the price to \$2 and in some transactions \$1.75. Reductions in prices announced in January by purchasing companies in the major fields of District No. 11 (Dallas) brought prices down from \$3.50 per bbl. to \$2, and early in February there was a further cut of 25c.

In sympathy with the price declines in crude oil, refined products and fuel oil showed substantial declines in District

No. 11 (Dallas) during the last thirty days. Production of crude petroleum likewise fell off during January. In District No. 11 (Dallas) the output was 12,746,315 bbl., which was 87,259 bbl. less than the December figure. The January production in Oklahoma and Kansas was 10,710,500 bbl. In California, however, production during January established a new high record for the fifth successive month, and for the second time since July, 1919, monthly output exceeded consumption, and stored stocks were consequently increased.

Refiners' operation in Districts No. 10 (Kansas City) and 11 (Dallas) likewise showed a decrease. In Kansas and Oklahoma it is reported that they have been reduced about 40 per cent, a number of the smaller refineries being shut down entirely, and others operating on shorter time. Pipeline purchases in most fields in District No. 11 (Dallas) were restricted to 50 per cent of the output. Field forces are being reduced by nearly all the large operators in the district, and, as a result, drilling operations have slowed up, particularly in North Texas. A decrease was likewise noted in Kansas, Oklahoma and Wyoming drilling operations during January, but the number of wells completed increased in California, and the initial daily production almost doubled.

Oil-Well Machinery Exports Show Increase In January, 1921

Exports of oil-well machinery during January, according to returns to the Bureau of Foreign and Domestic Commerce, were valued at \$1,449,013. Other types of mining machinery exported were valued at \$1,302,705. The exports of pumps and pumping machinery amounted to \$2,634,300. This is a decided increase over the exports in January, 1920, when the value was as follows: Oil-well machinery, \$145,310; other mining machinery, \$645,395; pumps and pumping machinery, \$800,307.

Book Reviews

Corundum in the Northern and Eastern Transvaal. By A. L. Hall. Union of South Africa, Department of Mines and Industries, Geological Survey, Memoir 15. Pp. 223; 6 x 9½; 33 figures, 21 plates, 3 maps. Pretoria, 1920.

This latest addition to the series of economic memoirs measures up to the high standard set by those on mica and asbestos. The corundum deposits of the northeastern Transvaal, covering an area of at least fifty-four by thirty-three miles, are the largest and most important yet discovered in the world, and thus constitute a fitting subject for study. Prior to 1914 there was a small production, but the demands of the war resulted in a maximum production in 1918 of 3,875 tons. The first chapter of the memoir is devoted to a review of the extent and situation of the deposits and the varieties mined, followed by a list of the corundum-bearing localities of the country.

Corundum occurs in the plateau region served by the Messina railway, and in the low country from which transportation is afforded by the Selati railway. Granitic and gneissic rocks constitute the chief formations, and in them are numerous, though relatively small, masses of basic magnesian rocks, such as serpentine, pyroxenite, and peridotite, in which the corundum occurs. A detailed study of the geology of the chief deposits indicates that the corundum is closely associated with the basic rocks at their contact with the more acid intruded types.

From the geological relationships it is concluded that the corundum has originated from an excess of alumina occasioned by absorption of silica from the granitic rocks, forming a talcose rock from the ultrabasic minerals which are low in silica. Instances are noted where an intrusive granite shows quartz and feldspar at the center, feldspar only in a succeeding zone, and, where a further absorption of silica has taken place, an outside zone of feldspar associated with corundum, the latter formed from the excess of alumina. This corundum-feldspar zone is termed "plumasite," and by subsequent pneumatolitic changes margarite is developed, forming a margarite-corundum termed "marundite." Plumasite is characteristic of the plateau region, and marundite of the low country.

Following a description of the varieties and physical properties of corundum, the methods of mining and treatment are given in detail. Practically all the corundum mined in the Transvaal is obtained from shallow open-pit workings in "eluvial" deposits. The various operations include cobbing, screening, washing and bagging. Many details are given of methods of making abrasion tests, qualities of corundum and artificial abrasives, uses of corundum, and statistics of world production. A two and one-half page summary is an addition that will be appreciated by the

busy reader. A feature of special economic value is an appendix giving the names of producers, buyers, and users of corundum who are interested in the South African product. O. B.

The Mining Manual and Mining Year Book for 1921. By Walter R. Skinner. Cloth; 5½ x 8½; pp. 931. Published by Walter R. Skinner, 11-12 Clements Lane, London E.C. 4, England. Price, 21s. 6d. abroad.

The 1921 edition of Mr. Skinner's handbook has just been published. This year's issue contains full particulars of 1,430 mining companies, gold, diamond, silver, copper, tin, iron, and coal; also exploration and mining investment companies, arranged in alphabetical order. The particulars of each company given include the names of the directors and other officials, date of establishment, seat of operations, description of property, the purchase consideration, plant erected or in course of erection, present working results, ore reserves, details of capital, calls, dividends paid, and the financial position as disclosed by the latest accounts. The book is unlike Weed's handbook in that it is prepared from the standpoint of the financier and investor rather than as a reference volume for the technologist.

Export Register of the Federation of British Industries, 1920. Cloth; 7 x 10; pp. 328 with pp. 312 advts. Published by the Federation of British Industries, 39 St. James' St., London, S. W. 1, England.

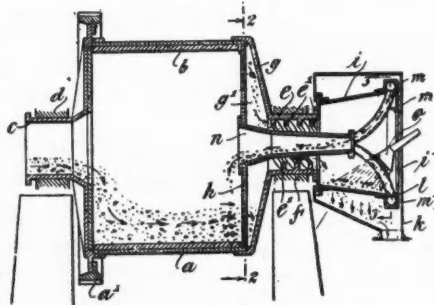
This book is similar to commercial registers published in this country, except that it is intended chiefly as a reference for foreign buyers. The principal lists are two in number, one being alphabetically arranged as to products, giving the names of British manufacturers, and the other giving a list of companies and their overseas agents. No price is given, but it is likely that the book would be sent free of charge to possible buyers.

Road Building — Mining companies are usually vitally interested in having good roads to their properties. The use of the motor truck has made such roads particularly necessary. Furthermore, greater care must be used in building them than formerly, as the service is heavy. "Modern Road Building and Maintenance," just issued by the Hercules Powder Co., and obtainable on request from that company, at Wilmington, Del., is a 146-page book which should be in the library of everyone interested in the subject. It is written by A. P. Anderson, highway engineer of the U. S. Bureau of Public Roads, and is free from advertising matter, with the exception of the final pages. Sections are devoted to planning the road, road materials, road construction, road maintenance and repair, and the use of explosives. Excellent typography and attractive photographs add considerably to the interest of the book and invite even the lay reader.

Recent Patents

Chloridizing Roasting and Volatilization—Robert H. Bradford, Salt Lake City, Utah. A cyclic process of chloridizing the copper content of ores, which comprises mixing the copper ore with an alkaline-earth-metal chloride in such proportions that the copper is capable of chemically combining with the chlorine to produce cupric chloride, heating the mixture in a non-reducing atmosphere to a temperature of approximately 800 deg. C., whereby substantially the entire quantity of copper is converted into cupric chloride, which is volatilized, collecting the cupric chloride fume in a dry state, mixing it with an alkaline-earth material and a carbonaceous reducing agent and heating to somewhat above the melting point of copper, whereby metallic copper is produced and the alkaline-earth-metal chloride regenerated for reuse in the first part of the process, and whereby the copper is caused to separate in a molten condition from the chloride slag. Patent No. 1,368,885.

Ball Mill—No. 1,368,739. P. T. Lindhard, Brooklyn, N. Y., assignor to F. L. Smidth & Co., New York, N. Y. A ball mill with grate discharge, the ground



material, after passing through the trunnion, falling on a screen from which the oversize is automatically conducted back into the mill.

Hydrometallurgy—No. 1,361,459. G. T. Hansen, Salt Lake City, Utah. A method of extracting gold, silver, and copper from their ores, by leaching with a cyanide solution at ordinary temperatures, heating the solution to 90 deg. F. or higher, and precipitating the copper with zinc or aluminum.

Jig—No. 1,361,171. Carl Nielsen and Olav Helleland, Lillebø Gruber, Norway, assignors to A/S Stordø Kisgruber, Lillebø Gruber, Norway. An improvement in jig construction which permits a rapid discharge of the concentrates.

Hammer Drill—No. 1,368,470. William T. Ayer, Dover, N. J., assignor to McKiernan-Terry Drill Co., Dover, N. J. The valve design is of interest.

Chloridizing—No. 1,368,973. W. A. Schmidt, Los Angeles, Cal., assignor to International Precipitation Co., Los Angeles, Cal. A process of chloridizing roasting, thereby volatilizing the valuable metals.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

San Francisco Section, A. I. M. E., Discusses Mining Geology

Application of the Science Quantitatively Needed in Studying Ore Deposits—Ore Hunting Must Be Developed as a Science

At the meeting of the San Francisco Section of the A. I. M. E. on March 8, C. H. White and Augustus Locke presented a joint paper on the "Need of the Quantitative Method in Mining Geology." Mr. White introduced the subject, and by a number of illustrations showed how slow the science of geology was in developing quantitative methods. The value of the services of a mining geologist increases as quantitative methods are developed. As an example he quoted the various descriptions of the outcrop of the Miami deposit and showed how they lacked specific characterization. He advocated the use of the Maxwell color wheel for determining the proportion of color constituents of specimens taken from significant areas, and according to his experiments definite results could be obtained by this method.

The inadequacy of studies of outcrops was discussed, and in Mr. White's opinion every possible variety of measurement should be applied in such studies. He said that too often geology served as the oxygen tank to expiring mining enterprises and that more and more research along quantitative lines was required if mining geology was to continue its usefulness to the industry and to the country.

Mr. Locke said that the profession of ore hunting was potentially important, but before it could win a place it was necessary to develop a technique and a method of applying this technique. In his opinion it was good business policy for the mining companies to spend considerable sums for research in this particular subject. The science of ore hunting was in its beginning stages and required persistent development. His plea for quantitative geology was for the invention of specific terms, the reduction of observations to quantitative statements, the development of keener observation, and the interpretation of the subtle phases of economic geology in such specific terms that they would be of service in ore hunting in the field.

As an example of some of the work he had done, Mr. Locke discussed an attempt to devise a method to discriminate between the outcrops over lean pyrite deposits of a disseminated nature and those enriched by the presence of copper sulphides. Two areas were taken, one over disseminated pyrite and one over a disseminated copper-pyrite orebody. About 250 specimens were collected from the surface of each area

and numbered. All the specimens were mixed together and an attempt was made to separate the groups of specimens by a study of their superficial characteristics. Although experienced men made the attempt, the result was inconclusive. Another attempt was made by definitely deciding upon points of comparison such as degree of acid action, amount of limonite, kaolin, sericite, quartz, pyrite, and other materials. Visual estimation of these superficial characteristics was made, and the result was more promising. At least one observer was successful in discriminating between the two groups of specimens.

The members present were much interested in the subjects under consideration, and a general discussion resulted. In the opinion of J. M. Hill, Mr. White and Mr. Locke have brought to the attention of the section and the industry something that will be recognized as important. Mr. Hill commented on the need for accurate descriptions of outcrops and stated that generally these were not given.

Materials-Testing Laboratory at Columbia University Reports a Busy Year

More than 3,500 tests were made during 1920 in the materials-testing laboratories at Columbia University, according to a statement by Dean George B. Pegram, of the Schools of Mines, Engineering, and Chemistry, who, in making public a report of Albin H. Beyer, chairman of the University committee on testing, said that the slump after the armistice was signed had been overcome and that the laboratories were again being worked to their capacity. The number of tests made last year exceeded by nearly a thousand the number made during 1919.

According to Dean Pegram, the recent tests were not only more extensive but more valuable than those made during the preceding period. In order that the high standard of the laboratory may be maintained, additional laboratory equipment is urgently needed. Fewer tests, however, were made at the fire testing station at Greenpoint, Brooklyn, which has been made an adjunct to the testing laboratories at Columbia.

The tests made during the year cover a wide range of industrial products, including leather, cement, brick, concrete, sheet steel, pipe, mortar, plaster, hollow tile, hose clamps, rock, boiler plate, bronze, and granite. Hundreds of tests were conducted for the city of New York. They embrace toughness tests on wood and rock, and abrasion tests on rock and brick.

National Safety Council and Bureau of Mines Create a New Position

While John Barton Payne was still Secretary of the Interior he approved an agreement between the National Safety Council and the U. S. Bureau of Mines, providing for a traveling mine safety engineer whose salary is to be paid by the Bureau, and *Engineering and Mining Journal* recently recorded the assignment of C. J. Colburn to this position. The text of the agreement, recently published by the *National Safety News*, reads in part as follows:

The National Safety Council will make the necessary arrangements whereby this engineer may take up to the best advantage with the mining company membership of the National Safety Council the matter of the technical safety service to be rendered to such companies and to other mining companies and individuals.

