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Excavating for Thickener Tanks

At the New Cyanide Plant of The South American Development Co.
in the District of Zaruma, Ecuador

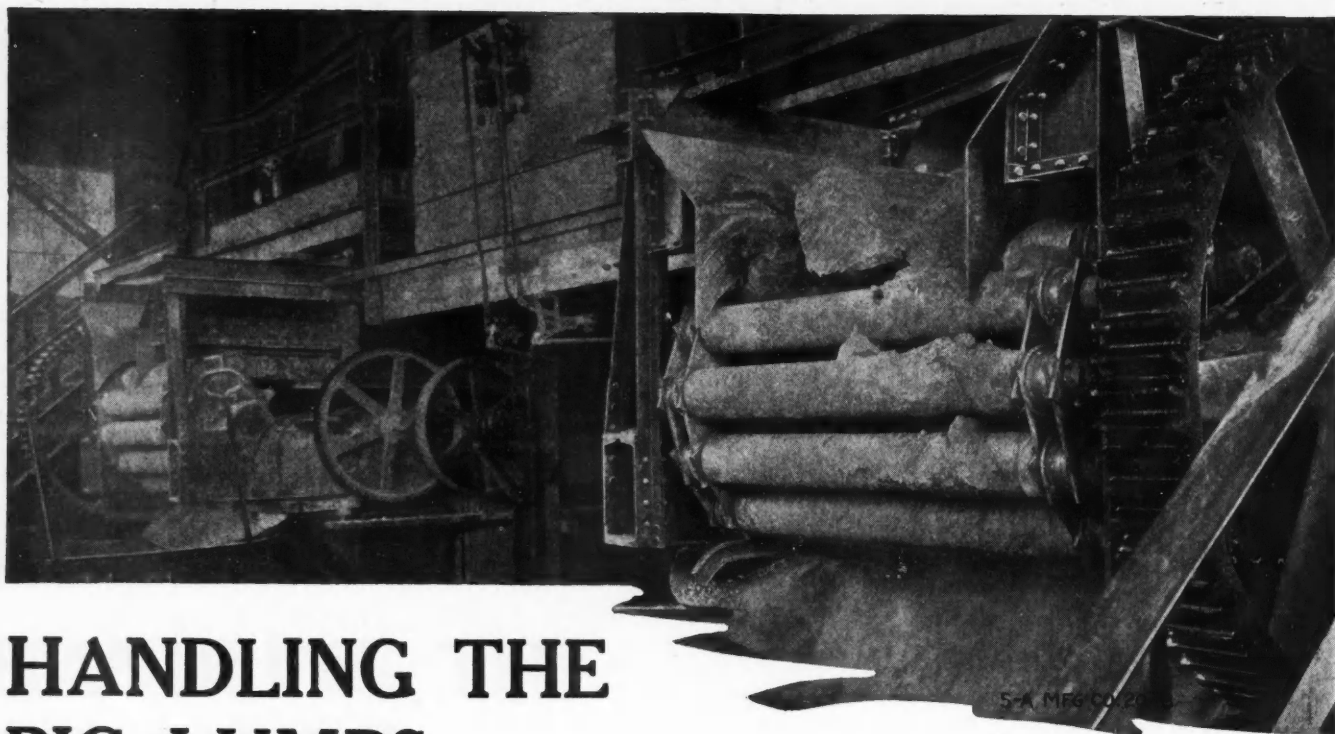
The Construction and Operation of a Cyanide Plant in Ecuador

By Paul C. Schraps

Tunnel Driving in War and Peace

By Harry A. Lee

Biographical Sketch of HON. A. B. FALL, Secretary of the Interior



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Number 14

Taxation and the Mining Industry

TAXATION AND WAR go together: but taxation is with us the longer. Whether we lose or win, we lose; and when the ardor of fighting is long past, we must settle down to the payment for shot and shell, for scrapped airplanes and condemned uniforms; to the payment of what was grabbed by the owners of "war babies" who grew rich, and by the war claimant who bursts with indignation at a government which lets him lose money.