Concerning the general methods to be employed in carrying on this work:

This engineer will visit the headquarters of the National Safety Council and become familiar with the work of its Mining Section; visit the mining company members of the National Safety Council and acquaint such companies with the scope of the technical safety service available to them through this co-operative arrangement; familiarize himself with the best methods of preventing accidents as demonstrated by the mining companies who are most advanced in this respect; establish cordial relations with the mine superintendents and foremen at the operations he visits and as occasion permits, disseminate suggestions looking to improved practices, which shall be free from criticism of the practices he finds; collect photographs, blueprints, sketches, and other information suitable for the preparation of "Safe Practices" leaflets of the National Safety Council and bulletins, technical papers, and other publications of the Bureau of Mines; coordinate and develop the safety work of the Mining Section of the National Safety Council with the safety work of the Bureau of Mines; disseminate among the operators, foremen and workmen in the mining industry, by personal visits and orally, with more concrete application and detail than written communications would probably provide, the arguments for and against increased or new activity along any line of endeavor or research, looking to increased safety in the mining industry.

"Geological Magazine" Needs Help

The *Geological Magazine* of England is still in financial straits and struggling to maintain its existence. Any readers wishing to help keep alive this old and excellent magazine, while securing a valuable professional journal at advantageous rates, may do so by sending a subscription to E. O. Hovey, American Museum of Natural History, New York City. At the present rate of exchange the subscription rate is only \$5.75.

MEN YOU SHOULD KNOW ABOUT

F. J. Bourne, general manager of the Bailey Silver Mines, Ltd., has resigned.

H. H. Knox, mining engineer, of New York City, is away on professional business.

E. A. Holbrook, assistant director of U. S. Bureau of Mines, has returned to Washington from his tour of the western experiment stations.

Milton McLain, formerly mine manager of the Phelps Dodge Corporation's Morenci branch, is in Morenci, Ariz., looking after his various interests there.

N. J. Evered has resigned as manager for the Davidson Consolidated Gold Mines, Ltd., at South Porcupine, Ont. His present address is care of Hotel Elliott, Toronto.

M. M. Makeever, of New York, in company with a party of Winnipeg capitalists, is examining the Rex and Bingo properties in the Herb Lake gold area of Manitoba.

Mark R. Lamb, of New York City, is in Rio Janeiro adjusting some commercial accounts for several New York banking organizations. He expects to return the first week in April.

George A. Sharpe, of Alabama, member of American Mining Congress, was elected permanent head of the minerals section of the Southern Tariff Congress at its recent session in Atlanta, Ga.

G. C. Bateman, general manager of the La Rose Mines, Ltd., has been appointed consulting engineer for the Bailey Silver Mines, Ltd., and will have charge of the mine and customs mill.

L. P. Anderson, chief divisional geologist for the Montana-Wyoming division of the Carter Oil Co., is moving with the divisional headquarters from Casper, Wyo., to Continental Building, Denver, Col.

George S. Rice, chief mining engineer of the U. S. Bureau of Mines, will proceed early in April to Arizona, where he will visit several of the camps to gather first-hand data with regard to ventilation problems.

Karl Baumgarten, mining engineer, examiner for the War Minerals Relief Commission, Washington, D. C., has been transferred to the Mississippi Valley experiment station of the U. S. Bureau of Mines at St. Louis, Mo.

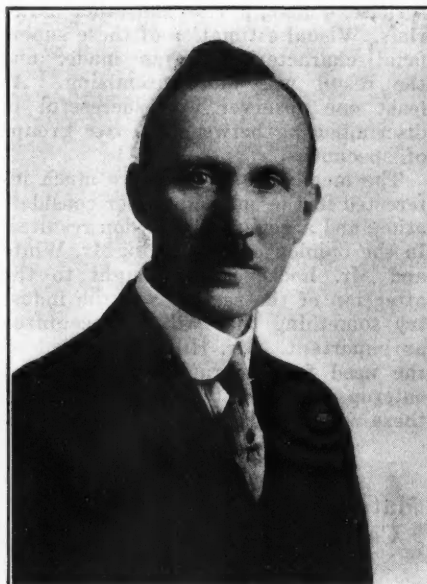
S. C. Lind, superintendent of the Reno, Nev., station of the U. S. Bureau of Mines, has been visiting the Seattle, Wash., station of that bureau. While in Seattle he gave a lecture on rare metals before the students of the Washington College of Mines.

John D. Northrop, former petroleum expert for the U. S. Geological Survey, and with the Royal Dutch Shell Company since January, 1919, left the Peruvian field in January of this year. He is now working in Ecuador, and may

be addressed in care of the U. S. Consul, Guayaquil.

J. A. T. Robertson recently resigned as metallurgist with the Missouri Cobalt Co., Ltd., at Fredericktown, Mo. He has taken a position with the Yunnan Ming Hsing Mining Co., Ltd., at Tengyueh, Yunnan, China, and expects to sail in March. Mr. Robertson was professor of mining and metallurgy in the technical college at Cheng Tu, Szechuan, China, from 1912 to 1916.

Prof. J. Volney Lewis, head of the department of geology of Rutgers College, New Brunswick, N. J., was elected first secretary and treasurer of the



Champlain Studios, Inc.
J. VOLNEY LEWIS

Society of Economic Geologists at its constituting meeting last December. He has just issued an outline report of the proceedings of that meeting.

Rolland Craten Allen, vice-president of the Lake Superior Iron Ore Association, has resigned, his resignation to become effective Sept. 1, and thereafter will be with the mining department of Oglebay, Norton & Co., with headquarters at Cleveland, Ohio.

Mr. Allen was appointed vice-president of the Iron Ore Association in the fall of 1919, and has had active charge of important work in connection with taxation and rate matters pertaining to the interests represented in the association. He is a geologist and engineer of broad training and experience. After being graduated from the University of Wisconsin in 1905 he spent three years in graduate study and field work for the U. S. Geological Survey and private interests in the West, Canada, and the Lake Superior iron ranges. From 1908 to 1913 he was special lecturer in mining geology in the University of Michigan, from 1909 to 1919 state geologist of Michigan, and from 1913 to 1919 appraiser of mines for the State of Michigan and technical advisor to the Michigan Securities Commission. During the war he served the Government as a member of the tax advisory board,

as chief mine valuer and head of the division of natural resources in the U. S. Treasury.

In recent years Mr. Allen has devoted his attention chiefly to the economics of mining, with special work in taxation and the theory and practice of valuation of mining property. He is a member of the special committees of the National Tax Association and the American Institute of Mining and Metallurgical Engineers on the taxation of mines.

OBITUARY

Jesse Knight, pioneer mining man of the Tintic district and for many years associated with important developments in that section, died on March 15, at the age of seventy-five, as the result of a paralytic stroke which he suffered about a month ago. Born in Navoo, Ill., on Sept. 6, 1845, he went to Salt Lake with his widowed mother, at a very early age. At sixteen he was hauling wood with a team of oxen bought with money earned by himself. Later he freighted into Montana, and also took part in the Black Hawk war. For a number of years he traded in cattle. Then he began prospecting in the Tintic district, where he located a number of claims, but for a considerable time he did not achieve success. The foundation of the fortune which later acquired came through a property popularly known as the Humbug, and which was called the Dream Mine. Mr. Knight and his sons worked intermittently seven years on the Humbug claim in Tintic before striking ore.

In the course of these years Mr. Knight was interested in many minor properties in the district where he made his fortune. His name is associated chiefly with the Iron Blossom and Colorado mines, which he brought to successful operation and put on a dividend-paying basis. Mr. Knight's interests were extensive and not confined to mining. Among his industrial enterprises the Knight Woolen Mills and the Knight Sugar Factory were included in the Knight Investment Co., of which he was president. Mr. Knight, as the name of Uncle Jesse by which he was popularly known will testify, was much beloved, particularly for his kindly generosity. It is said that at times he found himself embarrassed from having given his notes to friends who needed help. In his cattle trading days he paid more for calves bought of widows and poor people than for others.

Fred W. Nash, a mining engineer of San Diego, Cal., was instantly killed on the Mussey grade, near Ramona, Cal., on March 11, when the automobile he was driving plunged off the highway and tumbled 100 feet down the side of a precipice. Mr. Nash, who was a member of A. I. M. E. and other societies, was forty-eight years old, and leaves a wife and two children.

THE MINING NEWS

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

LEADING EVENTS

Judgment Rendered Against Silver King of Arizona

G. S. Cunningham Wins Action for Damages in State Supreme Court—Receiver To Sell Mine

Judgment for \$361,731 against the Silver King of Arizona Mining Co., which has operated the famous old Silver King mine, has been entered in the Superior Court of Pinal County in a suit instituted by G. S. Cunningham. The receiver, John Fowle, has been instructed to sell the property, if possible, for a lump sum. The principal creditor is the Empire Trust Co. of New York, which has been awarded \$280,700 for bonds due, \$14,884 for interest, \$29,558 for attorneys' fees and \$1,105 for costs. The receiver has a priority claim for \$4,000 a year, salary, and \$3,832 for expenses. A claim of \$16,000, payable to Edward Kendall for injuries received in the mine, is also included.

The King, once known as the richest silver mine of the Southwest, has had a number of reworkings since its palmy days. Four years ago it was taken over by the company now defendant.

North Butte Suspends Production

On account of the abnormally low price of copper, the North Butte Mining Co. has decided to cease productive operations—stopping—but will continue development work. As soon as the unsettled copper market improves production will be resumed. Only the ore resulting from actual development operations will be mined at present.

Non-Metallic Mining Shows Stimulation in the Carolinas

L. A. Campbell, of Gafney, S. C., reports that he has an order for 3,000 tons of monazite for export to Europe. This may mean a revival of an industry which has been dormant for some time. It is stated that monazite sand in Cherokee, Spartanburg, and Greenville counties will average about 5 per cent thorium oxide, which is sufficiently rich to respond to reasonable requirements. Mr. Campbell is planning to install a magnetic separator for cleaning monazite.

The Talc Products Co., of New York, will develop a 200-acre talc deposit near Glendon, Moore County, N. C. This company is considering the erection of a new grinding plant with an estimated output of 100 tons daily.

WEEKLY RÉSUMÉ

Reports from the Carolinas indicate marked activity in non-metallic mining. A British company has bought Texas oil and sulphur lands. John Barton Payne, just before leaving office as Secretary of the Interior, issued a statement in reply to alleged criticisms by the American Mining Congress. The Federated Engineering Societies have established headquarters in Washington. Scientists at the national capital are planning a noteworthy reception to Mme. Curie. Secretary Hoover has appointed a committee to investigate the statistical work of the Bureau of Foreign and Domestic Commerce. Special correspondence from London declares the position of the British owners of gold and tin properties to be still unsatisfactory. Conditions in Mexico continue unsettled, the low price of silver threatening many shutdowns.

Northwest Magnesite Case Settled Out of Court

R. S. Talbot, of Spokane, Wash., who sued President Crocker of Crocker National Bank, San Francisco, for a half interest in the Northwest Magnesite property at Chewelah, Wash., alleging that he had been defrauded out of 2,500 shares of stock, par value of \$250,000, and \$180,000 worth of bonds of the company, which he had pledged for a \$115,000 loan from Mr. Crocker, has ended the litigation by dropping the suit. It has been dismissed from the Spokane court having jurisdiction.

The basis of settlement is known to the litigants only, but it is certain that the Crocker interests are left at least in complete possession of the Northwest Magnesite holdings, which are regarded as the largest and most valuable property of that kind on this continent. They are situated in the vicinity of Chewelah, Wash.

Iron-Ore Tax Bills in Minnesota Legislature

An occupational tax bill relative to the industry of iron-ore mining has been passed by the House of Representatives of the State of Minnesota by a vote of 99 to 25. This bill provides for a 6 per cent tax on the net value of ore mined in Minnesota. At the same time a bill was passed also taxing 6 per cent of the net value of the ore mined, but provision is made in the second bill for a constitutional amendment to place 50 per cent of the tax in a trust fund.

Wages Reduced in Northern Ontario

The two operating companies of the Sudbury nickel district in Ontario have recently announced reductions in the rate of wages over those prevailing since the war peak was reached. The Mond Nickel Co. announced a cut of 5c. an hour about three weeks ago, and the International Nickel Co. has now given notice of a 15 per cent reduction effective April 15. Married men, it is understood are to be exempted, however. Also, salaried men are not included, as their pay was not raised materially.

A board of conciliation has been appointed to investigate the dispute as to wages between the mine operators of Cobalt and their employees arising over the recent reduction of 15 per cent. The men, though not objecting to the reduction, claim that it should have been gradual, extending over a period of three months, instead of being made at once. The board consists of Robert A. Bryce, of Toronto, representing the operators, Arthur W. Roebuck, of Toronto, representing the employees, and J. M. Godfrey, of Toronto, appointed by the government as chairman.

Howe Sound Mill Burned

Fire, which started Saturday night, March 20, completely destroyed the mill of the Howe Sound company at Britannia Beach, B. C. It is believed that short-circuiting was the cause. Fortunately the surrounding buildings were saved, but the loss is estimated at close to a million dollars.

British Company Buys Oil and Sulphur Lands in Rustler Hills

The Anglo-American Sulphur Co. Ltd., of London, England, has purchased 1,280 acres of patented sulphur and oil lands in eastern Culberson County, Texas. The tract, which is underlain by petroleum-charged slates, adjoins the Consolidated Sulphur Co. property in the Rustler Hills district twenty-two miles west of Orla, Texas, on the Santa Fé Ry. The English purchasers have contracted to pay about \$60,000 for the property and made a cash payment of \$10,000. They are organizing a London company to develop the oil and sulphur resources of the tract, which was favorably reported on about 1909 by C. F. Z. Caracristi, oil geologist, to the late owners, O. W. Dunlap of Bloomington, Ill., and J. D. Smith of Los Angeles, Cal.

Arizona Legislature Provides for Heavy Appropriations

The Fifth Arizona Legislature has adjourned, with little legislation directly affecting the mining industry. The industry, however, was much in evidence at the session, endeavoring to cut taxes down to the lowest figure compatible with proper administration of government. It was explained that the mines pay 56 per cent of the taxes,

directly, and much more indirectly. So there was suggestion, strongly pressed, that every possible economy be made for the next two years. It would appear that the representations in behalf of the mining industry were not heeded, for the appropriation bill was larger than known two years ago, aggregating \$5,500,000.

For the first time since statehood there was no special labor legislation, though there was enactment of a work-

man's compensation law, with liberal allowances for injury. Mine operators must report to the state mine inspector the beginning or stoppage of work. A state immigration commissioner is authorized, especially for the benefit of cotton growers, but his services are available as well to mining operators. With much amendment permitting reports on mines by others than licensed engineers, a bill was passed for the licensing of engineers.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Ex-Secretary Payne Replies to His Critics

States That an Appeal to Court of Claims Was a Matter Within Jurisdiction of Congress — Makes Full Report

Just prior to relinquishing his office as Secretary of the Interior, John Barton Payne replied to the criticism of the American Mining Congress that he had not complied with a promise made in connection with war minerals legislation, and that the opinion of the Attorney General had been misinterpreted by the War Minerals Relief Commission.

The understanding of the American Mining Congress was that Secretary Payne had promised on Aug. 10, 1920, to write the chairman of the committees on Mines and Mining of the House and of the Senate to the effect that the department "had not, and would not, undertake to influence Congress either for or against the proposed legislation." In reply, Judge Payne states that what he did say was, "that the allowance of an appeal to the Court of Claims was a matter within the jurisdiction of Congress, which could do as it pleased, and that I was willing to write a letter to that effect at the next Congressional session."

In his letter, Judge Payne says that the Mining Congress "was not warranted in drawing the conclusion that I was personally in favor of pending bills with whose provision I was not then familiar. When requested to make an official report to the House Committee on Mines and Mining, I was bound to express my own convictions."

Judge Payne, in his communication, gives the number of claims that have been decided to the satisfaction of the claimants and the numbers who have acquiesced and those who have filed objections to the recommendations of the commission. He also cites a letter written by W. J. Loring, president of the Mining Congress, in which the work of the commission is commended and in which it is stated that the commission should not be blamed for not having the power to consider matters not within its jurisdiction. In that connection

he says it would seem that the Mining Congress "has been misled as to the true situation by the clamor of a few dissatisfied claimants." He adds that "the War Minerals Relief Commission has exhausted every resource to ascertain whether a personal, specific request has been made by any of the five Government agencies named in the law, and has in many instances established such a request or demand, notwithstanding that the claimant originally in his questionnaire stated that none had been made upon him."

New Surface Tension Apparatus Aids Flotation Research

The Bureau of Mines is much interested in the Fahrenwald improvements on the Elder surface tension measuring apparatus. Some difficulty was encountered in obtaining correct absolute values of the surface tension of water with the apparatus as originally planned. It has been improved and simplified by Mr. Fahrenwald into what is believed to be a very useful instrument. It reads direct in dynes per centimeter.

By the use of this instrument in studies of oil-water surfaces and of emulsions of flotation oil in water, it has been found that some of the oil in the emulsion must have been adsorbed on the surface of the mineral particles, so that the surface tension of the remaining emulsion is raised. From a curve of surface tension against quantity of oil in the emulsion, it is possible to tell exactly how much oil is adsorbed on a unit of surface of flotative mineral. Greater quantities of oil are found to be adsorbed on the surfaces of minerals which are regarded as easily flotative, with decreasing quantities on minerals which are reputed to have less flotable properties. With the apparatus it is possible to get definite comparable figures where before it was possible to secure only qualitative results. It is believed that this instrument can be used to great advantage in flotation studies. Further work on the apparatus will be encouraged by the bureau.

Federated Engineering Societies Opens Washington Office

To Consider Engineering Employment and Licensing of Engineers, with Branch Offices in Larger Cities

With the opening this week of its suite of offices in the National Savings and Trust Company Building, in Washington, the Federated American Engineering Societies will direct its work in the future from the national capital. L. W. Wallace, the executive secretary of the organization, has been in Washington completing the arrangements for the opening of the national headquarters.

The principal effort being made at this time at the offices of the Federated Societies is in connection with the extension of the employment service of the organization. In addition to having one central controlling office, the plan is to have branch offices in several of the larger cities. A full report on the employment service is to be made when the executive board meets in Philadelphia on April 16. Secretary Hoover of the Department of Commerce, the president of the organization, expects to attend the executive board meeting. At this meeting, a comprehensive report also is to be made on the activities looking to the establishment of a Department of Public Works.

Copies of a model bill on the matter of licensing engineers now are available at the office of the executive secretary. These bills are being sent out to those interested, not with the idea of offering a recommendation, but in the hope that any state legislation which may be enacted will follow the general lines of the model bill, which is the result of extended study.

More War Minerals Awards

Recommendation of an award of \$192,826.69 in the manganese claim of the Oneida Mines Co. brought the total of the recommendations by the War Minerals Relief Commission for the week ended March 12 to \$346,559.28. This includes amounts previously recommended on the claims in which additional amounts were allowed.

In the manganese claim of John P. Gose, an award of \$1,962.16, or 72 per cent of the amount claimed, was recommended. In the claim of the McQueen Manganese Co., an award of \$159.17, or 6 per cent of the amount claimed, was allowed. Previous action in the claim of F. J. and W. D. Fuller resulted in a recommendation for the payment of \$831.93. Additional evidence has disclosed that an additional sum of \$68 can be allowed. In the claim of A. H. Jarmon, an award of \$70,288.45 had been recommended previously. In the light of additional facts \$1,317.57 has been added to the recommendation. When the claim of Collins and Winninghoff was first considered it was disallowed. Additional evidence has made it possible for the commission to recommend the payment of \$2,124.60. This is 42 per cent of the amount claimed.

Co-operative Work in Black Hills Discussed

A concerted effort is being made by those interested in mining in the Black Hills to arrange for co-operative work with the Bureau of Mines. W. H. Coghill, of the bureau staff, has visited Deadwood, where he attended a meeting of mining and business men called for the purpose of discussing the matter of co-operation. There are three types of ores in the Black Hills which present problems. They are the complex sulphides, argentiferous galena in quartz, and the blue ores containing ore in sulphides. There is said to be a large tonnage of refractory ores throughout the district which cannot be mined until improved processes are devised.

The bureau is giving careful consideration to the matter, but there is some uncertainty as to its being able to obtain the funds with which to conduct the work.

Washington Scientists Plan Big Reception to Mme. Curie

Arrangements are being made to show every honor to Mme. Marie Curie on the occasion of her visit to Washington. The formal opening of the cryogenic laboratory of the Bureau of Mines will be delayed until her arrival. Plans are being made for a general reception which will make it possible for the scientists resident in Washington to meet the discoverer of radium.

Secretary Hoover, in a letter to Dr. Vernon Kellogg, who is in charge of arrangements for Mme. Curie's entertainment while in Washington, says:

"I am very glad to learn that Mme. Curie is to visit this country in May and that the women in America plan to present her at the time of her visit with a gram of radium for her use in carrying on her investigations.

"Mme. Curie is the foremost living woman of science, and her work has been not only of great scientific importance but of immense immediate value to mankind. Any recognition and support of this wonderful woman and her work that can be given by the women of America meets with my earnest approval."

Broad Pass Railroad Making Good Progress

Barring unusually bad weather or unexpected circumstance the rails of the Alaskan railroad will be laid over Broad Pass before the end of the calendar year. The big Susitna bridge, with a 504-ft. span, has been completed, and trains are going over it. Rail has been laid to mile 275.

The new Secretary of the Interior regards Alaskan matters of such importance that he expects to direct them for a time at least from his own office.

Civil Service Examination Announcements

Examinations for the following civil service positions are announced: Petroleum engineer, \$3,000 to \$4,500 a year; oil-recovery engineer, \$3,000 to \$3,600; expert driller, \$3,000 to \$3,600; chief oil gager, \$3,000 to \$3,600; assistant petroleum engineer, \$1,800 to \$2,000; oil gager, \$1,800 to \$2,100; supervising mining engineer, \$4,000 to \$5,000; mining and metallurgical engineer, \$4,000 to \$5,000; illuminating gas engineer, \$3,240; assistant refinery engineer, \$2,760 to \$3,000; mineral technologist, \$2,400 to \$4,000; assistant oil-shale engineer, \$1,800 to \$2,400.

Applications must be made before April 26, 1921. Full information may be obtained from the Civil Service Commission, Washington, D. C., or at post offices and custom houses in various parts of the country.

Hoover Appoints Investigating Committee

Owing to the discovery that customs officials have not been reporting all of their figures during the month in which imports and exports were made, Herbert Hoover, the Secretary of Commerce, has appointed a committee to make a broad study of the statistical work conducted by the Bureau of Foreign and Domestic Commerce. The committee is made up as follows: William S. Rossiter, Concord, N. H., former director of the census; Carrol Dolten, Massachusetts Institute of Technology; Walter F. Wilcox, Cornell University; Wesley C. Mitchell, New York City; Allen Young, Harvard University; Edwin Gay, New York *Evening Post*.

Purchases of silver under the Pittman Act totaled 42,345,391 fine ounces at the close of business March 12.

NEWS BY MINING DISTRICTS

Special London Letter

Tales of Financial Difficulties Among Both Tin and Gold Producers Chief Features of Overseas News

By W. A. DOMAN

London, March 8—The tin market has received another nasty blow. For some time the Federated Malay States' government assisted the mining companies within its borders by purchasing production at a fixed price. Having apparently discovered that world conditions were in opposition, and that the policy of "pegging" did not pay, it has ceased to buy at all. Consequently, mines that were subsidized can carry on now only at a loss, and are reducing the scale of operations. The tin market as a whole is affected, and until

the metal rises well above its present level there is no possibility of the Cornish mines, at least, reopening. The Geevor, which is interested in the famous Levant Mine, has quite come to grief, some of the larger shareholders—companies presumably—are unable to pay the calls on the last issue of shares at the end of 1919. The Geevor is in debt £15,000, and at least £5,000 is required for pumping. The directors propose an issue of £25,000 8 per cent tax-free debentures, redeemable in two years at par. This scheme may or may not go through, but a suggestion is being made of a drastic reduction of capital. There is plenty of tin ore in the mine, as also at East Pool, Cornwall.

Although small private syndicates in Nigeria can produce and sell tin at a

profit, there does not appear to be a single company that can do so. Total costs, generally speaking, are about £160 per long ton, so that a 70 per cent concentrate, with the metal at £153 a long ton, does not yield sufficient to encourage a continuance of operations. There is talk of closing down several mines.

Although work has been resumed at Rio Tinto, prospects are not bright, and a discussion of the dividend position has led to a further fall in the price of the shares to 24. Arizona Copper is reported to be in even worse financial plight, and shareholders are becoming restive at the delay in the proposed sale.

The Daggafontein Mines, a company under the control of the Consolidated Mines Selection Co. and its associates, among whom are the Anglo-American

Corporation, has reached the end of its financial tether. The reconstructed company has expended about £1,100,000. The percentage of payable area so far is not great, but at the end of December about 6,000 ft. had been sampled on reef averaging 23.38 dwt. over 10.8 in. A small footage in January showed 46.1 dwt. over 10 in. The reef is very narrow, and a dike has been encountered in one of the workings. Times are not propitious for raising further funds; hence the reported decision to close down, just at an interesting stage, too.

On the other extremity of the Rand lies the property of the Western Rand Estates. About eighteen years ago an extensive boring program proved the existence of the reef, or, rather, of two reefs, at depths ranging from 1,677 to 3,229 ft. Values of an encouraging nature were disclosed, but two difficulties existed. One was to provide additional capital, and the other was how to deal with the dolomite. The former still exists, but there is a possibility of overcoming the latter. It is said the Union government is urging the company to start operations, and a rumor is current that a scheme for raising money is under consideration.

An agitation is afoot to induce the directors of the National Mining Corporation to write off the uncalled liability of 10/- a share. The corporation will require additional funds, and there are difficulties in the way.