Under what claim shall we get a remission of our heavy war taxes, and thus be protected by our beneficent Government against the grief of war? There is, alas, no relief—taxes and death, as we believe Franklin once observed, are two things which we cannot go to Congress to have remitted. Nature exacts the one and the Government the other.

There is, however, science and efficiency in war making, and also in tax collecting. We did not get down to efficiency and economy in the carrying on of the war. We had no time, and our Government had forbidden preparation, or even the thought of preparation, lest we should offend the Germans. But there is nothing to prevent our applying our brains promptly to the taxation problem. It is in large part a cold-blooded, unsentimental problem, and we shall have it with us a long time—long after we have almost forgotten that we paid so much of the bills of the war, and that then our European and Asiatic friends divided up the spoils among themselves and threw us the advice that if we had no more money for them we had better go on home and mind our own business.

The debts and the running expenses of the Government must be paid; and we must provide money for the process. We shall attack the problem firmly, and every individual and corporation will cheerfully pay its fair share. The mining industry will gladly support the burden in proportion to its importance. We shall cut down our mining profits to build battleships; but we shall build none by shutting the mines down. That is the great danger from the Government side—the killing of the goose that lays the golden egg of taxes—and this is not an academic danger, for it is one of the great factors which are responsible for many closed mines today, and for the lack of enthusiasm about reopening them.

The Government will derive the maximum revenue from a policy and from methods of taxation which will enable a maximum prosperity in the mining business. In other words, the interests of the taxing Government and the taxed industry are identical, and, therefore, there should be mutual eagerness to work together toward the common end.

We are new also at this taxation game—but we can learn. Individually and as individual corporations, we

find taxation annoying. The income and excess-profits taxes are annoying, and sometimes we question their equity. Certainly, they create classes, on whom the burdens of government are loaded. In olden days, you will remember—and not so very long ago—the theory was to tax the poor so that the rich might enjoy life. Indeed, that was the way the rich became rich in those days. Now the process is reversed, and the theory is to tax the rich so that the poor may benefit. Either way erects a special class and militates against the ideal democracy: but there is something about the last-named that appeals to the sporting instincts even of the wealthy, who may well have had some Robin Hood in their ancestry.

So be thankful when you dig up for your income or your excess-profits tax; and get your compensation out of swelling up a little, as you reflect that you are paying the bills. Nevertheless, apart from sentiment, the whole system, and especially that part which applies to excess-profits tax, is on trial, and for sober business reasons: is not such a system destructive of the prosperity of the tax-collecting business? It is all very well to tax wealth, but to tax initiative is another thing.

Mining engineers are taking a deep interest in this most important factor in their industry. The mining industry must be encouraged, and tax laws and their application must keep this in view as the prime consideration. Afterward, the problem must be to tax equitably, and evenly—and simply.

The principles of mining are not difficult to those who know; and methods of taxation which keep every one guessing, and leave the problem where it is only dimly grasped by accountants and lawyers, and quite unintelligible to every one else, constitute an all-round loss and a wet blanket on all concerned.

Secondary Enrichment: Its Use And Abuse

THE MOST HARMLESS and conservative geological conception, when it becomes fashionable and the fad, is forced into positions of which its sober sponsors never dreamed. Such a phantasm was the "true fissure vein," which was held in the reports of engineers, and in the prospectuses of promoters, to represent the last word in stability and persistency. "This has been pronounced by geologists," the report would run, "a true fissure vein, which means that it can be mined as deeply as the art of man can devise methods for extraction." No fear, then, of the ore petering out.

Well, the "true fissure vein" has become rather unfashionable: too many ore shoots, in veins, fissure veins, and otherwise, have been bottomed; even the popular conception of the geology of a vein demands something a shade more complex, a thought more refined.

Such a conception was supplied by the coterie of geologists who, some years ago, came out with a more or less simultaneous boost for "secondary enrichment," showing how the downward action of surface waters may transform a lean copper ore, in a limited superficial zone, to a rich one. Since then the fertile idea has sprouted and run wild; and in the minds of the amateur geologist (and the operating engineer is often such) it explains satisfactorily all of the variations of ore deposition, which militate against the uniformity implied of yore by the "true fissure vein."