MEXICO

Low Price of Silver and Railroad Strike Seriously Affecting Operations — Many Small Properties Being Acquired for Operation When Normal Conditions Return

Durango

Durango — The smelter at Torreon (Peñoles Co.) opened in February, and despite the continued closing of mines throughout the northern part of Mexico, due to the low prices of metals, has continued to operate. The American Smelting & Refining Co. mines at Velardeña, Durango, closed down the last day of February, although the smelter of the same company at Asarco, Durango, has continued operations. The general strike of railroad workers throughout Mexico which began the last week in February, and which has continued without reaching a definite solution, aided in closing mines and smelters; for, although passenger trains have been handled so as to give nearly normal service, the transportation of freight, including ores destined to the smelters, has been practically nil. Encouragement is held out by the government and by the management of the railroads that the service will be made normal in at least two weeks more, by the substitution of new men for the strikers.

The governor of the State of Durango has recognized the plight of the mining industry in this state. Cognizant of the vital necessity of encouraging miners and owners of mines, he has extended through the "State Official Periodical" an invitation to all inter-

ested in mines, who, for lack of immediate capital, cannot continue their operations, to consult with the government direct, and the government will undertake to interest new capital in such enterprises as are promising and assist so far as is possible indirectly, by bringing the properties to the attention of foreign investors.

A state colonization agent has been appointed and a bureau established to distribute, among other things, such information as is possible to obtain for the benefit of prospective investors in mining properties and undeveloped claims.

That those interested in mining are optimistic is shown clearly by the number of new denouncements made, or claims filed for titles to new mining property. The new claims filed average from ten to twenty-five per week, as shown by the publications in the official newspaper of Durango. These claims are not in any one district that is being boomed, but are scattered generally over the various districts of the entire state.

Sinaloa

Culiacan—Large numbers of mining denouncements are being made in the mining agencies all over the state, in the Fuerte district, Mocerito district, Cosala, Mazatlan, and Rosario.

The Antigua gold mine known as the "Guajolote," in the Mocerito district, has been acquired through denouncement by Messrs. Cockaran and Coffee. This property has been worked to a depth of several hundred feet through inclined shafts, the ore formerly all being treated by amalgamation with arrastres, many of which are still in good condition. The present owners expect to have a modern mill and cyanide plant in operation before the coming rainy season, which begins in July.

The old "San Luis Gonzaga" mine, in the Badiraguato district, has been sold to F. E. Avery and associates, of Columbus, Ohio. There is a fifty-ton mill on this property, and it is anticipated that the new owners will soon install a complete flotation plant. This property was a silver producer for a great many years. In former years only the high-grade ore was shipped, carrying from 300 to 1,000 oz. After the mill was installed, the ore of 50- to 100-oz. grade was treated by the lixiviation method with good results, notwithstanding the high cost of salt, which had to be transported from the coast about one hundred and fifty miles distant. E. B. Holt is in charge of operations at the mine.

In the eastern part of the Culiacan district near the Durango line, W. C. Minsch and associates are exploring a number of silver properties with a view to purchase.

The K. & H. Mining Co., which has holdings in the Cosala district, is preparing to blow in its smelter. It will operate on a silver-lead ore. Chas. Kuenzel, Jr., is in charge.

J. H. Hudson and associates from Schrevesport, La., are preparing to

work their silver-gold properties, at "La Tuna" camp, in the Badiraguato district. This mine has produced several million ounces of silver, with a good ratio in gold.

Practically all the operating companies are holding up their silver shipments, on account of the extremely low price of that metal at present, and devoting their attention to development work, with the view to having their ore reserves in good condition when the silver price is again above the cost of production.

Coahuila

Torreon—An almost complete temporary paralysis of the mining industry is evident in Mexico. The low price of silver threatens to demoralize every silver camp. The federal government is striving to relieve the situation by enacting more favorable laws and reducing federal and state taxes.

The Torreon smelter is operating and has sufficient ore to keep going for some time, but the general railroad strike is interfering with freight shipments and the company's fuel supply is nearly exhausted.

In the Velardeña district several thousand miners have been discharged from the smelter and mines of the American Smelting & Refining Co., which has closed down. The Chihuahua smelter has suspended, and the mines at Santa Eulalia are idle. Four thousand men were discharged last week at the Santa Barbara mines, in the State of Chihuahua. At Guanajuato over five thousand are idle as the result of a complete suspension of the mines of that region. The smelters of both the American Smelting & Refining Co. and the Compania de Minerales y Metales at Monterrey are closed down indefinitely. The mining industry at Pozos, in the northern part of the State of Guanajuato, is at a standstill.

Walter C. Bishop has filed in a group of sixteen gold and silver claims in the municipality of Panuco. The survey embraces the old Panuco and Proviencia mines, which were abandoned and went by default for non-payment of taxes during the revolution. Another filing has been made by Mr. Bishop adjoining the old Philena mine, in the same district.

Drs. L. Sandell and W. E. King are in the vicinity of Santiago Papasquiario, with the intention of locating some mining properties.

It is again rumored that the railroads of Mexico are to be returned to the former owners on the first of next June. In the event that this should prove true the large mining and smelting concerns will not attempt to resume operations in Mexico until the transfer is made and the new management demonstrates its ability to control the labor problem.

According to interviews with a number of individual mine owners and shippers in this district, a majority will employ a reduced force to carry on developing work in blocking out their ore-bodies and improving their mine workings.

CANADA

British Columbia

Sheep Creek—Extensive development is in progress at the Motherlode, which now is controlled by the Nugget Gold Mines. The long crosscut driven from the fifth level of the old Motherlode workings tapped the Nugget vein at a distance of 1,165 ft. This gives a vertical depth on the vein of 625 ft. below the Nugget workings, or about 1,000 ft. below the apex of the vein. The large and well-equipped Motherlode mill operated from July to November of last year and continuous operations this season are proposed.

Golden—The Bunyan silver-lead property, Bunyan Mountain, is to be opened. Development, it is said, will be on a considerable scale, as 100 to 125 men will start to work as soon as weather conditions permit. The Brisco Mine, Columbia Valley, is also to be developed.

Stewart—Material contracts amounting to \$100,000 have been awarded by the American Smelting & Refining Co., to the Riblet Tramway Co., Spokane, Wash., for building the tramway at the Premier mine, which will probably have a longer single section than any other tramway ever constructed. It will be necessary to clear 11½ miles of right of way at the mine, and the Riblet company will furnish the superintendent for the crew. The work will take about five months.

Hedley—There appears no immediate prospect of resumption of operations at the Nickel Plate mine, except by arrangement between the company and the provincial government with respect to about \$70,000 due on retroactive taxes. The company is seeking to have the government cut this amount in two, with the understanding that the company will then spend \$70,000 for mine development.

Greenwood—Chicago interests are taking hold of the operation of the Providence mine, and are putting things in order for an active season. Equipment being added consists of a compressor and a motor. It is planned to open up the property to the 600 and 700 levels.

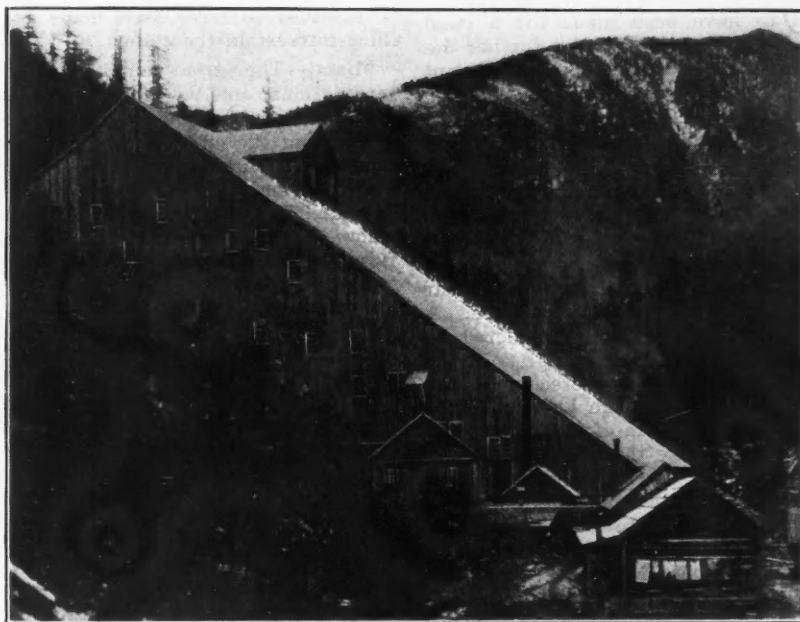
Ontario

Sudbury—The British America Nickel Corporation may resume development work at Murray mine about April 20, though the rumor is denied. A meeting of the bondholders of the corporation will be held in Toronto March 31 to consider a new financing scheme involving the issue of \$24,500,000 in bonds of three classes, viz.: \$6,000,000 first income; \$6,000,000 "A" income; and \$12,500,000 "B" income. Of the first issue \$4,000,000 would be hypothecated for debts and the balance held in the treasury. The second \$6,000,000 would be exchanged for fifteen-year first mortgage bonds, and \$10,000,000 of the last issue would be exchanged for debenture stock, the remainder being appropriated to satisfy Norwegian creditors.

Cobalt—The Nipissing during February mined ore of an estimated value of \$124,391, including cobalt valued at \$12,460, and shipped bullions from Nipissing and custom ores of an estimated net value of \$234,374.

Shipments for February were 86.69 tons of silver ore from the Coniagas; 179 tons from Dominion Reduction; 76.55 tons from La Rose; 43.99 tons from Mining Corporation and 64.11 tons from O'Brien; a total of 450.34 tons. Of this, 64.11 tons went to the Deloro works; 87.23 tons to the Coniagas plant at Thorold; 25 tons to the refinery at Chrome, N. J.; 87.14 tons to the A. S. & R., Perth Amboy, N. J.; and 186.86 tons to the Pennsylvania Smelting Co. at Carnegie.

Porcupine—Results of milling at the Davidson Consolidated during 1920 were



MOTHERLODE MILL AT SHEEP CREEK, B. C.

unsatisfactory, the recovery from the treatment of 3,003 tons of ore being only \$11,210, or an average of \$3.75 per ton, which was considerably less than operating costs.

Kirkland Lake—The Teck-Hughes mine is now opened up to its mill capacity of between 125 and 130 tons per day. The grade of the ore is satisfactory, and, as costs are low, a satisfactory profit is being realized on this operation.

It is probable that the Wright-Har Graves mill will start about May 1, when power should be sufficient to insure continuous operation. Development work on four levels is stated to be satisfactory.

Franklin Camp—A report to be submitted to the Dominion Department of Mines by experts who have been making examinations will show that platinum, palladium, iridium, osmium, radium, and ruthenium have been found in paying quantities here.

Salmo—Capital stock of Nugget Gold Mines, Ltd., has been increased from \$1,000,000 to \$3,000,000.

COLORADO

Labor Returning to Cripple Creek and Pueblo—Valley View on Full Time

Pueblo—The Colorado Fuel & Iron Co. has announced that, owing to improved conditions in the steel industry, 1,000 additional men will be employed. Four idle mills will reopen, running two eight-hour shifts. The company's orders for finished-steel products have increased during the last month.

Cripple Creek—Hard-rock miners are returning to the Cripple Creek district in large numbers, and more good mine labor is available today than at any time during the last two years. The interest in leasing is increasing, and development work is being resumed at numerous properties, under the leasing system. One of the factors that tends

to discourage leasing operations at this time is the high price of powder, which is now selling at about double its pre-war price, which makes small-scale mining operations almost prohibitive.

Matterhorn—The concentrating mill of the Valley View Leasing & Mining Co. is running full time, and producing about twelve cars of concentrate per month.

Silver Plume—The Burleigh mill is being remodeled, and a Ruth flotation machine has been installed. G. L. Cole is manager.

Central City—The Frontenac and Aduddel properties, in Russell Gulch, are being equipped and developed by New York capitalists who have recently purchased the properties for \$82,000, under a bond and lease extending over a period of thirty months. A new hoist will be placed at the Aduddel shaft, and connection will be made with workings from the Newhouse tunnel.

Rico—The Rico-Wellington properties are being developed and operated under a leasing system, and three groups of lessees are now at work.

ARIZONA

Consolidated Arizona Smelting's Finances Being Reorganized

Prescott—The formation of the Southwest Metals Co., a corporation that is to assume the property and liabilities of the Consolidated Arizona Smelting Co., of Humboldt, now in the hands of a receiver, is reported. The reorganization plans are for a stock issue of only 100,000 shares, to be distributed to the old stockholders, with their 1,663,000 shares, each new share to cost \$16 and 40 old shares. Thus there would be provision of \$655,000 of new capital and 58,425 shares would be left in the treasury.

A Jerome-Verde judgment of \$15,000 and costs has been settled out of court, presumably by a protecting group of stockholders who have been keeping the property in condition. Plans are understood to have been made for a bond issue to provide money for further development. An unsuccessful attempt was made last year to secure \$260,000 by this means. The company has a large acreage in the heart of the Jerome district.

The Big Reef property of eighteen claims in Big Bug district has been advertised by the sheriff to satisfy a claim of \$1,503.

At 400 ft. the Malapai shaft near Kirkland is in 7 ft. of milling ore. A reduction plant is being considered by the management.

A small mill is being erected by Andrew Smith and George Lane upon the Gloriana mine, south of Mayer, a property worked more than forty years ago and well known as the Valencia. Near Mayer is the Gillespie mine, on which a similar mill is to be in operation April 1. The property is owned by the Arizona Copper & Mining Co., with Samuel Hobson, of Mayer, in charge.

A ball mill of 300 tons' daily capacity is being built in Los Angeles for the Arizona Standard Copper Co., to be placed on the company's mine near Parker. A leaching process will be used. Thomas J. Carrigan, once of the Clara at Swansea, is manager.

Bisbee—Sinking has been completed on the Junction shaft, now the deepest in the district. The sump is 2,385 ft. below the collar. Following in order of depth are the Dallas, 2,200 ft.; the Copper Queen, C. & A., 1,870 ft.; the Sacramento, 1,841 ft., and the Denn, 1,810 ft.

Stockton Hill—The new 100-ton mill at the C. O. D. is completed, and is turning out the first concentrates from the old dumps and some mine ore. The successful operation of this mill vitally interests Mohave County, as it will mean, in a great degree, the solving of the complex ore problems of the Cerbat Range.

Wage reductions recently put into effect throughout the county have resulted in no serious difficulties. Practically all crews have accepted the cut in good spirit, and the mines without exception are operating full handed.

Tombstone—A fourth silver mill has been purchased for installation in the

Tombstone field. It has been bought near Casa Grande by Joe Best and Thomas Saunderson, for erection at their mine, near the State of Maine property.

Quartzite—A sulphide vein nearly 5 ft. wide, that samples 12½ per cent copper and material values in gold and silver has been cut at a depth of 600 ft. in the Copper Chief mine, twelve miles northwest of Quartzite.

Ajo—Mexican Consul Y. Gonzales, Pat Holland, and Jack O'Brien, all of Ajo, have announced, near the shores of the Gulf of California, the discovery of a large deposit of soda, found in two lake basins. The deposits lie about one hundred miles south of Yuma and thirty-five miles from the new gulf port of Rocky Point, where it is planned to establish the terminus of the new Ajo-Tidewater R.R. An offer of \$250,000 is reported to have been made for a third interest in the claims.

Miami—The great chimney of the International smelter is completed, and succeeds a steel stack that is deteriorating from the effect of sulphuric-acid fumes. The new stack is 275 ft. high, with interior diameter of 34 ft. at the base and 22 ft. at the top. The brick, amounting to 2,000 tons, was brought from Alamo, N. M. The stack is designed to withstand a wind velocity of more than 100 miles an hour.

CALIFORNIA

Sutter Creek—Central Eureka has taken a three-year option on the South Eureka. The sum involved is \$225,000, the first payment of \$50,000 to be made Feb. 1, 1922, if the development proves satisfactory. The two mines adjoin, and the lowest workings of the Central are 1,000 ft. lower than those of the South Eureka. The south drift of the Central is within ten or fifteen feet of the property line, and will probably follow pay ore into the South Eureka. The eighty-stamp mill of the South Eureka will be put in operating condition and used with the forty-stamp mill now operated by the Central.

Last Chance (Placer County)—Rich gravel is reported in the Glenn mine, a Tertiary river channel.

Georgetown (El Dorado County)—Two miles from Georgetown, a 2-ft. ledge yielding good assays has been opened up by two prospectors, and as a result a number of prospectors are out scouring the immediate country.

Oroville—The Steifer mine, on Magalia ridge, a drift mine, is to resume operations. A power line has been completed and a force of miners engaged.

Nevada City—The Debernadi quartz mine, at Indian Flat, is being reopened.

The Liberty Hill hydraulic mine near Dutch Flat is operating its full complement of monitors, and the outlook for a long season is excellent.

San Diego—New feldspar deposit is being opened up fifty miles east of San Diego. Franklin A. Kales is in charge, and first shipment is expected to be made this month.

OREGON

Copper Ore Shipments Resumed—Prices and Labor Encouraging

Gold Hill—The gradual drop in prices of mining machinery and supplies, coupled with a steady improvement in the labor situation, has been heartily welcomed by the gold-mine operators in this region, and is the forerunner of a general resumption the coming season. Although but two quartz mines, the Sylvanite group, two miles north, and the Gold Ridge group, two miles south, of Gold Hill, are actively operated, much work is being done in the larger mines in keeping up repairs, with a view to resuming. Among these are the Ashland mine, near Ashland; the Opp, at Jacksonville; the Alameda and the Greenback, near Grants Pass; the Braden, Bill Nye, and Millionaire, at Gold Hill.

The Blue Ledge, south of Gold Hill, and the Queen of Bronze, a copper property west of Gold Hill, are resuming shipments to the Tacoma, Wash., smelters. These copper ores are necessary to flux with several of the Alaskan ores, and run better than 12 per cent copper. Both of these mines are paying over \$10 per ton for hauling the ore to a shipping point.

The Blue Ledge owners, the Blue Ledge Mining Co., Copper, Cal., are planning a \$50,000 200-hp. electric power plant to operate the machinery and light the camp. Elliott Creek, at Seattle Bar, with a drop of 200 ft. eight miles from the mine, will supply the power.

The quicksilver mining industry in this region is still at low ebb, yet the War Eagle Mining Co. is in steady operation and reducing its ore with a twenty-five-ton Scott furnace and several units of twelve-pipe furnaces. Other operators in this district are also developing cinnabar mines, and over the mountains in Siskiyou County, Cal., in the Gottville district, several new high-grade cinnabar deposits are being developed.

WASHINGTON

Newport—Plans for additional development of Conquest claim, held by Bead Lake Gold-Copper Mining Co., are being considered. A shaft will possibly be put down from the surface to the 200 level.

Valley—The Double Eagle Mining Co. has let a contract for a 300-ft. extension on the 700 level. A number of shipments have been made from this level, the net value being \$95 per ton. A portion of the Double Eagle ground is under a ten-year lease to the American Refractories Co., of Pittsburgh.

Chewelah—Chewelah Silver Mining Co. this summer will drive an 800-ft. tunnel to tap the vein at 300 ft. vertical depth.

Spokane—Annual meeting of stockholders of the Hecla Mining Co. will be held in the Empire State Building here on April 12.

Northport—After accumulating bullion in excess of 3,500 tons the North-

port smelter has resumed shipment of some of it to Pittsburgh refineries.

Springdale—Western Materials Co., operating here, is reported to be meeting with success in marketing magnesite as a building material. It is ground to 200 mesh after calcining, then making a chemical mixture. The product is being sold chiefly along the Pacific Coast.

Nighthawk—The mill of the Pyragyrite mine, a short distance west of here, began operations the first week in March. There is a large reserve tonnage in the mine, and ample power is now available from the Okanogan Valley Power Co. plant at the Similkameen falls.

UTAH

Character of Ore Shipments to Smelters Changing—Connections Completed on 1,800 Level at Chief

The smelters in Salt Lake Valley are receiving a larger proportion of dry siliceous ores than formerly, owing to the fact that many mines are holding back their lead ores. This greater proportion of dry ores places the smelters in the anomalous position of having to curtail shipments of certain classes of ore while their plants are working at less than capacity.

The dry silver ores come chiefly from Tintic. In the case of the Eagle & Blue Bell mines and Victoria, owned by the Bingham Mines Co., there is a large tonnage of lead ore exposed in the mines, but very little ore of this character is being shipped, owing to the unfavorable price of lead.

Eureka—At the Zuma, machinery is being installed to permit of continuing the winze, which is down to the 800 level, as far as the 1,200. It is proposed to connect with the adjoining Iron King mine on the latter level, the two companies drifting toward each other. At the Chief Consolidated, connections have been completed on the 1,800 level between the new No. 2 shaft and the older workings. Ventilation has been improved, and the temperature perceptibly lowered. Plans have been made to hoist a large part of the waste through the new shaft, to relieve the No. 1, which has been taking care of all ore, waste, and supplies.

Shaft sinking has been resumed at the Lehi Tintic. The shaft is now down to the 340 level, and sinking will be done to 500 ft., when drifting will be started. Drifting in favorable ground has been done on the 200 level, but was given up owing to faulting. The shaft has cut a body of quartz 18 to 20 ft. thick. The Iron King is paying operating expense through the shipment of fluxing iron ore to the smelters. At the Scranton, shipments of zinc ore have been stopped for the present, owing to the state of the metal market, and development is being done with a small force. Work has been resumed at the South Scranton and shaft sinking started. The Grand Central is shipping its best ore only, the output coming from the levels above the 900.

Park City—The stockholders of the Park City King are meeting to consider plans of reorganization and financing, so that work may be resumed. The company owns four claims at the head of Thaynes Canyon adjoining the Iowa Copper and a part of the Silver King Coalition.

NEW MEXICO

Steeple Rock Copper Claims Sold—Burro Mountain Branch Closes April 1

Lordsburg—Ore shipments from this district for February amounted to twenty-seven carloads, 1,773½ tons, of an approximate value of \$26,202. The Great Eagle fluorspar mine company is hauling ore for shipment to the steel works in the San Francisco district.

The Blue Bell Mining Co., of Lordsburg, has been incorporated, with a capital of \$500,000. Incorporators are M. O'Neill, Tucson, Ariz.; Morgan Wilson, San Simone, Ariz.; G. W. Tremble, W. P. Downey, and L. P. McHalfey, all of Lordsburg, N. M. The property consists of a group of copper claims situated in the Steeple Rock district of Arizona, formerly owned by the Eclipse Mining and Milling Co., which were sold for debt about a year ago.

Tyrone—The Burro Mountain branch of the Phelps Dodge Corporation will shut down mine and mill on April 1. The mill has been handling 2,000 tons of ore daily and employing 1,100 men.

NEVADA

Tonopah District Is Normal—Round Mountain Company Has Started Hydraulic—United Comstock Haulage Tunnel Progressing

Tonopah—The Tonopah Divide Co. officially reports that an ore shoot has been entered with the southeast hanging wall drift on the 1,000 level at a point 280 ft. from where the crosscut from the shaft cut the vein. The drift has been in ore for the last 20 ft. said to average better than \$30 per ton, and values improving. The width of the ore is uncertain, as no foot wall has been developed. This is an important development for the entire district. It is rumored that the shaft is to be deepened to the 1,300 level, where it is expected water level will be reached. The Divide Extension, owning a small acreage northwest of the Tonopah Divide, has opened a narrow width of high-grade ore between the 100 and 200 levels from the Caldwell shaft. Developments are meagre to date.

Mine conditions in the district are good, production is normal, and developments are satisfactory, with nothing new of importance. There are some rumors of apex trouble between the Tonopah Extension and the Cash Boy over ore being developed in the latter company's ground, and said to apex in the Tonopah Extension. It is not likely that a suit will come to trial.

Candelaria—It is reported that the construction of a 150-ton plant for the Candelaria Mines Co. will be started about April 1.

Manhattan—The crosscut on the 800 level of the White Caps mine has cut the west orebody at a distance 800 ft. from the shaft.

The Round Mountain Mining Co., owning lode and placer mines at Round Mountain, sixty miles north of Tonopah, has started hydraulic operations. Conditions are favorable for a successful season, there being more water than usual at this time of the year.

Comstock—The United Comstock Mines Co. is making excellent headway on its main haulage tunnel, work being carried on from seven faces. A mechanical shovel is being used with success.

Rawhide—Construction of a custom mill for the Rawhide district is to begin in the immediate future. Plans for the mill are being drawn by a firm of Reno engineers, with sufficient ore pledged by leasing companies to insure its activity for several years.

IDAHO

Bonnors Ferry—Cyanide Gold, operating in northeastern part of Boundary County, twenty-five miles from here, has maintained a crew of twenty-five or thirty men on underground and surface development during the winter. The mill has been remodeled, and the two-bucket tram connecting the lower mine workings and the mill site has been partly completed. It is expected the tram will be in working order by the time the snow is gone, and mill operations may then be started.

Sandpoint—An organization has been formed here to further mining interests in Bonner County, embracing the Pend Oreille section.

Hailey—More interest appears to be taken in central and southern Idaho's mineral resources than for some time past, and it is reported that there are preparations for much new work to be undertaken soon, particularly in the case of known silver and gold properties. The Bunker Hill & Sullivan Mining & Concentrating Co., of Kellogg, Idaho, has taken a lease and bond on the Bullion and Mayflower groups, in the Wood River district.

Mullan—New machinery will be installed by the American Commander Mining Co., which operates the First Thought mine. The machinery includes a compressor, motors, transformer, and several machine drills. Two shifts are being worked.

MONTANA

Anaconda Fabricates Most of Its Butte Copper and Sells It West—Churn Drilling at East Butte Properties—Boston & Montana Mill at Elkhorn Progressing

Butte—The bulk of the copper output of the Butte mines of the Anaconda Copper Mining Co. is going to the rod and wire plant of the company at Great Falls, Mont. Production is around 9,000,000 to 10,000,000 lb. monthly, the former being the output for the last month, and more than 5,000,000 lb. is being shipped to the manufacturing works of the corporation. The com-

pany is finding a sale in the West for its products at about 2½c. above the basic price.