Not only copper but all the other metals indiscriminately are brought under this law. Does an orebody peter out in depth? The explanation is "secondary enrichment." On the other hand, does it go down? The reason is "secondary enrichment." If it peters out and gives way to barren vein below, go still deeper, and look for the "secondary enrichment." In the California gold mines, it has been found in some cases that after the orebodies in the first thousand feet or two have been worked out, still deeper work may develop new orebodies. The explanation? Why, "secondary enrichment." Ah, secondary enrichment! How many crimes have been committed in thy name! Thou and the "true fissure vein" and the "good hanging wall" and the "favorable f'mation" and the "porfry dike," and the "contact"!

A case of true secondary enrichment is like a case of typhoid; if you diagnose it correctly and promptly you know how to treat it, and the knowledge is worth while: on the other hand, if what ails you is dyspepsia, or its geological equivalent, the sooner you find that out the better for your bank account. And the way to find out is to consult a real doctor, and not listen to the wise dictum of the quack.

Advertising Propaganda And Scientific Discussion

OUR scientific and engineering societies owe it to their members to exert some degree of censorship on the papers which are presented at their meetings. The opportunity is a most attractive one for interested people to push their own machinery or processes, and unless considerable care is exercised things may be said and statements be published which might better be confined to a catalog. The American Institute of Mining and Metallurgical Engineers had experience of this kind several years ago when the ball-mill controversy received much more attention than should have been accorded to it. Some other technical groups have yet to profit by the Institute's experience.

We are led to comment on this subject by a paper which was read at the Montreal meeting of the Canadian Institute of Mining and Metallurgy. This paper dealt with a certain kind of alloy steel castings; it was presented by a representative of the company which specializes in such castings; and its general tone was that of advertising propaganda rather than a technical discussion of the subject. One would think that castings of the kind described should displace all other kinds in all of the highly diversified applications which were mentioned and illustrated by lantern slides. No discussion whatever followed the paper, but we venture to say it was not because counter arguments could not have been made by many of those present. We think the members showed their good sense by refusing to comment.

It is not to be denied that papers of this kind have a certain value and can be made interesting and informative, as was the paper in question. We do think, though, that they should be presented frankly for what they are, and should not be subsequently incorporated into the proceedings, thereby making the society responsible in a way for the opinions expressed. Advertising is certainly not colorless these days, and often we read the back pages of a magazine before turning to the "reading matter." But it belongs on the back pages, and we do not relish it so much when it is promiscuously mixed with the text.

Technical societies should require that papers be submitted for examination before presentation to their members, for thereby much outright propaganda can be toned down or excluded, as seems advisable. Some nice points will undoubtedly arise, but the matter is one of too much importance to be allowed to go unnoticed.

Proposed Changes in California Industrial Compensation Laws

AN ATTEMPT IS BEING MADE at the present session of the Legislature of California to recodify and amend the Workmen's Compensation Act of California, which has been in operation since 1917 and which has reached a condition of equilibrium such that it may be said to be operating with a fair degree of satisfaction. Most of the dubious points have been cleared up by interpretation of the courts, and the administration of the existing law appear to be going along smoothly. We understand that the proposed legislation embodied in Senate bill No. 259, otherwise known as the Jones bill, was initiated by the California State Industrial Accident Commission, which is charged with the administration of the existing law. It is a fact, we are informed, that the existing law is one of the most liberal in operation in the United States.

We are thoroughly in accord with the objectives of compensation laws generally, and believe that they have been productive of much good. They are in spirit equitable, and have been generally well administered.

We have examined the proposed Jones law, and find it voluminous and complex. It attempts to be specific, and then allows unreasonable discretionary powers to the Industrial Accident Commission. It increases compensation allowances, despite the fact that existing allowances are exceedingly liberal as compared with those of other states. It provides for guarantees by employers and insurance carriers, and then proposes that they shall pay death-benefit payments to the commission, to constitute a "death-benefit fund," to be administered by itself. It allows an almost indefinite time to elapse before a given case can be closed. It throws the burden of proof upon the employer in cases of alleged injury. It places a 2 per cent assessment upon the workmen's compensation insurance premium, payable by the employer, of which 60 per cent is to go to the accident-prevention fund and 40 per cent to the industrial rehabilitation fund.