Aside from making a drainage connection with the High Ore mine of the Anaconda, which adjoins, the North Butte's chief objective at present is decreasing even its curtailed production, about 450,000 lb. of metal monthly, because of low copper prices. No change is reported from the development work on the 3,600 level.

Working forces at the Colorado mine of the Davis-Daly were somewhat further reduced in the last week. The octagonal air shaft is now connected from the 2,700 level through to the surface.

The Main Range shaft of the Tuolumne is close to the 1,500 level. This mine is confining attention principally to its silver ores, a carload of which daily suffices to carry on all its shaft and development expenses. Sinking probably will continue to 2,000 level unless the copper metal market revives.

With the No. 3 Black Rock shaft practically at the 2,300 level, the Butte & Superior company has under consideration the continuation of sinking to the 2,600.

Development work on the lower levels of the Pittsmtont properties of the East Butte Mining Co., appears to promise a material improvement at greater depth. Churn drilling is under way from the surface to determine the depth of the quicksands, which are found in the westerly part of the East Butte's territory, which is situated partly on the so-called "flats" below the Butte hill.

Copper ore development, together with some zinc, is proceeding at the Elm Orlu. The former has proved the chief feature of operations at this property in the last year. The Timber Butte mill of this company is closed on account of the condition of the zinc market.

Elkhorn—Installation of milling equipment is progressing at the Elkhorn property of the Boston & Montana company. Housing of the plant has been completed. Idanha workings on the 300 level continue in ore, the drift now having been extended more than 600 ft., with the ore continuous in both faces.

MINNESOTA

Cuyuna Range

Operators Again Present Claims to War Minerals Relief

Ironton—Cuyuna Range manganiferous ore operators are elated over the announcement of the award of \$52,000 compensation to the Gloria Mining Co. by the War Minerals Relief Board. This is the first of the War Minerals Relief claims of Cuyuna operators to be favorably acted upon. The Gloria Mining Co., of which E. J. W. Donahue, of Duluth, is manager, operated the Gloria mine during 1918. Under the wider interpretation of the War Minerals Relief Act several operators are again presenting their claims and feel

that the action taken on the Gloria claim presages more favorable consideration of all Cuyuna Range cases. One of the largest claimants is the Oneida Mines Co. for operation of the Clark mine and installation of washing plant at the Sultana mine for a total expenditure of \$231,364.

It is reported that plans are under way for unwatering the Ida Mae mine and resumption of mining this summer. The Ida Mae is a manganiferous iron ore property, operated by the Cuyuna-Minneapolis Iron Co. The mine has been idle since last May.

MICHIGAN

Marquette Range

Jones & Laughlin to Increase Scope of Operations

Ishpeming—Mark Elliott, general manager for the Jones & Laughlin Co. in the Lake Superior mining districts, was here from Virginia, Minn., recently, arranging for the future operations of the company on the Marquette Range. Offices at Negaunee have been secured, and plans are under way for a thorough investigation of the mineral lands of the company. The latter now have control of the Breitung hematite mine, and it is probable that work will soon be resumed at this property. The company owns a property at Iron Mountain Lake, Ishpeming, but this has been idle several years awaiting some plan of mining under the lake. The company also has leases for lands on the western end of the Gogebic Range, where the management has been waiting for railway connection to get in the needed equipment.

The Cleveland-Cliffs Iron Co. will soon begin the unwatering of North Lake to permit mining operations to be carried on in that basin.

Gogebic Range

New Crosscut Being Driven on 25th Level at Pabst

Inwood—At "H" shaft of the Pabst mine another 1,000-ft. double-track rock crosscut is being driven. It is on the 25th level, and will be similar to that on the 24th level. The mucking is being done by a Hoar loader, which has just completed the mucking work in the large pump house at the Davis mine. The drilling is being done by three Leyner machines.

Except for work at the power and substations, the high-tension transmission line from the Pabst to the Davis and Puritan mines is completed. It is built with four-post steel towers carrying duplicate lines of steel-cored aluminum cables with spans up to 700 ft. Owing to delays, the power and substations will not be completed for several months. The Davis pump house, which was about ready for installation of the electric pumps, has caved in badly and so that work will also be considerably delayed. The pump house, which was about 65 ft. x 85 ft. x 11 ft., was cut in the foot-wall slate, and was lined with 4-in. reinforced concrete lath supported by 15-in. and 20-in. I-beams on 8-in. H-beam columns. After this

was all in place and thoroughly blocked some of the rock over the back began to loosen and broke a few of the roof slabs and bent a roof beam, and additional timber supports for the roof were put in. A day or two later, while this reinforcing was going on, a large amount of rock, probably 1,000 tons or so, loosened and settled down on the roof system, crushing everything flat over an area about 40 ft. x 40 ft., the miners narrowly escaping. The trouble was caused by faults which had cut off the fallen block from the surrounding rock. The method to be used in repairing the place has not yet been decided upon.

NORTH CAROLINA

Crushing Iola Dump for Road Material and Amalgamating Fines

Candor—At the Iola mine a rock breaker and screening plant have been installed and are now crushing the dump near the main shaft. A fleet of trucks operates night and day moving the rock to a siding a mile away, where it is shipped as road surfacing material.

Some of the fine has been going to a ten-stamp mill now in operation, ground to forty mesh and amalgamated. Two discoveries of ore near surface have lately been made at this mine, which ceased operations about four years ago.

TEXAS

New Iron Ore Plant Under Construction at Bowie Hill

Linden—Pratt Bros. Iron Ore Development Co., of Minneapolis, is erecting a 400-ton plant at Bowie Hill, near Linden, for crushing, screening and roasting iron ore. The property at Bowie Hill is estimated to contain 5,000,000 to 6,000,000 tons of 54 per cent iron ore. Mining will be done by steam shovel.

GEORGIA

Mica Industry in State Said To Suffer from Foreign Competition

Atlanta—The Georgia School of Technology, of Atlanta, has announced the establishment of an industrial development department. One of the objects of this department will be to interest capital in the possibilities of iron ore mining in Georgia, and to secure furnaces in the state to handle the raw product of the mines.

J. E. Burleson, who is connected with the mica industry in Georgia and who was in Atlanta recently to obtain support for the proposed mica schedule, said:

"A few years ago when we had the Payne-Aldrich tariff the mica mines of Georgia employed 2,000 people. Not half that number are employed now and unless we get relief the single mine now operating will have to shut down and the industry will become a thing of the past in this state."

Mica is abundant in the western and northwestern part of the state. Mr. Burleson pointed out that while the manufacturers of mica products are protected by tariff, the mining operators are forced to come in direct competition with the coolie labor of British India.

THE MARKET REPORT

Daily Prices of Metals

March	Copper, N. Y. net refinery*		Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.	
17	11.75	27.25	28.25	4.00	4.00	4.75	
18	11.75	27.00	28.00	4.00@4.15	4.00	4.70@4.75	
19	11.75	27.00	28.00	4.00@4.15	4.00	4.70@4.75	
21	11.75@12.00	27.25	28.25	4.00@4.20	4.00	4.70	
22	11.75@12.00	27.50	28.25	4.00@4.20	4.00	4.70	
23	11.75@12.00	28.50	29.25	4.00@4.20	4.00	4.70	

*These prices correspond to the following quotations for copper, "delivered": 12, 12, 12, 12@12.25, 12@12.25, and 12@12.25c.

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

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

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

has temporarily reached a deadlock. Most of the few domestic sales for the last three or four days have been confined to copper for forward delivery, and commitments have been made for shipment as late as July. Future business, however, has commanded a premium of about ten points a month. The large producers continue to hold at 13c. delivered, and, if they persist in this policy, the price may reach that figure, as the production of those willing to sell for less does not seem quite sufficient to satisfy the demand.

Export business has been about the same as in the last few weeks, and is confined largely to sales to Germany, both directly, for cash, and to a less extent through the Copper Export Association.

Further curtailments in the copper industry are expected soon. The complete cessation of activities at North Butte is announced, and rumors are current of a similar action soon by some of the Arizona producers. The sooner this happens the better for the market.

London

March	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3 M	Spot	3 M	Spot	3 M
	Spot	3 M							
17	67	66½	70½	156	159½	18½	19	24½	25½
18	68	66½	70½	154½	157½	18½	19	25	25½
19
21	67½	66½	70½	156	159½	19	19½	25	26
22	68	66½	70½	157	160½	19	19½	25½	26½
23	69	68	71½	160½	164	19½	19½	25½	26½

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

Lead

The A. S. & R. official price continues at 4c., New York and St. Louis.

The week has been a quiet one in the lead market. The price of 4c., St. Louis, seems to be temporarily accepted by both buyers and sellers, and we have heard of no business either above or below this figure. The New York market is more variable. Small tonnages for prompt shipment may still be obtained for 4c., but for forward delivery up to 4.25c. is asked, with some of the largest sellers out of the market. Business among consumers is improving somewhat. Inquiries have been fairly numerous from lead-pipe manufacturers in the South and Middle West, where building activity is said to be increasing. White lead in oil is also recognized to be a bargain at current prices, and is, therefore, in more demand than for some time. The battery business is experiencing a seasonal increase. Cable manufacturers have been using a fair amount of lead for some time. Chemical lead, 4.25c., St. Louis.

Zinc

Zinc continues weak. Practically all the demand is from galvanizers, but inquiries were more active yesterday, particularly from some of the larger interests in the Middle West. "Brass-special" zinc commands about ten points premium over Prime Western, and "high grade" continues to be sold at about 7c., delivered at eastern points.

Tin

A slight improvement can be noted in the tin market, coupled with the steadier conditions in London. Yesterday there were more buyers than sellers

Silver and Sterling Exchange

Mar.	Sterling Exchange	Silver			Mar.	Sterling Exchange	Silver		
		New York, Domestic Origin	New York, Foreign Origin	London			New York, Domestic Origin	New York, Foreign Origin	London
17	389½	99½	55½	32½	21	391	99½	57½	33½
18	390½	99½	56½	32½	22	390½	99½	58½	34½
19	390½	99½	57½	33½	23	390½	99½	56½	33½

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.

Metal Markets

New York, March 23, 1921

Though not characterized by more than the usual amount of buying of the last few months, the tone of the market is distinctly encouraging. An increasing number of sellers are becoming disinterested factors at present prices. Many large consumers are making inquiries, but do not seem disposed to place orders and expect to be offered cut prices, as in the past. When they find that metal is not obtainable below the quoted market, they may become more active purchasers. Several factors have influenced the firmer feeling. London has been wavering less, and in the last three days has shown a distinctly

firmer tendency all around; business conditions seem to be improving in certain industries; and further curtailments of production are taking place. Mexican production during recent weeks has been particularly small, both on account of the low prices realized and because of the railroad strike in that country. Zinc seems to be the only metal which has so far not responded to the better sentiment.

Copper

Most of those interests which have been selling copper at 12c. delivered, seem to have disposed of their current output, and it is doubtful if any large tonnage could now be obtained at this price. Consumers do not seem disposed to pay more, however, so the market

here in New York, and some of the larger consuming interests seem to be coming into the market. Electrolytic continues to be marketed to the extent of current production, which is now about 800 tons per month. The price received is practically the same as for Straits.

Straits tin for future delivery: March 17th, 28.50@29c.; 18th, 28.50@29c.; 19th, 28.50@29c.; 21st, 29@29.25c.; 22d, 28.50@29c.; 23d, 30.50@31c.

Arrivals of tin, in long tons: March 16th, Buenos Aires, 5; 18th, Straits, 150; China, 5; 19th, Batavia, 200; Liverpool, 25; 21st, Straits, 475; China, 50; 22d, Liverpool, 50.

Silver

The strength of the silver market was due to buying for the Indian bazaars and to bear covering; but apparently the demand has been satisfied, for a sharp reaction occurred today, the London price falling 1d. overnight to 33½d. The New York market has closely followed London, and closes quiet on prospect of the Easter holidays.

Mexican Dollars—March 17th, 42½; 18th, 42½; 19th, 43½; 21st, 43½; 22d, 44½; 23d, 43.

Gold

Gold in London: March 17th, 105s. 4d.; 18th, 105s.; 21st, 104s. 10d.; 22d, 105s.; 23d, 105s.

General stock of money in the United States, March 1: Gold coin (including bullion in Treasury), \$2,916,884,770; standard silver dollars, \$269,802,326; subsidiary silver, \$271,204,125; United States notes, \$346,681,016; Federal Reserve notes, \$3,345,123,895; Federal Reserve Bank notes, \$207,446,400; National Bank notes, \$727,793,864; total, \$8,084,936,396. The proportion of gold to paper money continues to increase.

Foreign Exchange

European exchanges have been dull. Italian lire showed a marked advance last week, but have been weaker again in the last three days. Chinese rates are strong. On Tuesday, March 22d, francs were 6.95c.; lire, 3.855c.; and marks, 1.61c. New York funds in Montreal, 13½ per cent premium.

Other Metals

Aluminum—List prices of 28@28.5c. are nominal. Outside market, 23@24c. per lb. Market quiet.