Apart from many other considerations, the increased expense to industry generally in California is estimated to be 30 per cent of the existing cost for compensation. The mining industry of California is passing through a lean period. It will probably be hit harder by the increase in compensation than other

industries. At a time when it is gradually getting on its feet, we feel that additional burdens by legislative enactment might well be spared. We also feel that the commission, in initiating this new legislation, has not given the industrial side of the case due consideration, and does not appreciate what "working in the red" means to industry. We commend its humanitarian viewpoint, but we question its practicability.

Hearty co-operation of employers and companies cannot be expected unless the commission fairly considers both sides, and is as solicitous of the welfare of industry as it is of the welfare of its workers.

Trade With Russia

WE REJOICE that Hoover, in a newspaper interview, has declared himself against opening diplomatic trade relations with Soviet Russia. We approve all the more this frank expression of opinion, as it comes so quickly on the bid for trade by Lloyd George, and the reopening of trade relations between England and Russia. Yet the views of Hoover are more eminently practical than sentimental, and directed to the pragmatists. "What is there to trade for?" he asks pertinently. "Soviet Russia has neither raw materials nor manufactures. There is nothing but a 'parcel' of gold and platinum, which the present holders have obtained by cutting the throats of the original holders. We would derive no economic benefit from holding this dirty gold; nor would the condition of Russia be alleviated by our shipping her sundry supplies. Therefore, Russia's only recovery, her only regeneration, must come from within."

A wise, simple, and true word. Why, then, has England "reopened trade"? For various and political reasons, which do not apply to us. England has a lower labor stratum which looks on revolution and anarchy kindly, and will be appeased by England stretching a pseudo-friendly hand to the bloodiest of dictators, who sits in the ruins of what the Czars had built. We have no such important stratum, which is a natural antithesis to a persistent aristocracy. Then England would make friendly gestures, to relieve the pressure of Russian conquest on some of her far-flung outposts of empire—a pressure that she does not well know how to support by force of arms. She would also like from Russia a little oil; in fact, a little breathing space, and to "stand in" as first and next friend, on any division of property. In all of these things we either are not interested or prefer to express our problem straight out and as it stands, as our State Department has done to England and France regarding the "partition of petroleum" in Mesopotamia.

We moderns, who assume all too swiftly that we live in new days, and that the precepts of our earlier statesmen, well enough in their day, do not apply in our generation, are perceiving with astonishment that Washington, who counseled keeping clear from entanglement in European affairs, is perhaps not so much out of date. There have been a lot of things in our day, like government operation of railroads and especially the League of Nations, which appealed to our reason at once as thoroughly desirable. But we reckoned in part without making due allowances for the weaknesses of human nature; and when partial government railroad operation took place during the war, we were grieved at the inefficiency and the rapacity which made things worse than before.

Similarly, as we view the European and the Asiatic nations at close quarters, in the light of being associated with them in a closely controlled World-Government, we perceive that they are wedded to ideals and methods which are repugnant to us and injurious to what we believe to be our best growth; and we see more and more clearly the dangers we have escaped at the hands of the most maladroit American statesman in our history.

It Speaks for Itself

WE HAVE RECEIVED from the Tri-Hemisphere Brokerage & Trading Co., of Seligman, Ariz., an article entitled "Big Power Project May Electrify Santa Fé" and describing a proposed hydro-electric development in Mojave County, Ariz., for which publication was asked. Excerpts from this article follow:

Application for a mammoth water-power development on the Colorado River in Mojave County, Ariz., which producing 480,000 hp., will make possible electrification of 500 miles of the Atchison, Topeka & Santa Fé R.R., and irrigation of approximately 500,000 acres of land, has been filed with the Federal Power Commission by E. L. Beyard, of Seligman, Ariz.

Backed by Kansas City and Philadelphia financiers in a corporation capitalized for \$6,000,000 to start with, and ultimate capitalization of \$60,000,000, Mr. Beyard proposes in his application to construct eight dams, the first of which will be located about twenty-five miles due north of Needles, Cal., and the last of which will be built outside Grand Canyon National Park.