Antimony—Chinese and Japanese brands, 5½@5¾c.; market quiet. W.C.C. brand, 5½@6c. per lb. Cookson's "C" grade, spot, 9¾c. Chinese needle antimony, lump, nominal at 4½c. per lb. Standard powdered needle antimony (200 mesh), 6½@6¾c. per lb. Demand light, with heavy supplies available.

White antimony oxide, Chinese, guaranteed 99 per cent Sb₂O₃, wholesale lots, 7c.

Bismuth—\$1.50@\$1.65 per lb., 500-lb. lots.

Cadmium—Nominal, \$1.10 per lb., in 1,000-lb. lots. Price reduced as a reflection of London drop. Smaller quantities, \$1.10@\$1.25 per lb.

Cobalt—Metal, \$4.50 per lb.; black oxide, \$3@\$3.10 per lb. in bbls.; sulphate, \$1.35 per lb. in bbls.

Iridium—Nominal, \$250@\$300 per oz.
Molybdenum Metal in rod or wire form, 99.9 per cent pure, \$32@\$40 per lb., according to gage.

Nickel—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small tonnages, spot, 38@40c.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—Open market, \$70@\$80 per troy oz.

Palladium—\$65@\$70 per oz.

Platinum—\$72@\$75 per oz.

Quicksilver—Nominally, \$46@\$47 per 75-lb. flask. San Francisco wires \$45. Market dull.

Rhodium—\$200@\$225 per troy oz.

Ruthenium—\$175@\$200 per troy oz.

Selenium—Black powdered, amorphous, 99.5 per cent pure, \$2@\$2.25 per lb.

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

Tungsten Metal—Wire, \$35@\$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Guaranteed 50 per cent Cr₂O₃, foreign ore with a maximum of 6 per cent silica, 45@50c. per long ton unit, f.o.b. Atlantic ports.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, \$7.45; Mesabi bessemer, 55 per cent iron, \$7.20; Old Range non-bessemer, 51½ per cent iron, \$6.70; Mesabi non-bessemer, 51½ per cent iron, \$6.55.

Magnetite Ore, f.o.b. Port Henry, N. Y.: Old bed 21 furnace, \$5.80; old bed concentrates, 63 per cent, \$6.70; Harmony, cobbled, 63 per cent, \$6.70; new bed low phosphorus, 65 per cent, \$9.50.

Manganese Ore—35@40c. per unit, seaport; chemical ore (MnO₂) \$60 per gross ton, lump; \$70@\$75 per net ton, powdered. Market dull.

Molybdenum Ore—85 per cent MoS₂, 55@60c. per lb. of contained sulphide, New York.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

Titanium Ores—Ilmenite, 52 per cent TiO₂, 1½@2c. per lb. for ore. Rutile, 95 per cent TiO₂, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite or wolframite, 60 per cent WO₃, and over, per unit of WO₃, \$3@\$3.25, f.o.b. Atlantic ports.

Uranium Ore (Carnotite)—Ore containing 1½ per cent U₃O₈, and 5 per cent V₂O₅, sells for \$1.50 per lb. of U₃O₈, and 75c. per lb. of V₂O₅; ore containing 2 per cent U₃O₈, and 5 per cent V₂O₅, sells for \$2.25 and 75c. per lb., respectively; higher U₃O₈ and V₂O₅ content commands proportionately higher prices.

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

Vanadium Ore—\$1.50 per lb. of V₂O₅ (guaranteed minimum of 18 per cent V₂O₅), New York.

Zircon—Washed, iron free, 3c. per lb.

Zirkite—According to conditions, \$70 @\$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at \$1.15 per lb. in ton lots.

Zinc and Lead Ore Markets

Joplin, Mo., March 19—Zinc blende, per ton, high, \$23.90; basis 60 per cent zinc, premium, \$22.50; Prime Western, \$21; fines and slimes, \$20@\$17.50; calamine, basis 40 per cent zinc, \$12. Average settling prices: Blende, \$22.20; calamine, \$16; all zinc ores, \$22.19.

Lead, high, \$43.25; basis 80 per cent lead, \$40; average settling price, all grades of lead, \$41.83 per ton.

Shipments for the week: Blende, 6,523; calamine, 20, lead 1,562 tons. Value, all ores the week, \$210,560.

Some lead ore was settled for as high as \$50 basis, purchased months ago, and considerable lead was settled for on \$35 basis, purchases of the last few weeks. The advance to \$40 this week brought on the market considerable reserve ore. Zinc ore was purchased again this week on \$22.50 basis, but it was a decreased tonnage. Outputting continues around 7,300 tons per week, while the average purchase this year has been but 5,375 tons per week. Estimates of ore stocks in bins are from 70,000 to 80,000 tons.

Platteville, Wis., March 19—Blende, basis 60 per cent zinc, \$26 per ton. Shipments for the week: Blende, 833 tons. Shipments for the year: Blende, 8,798; lead, 510 tons. Shipped during the week to separating plants, 337 tons blende.

Non-Metallic Minerals

Asbestos—Crude, No. 1, \$2,000@\$3,000; No. 2, \$1,400@\$2,000; spinning fibres, \$400@\$1,000; magnesia and compressed sheet fibres, \$325@\$500; shingle stock, \$110@\$150; paper stock, \$60@\$75; cement stock, \$17.50@\$30; floats, \$8.50@\$15, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada; 5 per cent to be added as export sales tax.

Barytes—Crude, 88 to 94 per cent barium content, \$10@\$12 per net ton; ground (white) \$24@\$30 in bags, carload lots; (off-color) \$22@\$26 in bags, carload lots; all f.o.b. South Carolina points. Foreign barytes, prime white material, \$25 per net ton f.o.b. Atlantic seaports. Western grades, \$24.50.

Chalk—English, extra light, 5@5½c. Domestic light, 4½@5c.; heavy, 4@4½c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, \$8@\$10; washed, \$10@\$12; powdered, \$15@\$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, \$15@\$20, f.o.b. Virginia points. Domestic lump, \$10@\$20; powdered, \$25@\$30; imported lump, \$15@\$25, f.o.b. American ports; powdered, \$35@\$45, f.o.b. New York.

Feldspar—Crude, \$8@14 per gross ton, f.o.b. Maryland and North Carolina points; \$7.50@10, f.o.b. Maine; ground, \$27@30, car lots, f.o.b. Baltimore; ground, \$17@21, f.o.b. North Carolina points; \$17@21 per ton, No. 1 ground, f.o.b. New York State; \$21@23 per ton, ground, f.o.b. Maine.

Fluorspar—Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, \$20 per ton, f.o.b. Illinois mines, and \$20, f.o.b. Kentucky; ground, suitable for acid, chemical or enameling purposes, \$60; lump, \$17.50, f.o.b. Heathden, N. M. In Canada 85 per cent calcium fluoride sells for \$20 per ton, f.o.b. Madoc; output limited. Canadian price generally \$18 (Canadian currency) per ton, f.o.b. mines.

Fuller's Earth—\$16 per ton, carload lots, f.o.b. mines.

Graphite—Ceylon lump, first quality, 8@9c. per lb.; chip, 7c.; dust, 5½c. No. 1 flake, 7c.; high-grade amorphous crude, 3c.

Gypsum—Plaster of paris in carload lots sells for \$4.25 per 250-lb. bbl., alongside dock, New York. Raw crushed rock, \$3.50@4.50; calcined stucco, \$9; f.o.b. works, Illinois.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, \$1.40@2 per net ton; 1½ in., \$1.50@2. Prices for other sizes practically the same. Agricultural limestone, \$2.50@4.50 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite, Calcined—High-grade caustic calcined, lump form, \$30@35 per ton, carload lots, f.o.b. California points. In Chicago district, \$57.70; Atlantic seaboard, \$60.

Dead - Burned—\$38 per net ton, Chewelah, Wash.; \$58@64, Chester, Pa. Austrian grade, \$55@60 per ton, f.o.b. Baltimore. (Magnesite brick—See Refractories.)

Mica—India block mica, slightly stained, per lb.: No. 6, 35c.; No. 5, \$1.20; No. 4, \$2.50@3; No. 3, \$3.50@4; No. 2, \$4.50@6; No. 1, \$5.50@6.50. Clear block: No. 6, 50c.; No. 5, \$1.75; No. 4, \$3.25; No. 3, \$5; No. 2, \$6.50; No. 1, \$8; A1, \$6.50@8.50; extra large, \$25; ground, wallpaper grade, \$90@160 per ton (depending upon quantity); all f.o.b. New York.

Monazite—Minimum of 6 per cent thorium oxide, quoted \$30 per unit, duty paid.

Phosphate Rock—Domestic demand weak; movements of stocks into consuming channels reported slow. Per long ton, Florida ports: 77 per cent tricalcium phosphate, \$12; 75 per cent, \$11.50; 75@74 per cent, \$11; 70 per cent, \$8.35; 68 per cent, \$7.85; 68@66 per cent, \$7.60.

Pumice Stone—Imported, lump, 4@50c. per lb.; domestic lump, 6c.; ground, 4@7c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 16c., c.i.f. Atlantic seaport; furnace size, 16½c.; Spanish lump, 14@15c.; domestic fines, f.o.b. mines, Georgia, 12@14c.

Quartz—(Acid tower) fist to head, \$10; 1½ to 2 in., \$14; rice, \$17; all net ton, f.o.b. Baltimore; lump, carload lots, \$5@7.50 net ton, f.o.b. North Carolina mines.

Sulphur—\$18 per ton for domestic; \$18@20 for export, f.o.b. Texas and Louisiana mines. Market quiet.

Talc—Paper making, \$11@20 per ton; roofing grades, \$8.50@13; rubber grades, \$11@18; all f.o.b. Vermont. California talc, \$18@40, talcum powder grade. Southern talc, powdered, carload lots, \$10@14 per ton; less than carload, \$25, f.o.b. cars; freight to New York \$5.25 per ton, carload lots; less than carload lots, \$9.25. Imported, \$35@40; Canadian, \$20@40 per ton.

Mineral Products

Arsenic—White arsenic, 8@9c. per lb. in carload lots. Decline due to a further falling off in demand for arsenical products for use in agricultural work. Market quiet and dull.

Sodium Nitrate—\$2.75@2.80 per cwt. ex vessel, Atlantic ports. Market quiet.

Sodium Sulphate—For 95 per cent material, \$20 per ton, f.o.b. mines, Idaho and Arizona, spot and six months' contract; \$30 per ton, New York.

Potassium Sulphate—Domestic, \$220@230 per net ton, basis 90 per cent, f.o.b. New York.

Ferro Alloys

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

Ferrocromium—Per lb., \$12@15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 15c. per lb. of chromium contained; 4 to 6 per cent carbon, 14½c., f.o.b. works.

Ferromanganese—Domestic 76 to 80 per cent, \$90@95, f.o.b. furnace; resale, \$90, delivered; English, \$90@95, c.i.f. Atlantic seaports. Spiegeleisen, 18@20 per cent, \$30, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, \$2.50 per lb. of contained metal, f.o.b. works.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, \$55@60; 50 per cent, \$85@90; 75 per cent, \$145@150.

Ferrotungsten—Domestic, 70 to 80 per cent W, 50@55c. per lb. of contained tungsten, f.o.b. works. Foreign, 60c.

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

Ferrovandium—Basis 30 to 40 per cent, \$5 per lb. of V contained, plus 75c.@2 differentials and according to silicon content, f.o.b. works.

Metal Products

Copper Sheets—Current New York list price, 20½@20¾c. per lb.; wire, 14.50@15c.

Lead Sheets—Full lead sheets, 8c.; cut lead sheets, 8½c. in quantity, mill lots.

Nickel Silver—33½c. per lb. for 18 per cent nickel.

Yellow Metal—Dimension sheets, 18½c.; sheathing, 17½c.; rods, ¾ to 3 in., 15½c.

Zinc Sheets—\$11 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 10c. per lb.

Refractories

Bauxite Brick—56 per cent alumina, \$160 per 1,000, f.o.b. Pittsburgh.

Chrome Cement—40@45 per cent Cr₂O₃, \$45@50 per net ton, and \$55 in sacks, carload lots, f.o.b. eastern shipping points.

Chrome Brick—Straights, \$80 per net ton, shipping point; arches, keys, wedges, \$85; splits, soaps, \$100.

Fire Brick—First quality, 9-in. shapes, \$55@60 per 1,000, Pennsylvania, Ohio and Kentucky. Second quality, \$45@50.

Magnesite Brick—9-in. straights, \$90@100 per net ton; 9-in. arches, wedges and keys, \$105; soaps and splits, \$120.

Silica Brick—9-in., per 1,000: \$45@55 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, March 22, 1921

Production of steel on the part of the Steel Corporation has been decreasing more sharply, but the decrease has farther to go, being still well above the rate of the independents.

As was the situation in the review a week ago, sheets show the only marked decline among the prominent finished-steel products. Black sheets can now be had in single carloads at 3.85c. and galvanized at 5c., and in one transaction, involving heavy gages, a base price of 4.75c. was done on galvanized. Bars remain at 2c. and shapes and plates at 2.10c., one or two mills taking single carloads.

The demand for steel products has made a slight further gain, chiefly in releases on orders previously suspended.

Pig Iron—The first important inquiry for basic pig iron for some time has just developed, there being three lots in the market, aggregating 5,000 tons. The merchant furnaces are firm at their previous quotation of \$25, Valley, and it now seems improbable that steel works will try to take the business, and some may go to middlemen with some speculative iron. Bessemer remains nominal at \$27, and foundry is quotable still at \$26, with light demand.

Semi-finished Steel—Sheet bars quoted at \$38, or \$2 decline, without takers. Billets nominal at the same price.

Coke

Connellsville—Furnace, \$4.50@5.00; foundry, \$5.50@6.00.

World's Zinc Industry Depressed

Germany's Production of Cheap Zinc Under Present Light Consumption Prevents Rise—
Belgium Unable To Compete in Quiet World Market — United States
Production Heavily Curtailed—Zinc Should Recover Quickly

THE KEY TO THE DEPRESSION in the zinc market is the apparent ability of one country, Germany, to outsell the world. All other important zinc-producing countries, in particular Belgium, the United States, and Australia, are not meeting the low prices at which Germany is offering zinc abroad. As a result of this situation, the entire zinc market of the world is in an unhappy position. Almost every zinc-producing country is disposing of its output, in whole or in part, at prices almost universally below the cost of production, and the United States zinc industry especially is feeling acutely the effect of European competition. Production has been curtailed from month to month in an effort to meet the situation, but without any result in stimulating the domestic market. Importations are continually threatening the market, regardless, seemingly, of how low it drops.

Primarily, German competition in zinc at low prices is possible because of the low value of the mark, and trading is being pushed to the limit by the Germans in an undoubted effort not only to regain some measure of the hold exercised upon the world's zinc trade before the war, but also to convert a valuable domestic resource into much-needed cash. Of course, the low value of the mark alone does not allow of cut-throat competition. It is only because of the fact that labor and fuel costs are paid in depreciated paper currency at a rate far lower than the equivalent in any other important competing country that Germany can underbid other zinc producers.

Belgium's Unfavorable Position

The resultant disorganization in the world's zinc markets has left Belgium and Australia in peculiar positions. The Belgian producers are holding their zinc output, which is almost entirely smelted from Australian concentrates, at a price of about £34 per long ton, which is more than 30 per cent higher than the present London quotations for spot zinc, and it is reported that they have succeeded in obtaining a loan on their stocks. Belgian zinc-smelting companies have contracted to take deliveries of Australian concentrate at prices equivalent to about \$9½ per ton laid down at Antwerp. These contracts were made at a time when zinc was selling for much higher prices and when Belgium had begun to make determined efforts to regain her position in the zinc industry. The eagerness of the Belgian operators to book shipping from Australia (Port Pirie) incidentally has kept the freight rates between the two points at a high level. Belgium cannot profitably produce zinc under present prices of concentrates and market conditions.

German zinc production is not large, possibly a third as much as the monthly production of the United States, but it is sufficient under the present state of affairs and the demoralized markets to cut a big figure in cheaply supplying a good part of the world's light requirements. Germany is relying entirely on her own resources in producing zinc, as the supply of Australian concentrates normally furnished the country has been entirely cut off. Although the result of the recent Upper Silesian plebiscite has not been definitely announced, it seems to insure German retention of the rich and favorably located zinc deposits in the province and to strengthen Germany's importance as a zinc producer.

That Germany is making a strong bid for her former share of Broken Hill concentrates seems evident from present market tactics and from advices abroad, where the impression is prevalent that inasmuch as Australia is denying the German zinc industry a supply of concentrates, Germany is doing and will do everything in her power to depress the zinc industry of that continent. The great

advantage possessed by Germany in carrying out this policy is the low foreign exchange value of the mark. Desirable as it may be to solve the perplexing problem of exchange and to introduce some measure of stabilization, it matters little to Germany how low present exchanges are so long as they do not fluctuate greatly.

Zinc Prices Respond to Political Situation

The inability of the Allies and Germany to reach an agreement over reparations, and the steps consequently taken by the Allied countries to enforce penalties, have resulted in stiffening the price of zinc, and arresting a decline that has been proceeding for months. However, it is noticeable that the London spot quotation for zinc was influenced more than was that for futures, indicating that the London market discounts the duration of the present situation and that there is little reason for becoming over-optimistic regarding the duration and effect of the present political conditions with respect to zinc.

The pre-war London average price of zinc was about \$24. For many years it averaged annually below this price and for a few above it. The price today varies around \$25, somewhat above the pre-war average, although it had been quoted lower earlier in March. London zinc quotations generally show a thorough deflation to the pre-war level, and American quotations are below this level. It must not be forgotten that practically the entire world calculates, internationally, on the basis of the pound sterling, despite the strong attempt made by American financial interests to introduce the stable United States dollar in foreign trade settlements, and hence, although zinc in the United States is considered to have dropped much below its pre-war price, the extent of the deflation in other countries, particularly in London, may still be considered as not having progressed the same distance. This is not meant as an inference that zinc will go lower, but to serve as a reminder that worldwide deflation seemingly has no definite level.

The absence of a real consuming demand all over the world serves to keep the zinc market in its present condition. In the United States little zinc is being consumed compared with the normal demand, so that with the great decrease in production any sudden increase in consuming demand would probably be difficult to meet with domestic supplies alone. Zinc is in a good statistical position and should be one of the first metals to recover. Stocks on hand at the beginning of 1921 are estimated by the U. S. Geological Survey at about 71,000 tons, or more than two months' consumption based upon the 1920 record. The present low production should be of material assistance in making inroads in this surplus.

It is out of the question for the domestic market to rise under the influence that European zinc conditions now exert over the world's market. Although the United States produces the greatest proportion of the world's zinc, prices are controlled by minority outputs. Sentiment abroad, particularly in Belgium, seems to center around the possibility of large quantities of zinc being required in the upbuilding of the devastated area in France. The Belgian producer would like to have the price of zinc somewhat nearer cost of production, and loses sight of the fact that present costs of production have little to do with the marketing of any product, agricultural or mineral, the world over.

American producers will undoubtedly seek a higher tariff as a solution to their difficulties, but they should not lose sight of the fact that the tariff alone is not a complete cure, as their own industry is linked closely to the general prosperity in this country, to the steel trade, paint trade, building construction, and other activities no one of which is in a happy or satisfactory position.

COMPANY REPORTS

American Smelting & Refining Co. Reports Improvement

The annual report of the American Smelting & Refining Co. for the year 1920 states that the net income amounted to \$6,674,778, after deducting all charges, depreciation, and Federal taxes, compared with \$5,595,584 for 1919. Consolidated general income and loss sheet follows:

	Year Ended Dec. 31, 1920	Year Ended Dec. 31, 1919
Total net earnings of operating properties..	\$14,175,693.44	\$13,386,253.49
Other income—net:		
Interest, rents, dividends, commission, etc..	1,572,021.83	1,309,489.44
Gross income.....	\$15,747,715.27	\$14,695,742.93
Administrative expenses.....	1,166,340.87	932,693.24
Research and examination expenses.....	312,295.87	83,758.95
Corporate taxes (including estimated Federal taxes).....	979,458.96	814,275.82
Interest on 5% first mort. bonds outstanding..	1,592,834.94	1,605,949.16
Interest on Rosita Coal & Coke Co., 6% collateral trust bonds outstanding.....	71,135.00	11,414.22
Depreciation.....	3,500,244.69	3,514,097.90
Ore depletion.....	964,983.64	1,687,881.99
Miscellaneous profit and loss adjustments.....	485,642.60	450,087.08
Total charges.....	\$9,072,936.57	\$9,100,158.36
Net income for the year.....	\$6,674,778.70	\$5,595,584.57
Less dividends:		
Total preferred stocks.....	\$4,222,137.25	\$4,241,322.25
Total dividends.....	6,662,057.25	6,681,242.25
Profit and loss surplus at beginning of year.....	\$25,974,571.20	\$27,060,288.88
Profit and loss surplus at end of year.....	\$25,987,292.65	\$25,974,571.20

A table of production and receipts from sales of metal follows:

	Production	
	1920	1919
Gold, oz.....	1,849,048	2,190,041
Silver, oz.....	77,732,911	78,200,298
Platinum and palladium, oz.....	936	1,824
Lead, tons.....	205,249	208,439
Copper, lb.....	590,850,000	705,676,000
Zinc, lb.....	44,106,253	33,375,301
Nickel, lb.....	375,167	662,637
Tin, lb.....	18,511,160	15,340,000
Sulphuric acid, lb.....	51,688,000	40,362,000
Arsenic, lb.....	17,695,266	9,359,541
Copper sulphate, lb.....	3,618,172	3,675,499
Byproduct metals, lb.....	1,549,426	884,438
Sulphur dioxide, lb.....	8,154,734	4,988,000

During 1920 the companies underwent the same general experience as did practically all other industrial companies engaged in business in the United States. The earlier part was quite satisfactory, but the latter part of the year was one of declining business and consequent lessened profits. Nonetheless, the entire year shows a surplus of \$12,721 over and above all fixed charges, including the preferred dividends and a 4 per cent dividend upon the common stock of the smelting company. This compares with a deficit in the year 1919 of \$1,085,657.

Hecla Mining Co. Makes Large Payments

Lead; Idaho

A report of operations of the Hecla Mining Co. for the calendar year 1920 states that 33,717,468 lb. of lead and 924,179 oz. of silver were produced from 264,093 tons of ore mined or shipped. Net income from ore sales, interest, and rents amounted to \$2,573,840.08. Expenditures covering mine development, mining, milling, and miscellaneous expenses totaled \$1,285,882.56. Reserves for depreciation were \$99,891.41. Net profit was \$1,188,066.11, from which dividends amounting to \$650,000, and taxes (\$303,137.37) and litigation settlements (\$450,000) were paid, together with surplus debits of \$5,367.54 a total of \$1,408,504.91. The sum of \$220,438.80 was drawn from surplus account of Dec. 31, 1919, amounting to \$2,235,024.74, leaving a surplus on Dec. 31, 1920, of \$2,014,585.94.

Shattuck Arizona Copper Co. Ceases Productive Operations

A report of the Shattuck Arizona Copper Co. for the year 1920 states that productive operations were stopped on Oct. 29, 1920, owing to the heavy loss on sales of copper. There was produced during the year, 2,374,148 lb. copper, 8,279,678 lb. lead, 401,626 oz. silver, and 4,971 oz. gold. Net operating cost amounted to 23.524c. per lb. of copper and 5.394c. per lb. of lead milled. The average price received for copper was 18.257c. per lb. and for lead 8.182c. per lb. Sales of copper amounted to 4,318,386 lb., which included some unsold copper carried over from 1919. Income account follows:

Gross value of production.....	\$1,529,669.89	
Interest.....	49,944.55	
Miscellaneous receipts.....	7,309.27	
Gross income.....		\$1,582,923.71
Mining and development work, refining and marketing.....	\$1,557,565.67	
General administrative expense and taxes.....	52,306.02	1,609,871.69
Loss.....		\$26,947.98
Reserved for depletion of mine.....	\$99,765.55	
Reserved for depreciation of plants and equipment.....	112,401.64	212,167.19
Net loss for year, carried to surplus.....		\$239,115.17
Surplus Account		
Balance, Dec. 31, 1919.....	\$557,670.78	
Deduct net loss for year 1920.....	239,115.17	
Balance, Dec. 31, 1920.....		\$318,555.61

Goldfield Consolidated Mines Co.'s Surplus Decreases

Gold; Nevada

The fourteenth annual report of the Goldfield Consolidated Mines Co. for the year ended Dec. 31, 1920, states that during that year the entire property was held under lease by the Goldfield Development Co., which performed considerable underground work and mill repairs, in preparation for milling low-grade ores on a large scale. It began operating the mill during the latter part of the year, but, owing to high costs and low grade of the ore, the attempt proved unprofitable, and, accordingly, the development company relinquished the lease at the close of the year.

The receipts for the year to the Goldfield Consolidated company on account of royalties and rentals were \$20,411, and the expense in this connection was \$5,207. Sales of surplus equipment and stores totaled \$57,963, and the cost of dismantling and hauling was \$10,525. From these sources the total net receipts were \$62,641. Profit-and-loss account is as follows:

Earnings		Expenses and Losses	
Rentals.....	\$11,215.00	Goldfield operating expense.....	\$5,207.00
Royalty.....	9,196.25	General expenses.....	8,255.17
Interest.....	9,155.74	Taxes—state, county and Federal.....	3,841.61
Sale of junk.....	1,514.45	Exploration.....	1,592.82
Miscellaneous receipts.....	2,373.90	Uncollectable accounts	1,835.56
Total earnings.....	\$33,455.34	Depreciation of buildings and equipment	211,081.79
Reduction of surplus....	214,875.78	Depletion of ores.....	14,093.73
		Loss on securities sold.	2,423.44
	\$248,331.12		\$248,331.12
Surplus Account			
Surplus Dec. 31, 1919.....		\$898,099.83	
Reduction as above.....		214,875.78	
Balance.....		\$683,224.05	
Distribution of 3,559,148 shares of Goldfield Deep Mines Co. stock carried at book value of.....		55,428.10	
Surplus Dec. 31, 1920.....		\$627,795.95	