The large group of producing gold and copper mines located at Chloride and Oatman, in the mountains, a short distance from Kingman, Ariz., will be supplied with hydro-electric energy from the first of the eight power plants, each of which, it is estimated, will produce 60,000 hp.

The application filed with the commission states in detail:

"It will be the aim of our company to duplicate approximately 60,000 hp. from sites one or five for the Oatman and Chloride mining district, and, as development progresses, the Atchison, Topeka & Santa Fé R.R. will without doubt start negotiations for the electrifying of two divisions from Seligman, Ariz., to Barstow, Cal.

"Located in the desert a considerable distance from California, the source of crude oil used in locomotives, and a still greater distance from the nearest coal fields, the two divisions mentioned, while almost entirely non-revenue producing, cost it is understood three times as much to operate as any other stretch of track belonging to the Santa Fé. Repeatedly the railroad as well as private interests has endeavored to develop irrigating water in the Hualapai Valley by drilling for artesian wells in a hope of turning its wondrously fertile soil into producing territory, but without success."

Interested in this as something that would benefit the mining industry, we wrote to the main office of the Santa Fé railway at Chicago, and received the following reply:

Your letter of March 8 addressed to Atchison, Topeka & Santa Fé R.R. in regard to possible electrification of some 500 miles of that railway in Arizona—we do not have at the present time any plans looking toward the possible electrification of our lines in that territory or at any other point. So far as a water-power development plant is concerned, we are in no position to advise, as, if one is contemplated from a private source, we have not had negotiations of any sort covering the subject.

A. G. WELLS,
Vice-president.

We are now wondering what makes the Tri-Hemisphere Brokerage & Trading Co. so solicitous about the welfare of the Santa Fé, when the latter does not seem at all concerned.

WHAT OTHERS THINK

The Naica Controversy

I notice on page 320 of the Feb. 12, 1921, issue of *Engineering and Mining Journal*, under the title "The Naica Controversy," an article written by John E. Kelly that I, as a Mexican lawyer and interested in the future of my country, feel bound to rectify.

There is no possible description of the havoc this article, if uncontested, could produce in Mexico. If foreign investors think that companies even so conservative and so well informed in Mexican laws as the American Metal Co. can be made the victims of legal chicanery; if, after more than twenty years of quiet possession, the shareholders of a Mexican company are still subject to a claim based on merely formal defects of an old contract which may destroy their company and divest them of their rights; if the statute of limitations can never bar an action based solely on technical errors; if the voluntary performance of a contract by the parties to it, together with their silence for more than twenty years, does not stop them from bringing an action for the nullification of that contract, brought by the very parties who made it—if such is the law of Mexico, then it would be the death blow to the development of Mexican industries and wealth, either by investors at home or abroad.

Fortunately, that is *not* the law of Mexico, which is based upon all those principles of equity and good judgment of the civil law traditions. On the contrary, it considers the statute of limitations a base of social order and a principle of public policy. For mining enterprises all actions, without any exceptions, are barred after ten years, unless the law provides for a shorter period. For corporate matters that period is five years, and in commercial transactions the statute of limitations runs against minors as against persons of age.

In this unfortunate case of Naica, the Mexican courts, misconstruing our law, have based their decision on the opinion of French authors; but the French law, at variance with ours, provided, at the time those opinions were given, that actions of nullity of a corporation were never barred by limitation when based upon defects of the original charter. This French law was since changed and now limits such action to ten years. Lyon Caen, the most famous commentator of that law, explaining the amendment, states: "It would be ruinous to have the action of nullity subsisting in perpetuity." The Mexican courts ignored this comment, which explains our own law.

Mr. Kelly apparently intended to be neutral, but undoubtedly he was misinformed in many substantial points. He thus says: "The heirs of Santiago Stoppelli are suing the Compañía Minera de Naica, S. A., for the return of the Maravillas mines." Such is not the fact. Saturnino González and the heirs of Stoppelli sued jointly the Naica company for the nullity of a contract of association which González and Stoppelli themselves made in 1896. That contract, in the Mexican law, constitutes the charter of the Naica company. The foundation of the complaint is that the plaintiffs themselves overlooked in the contract to comply with certain legal formalities; and, as a result of their own fault and the

ensuing nullity of the Naica charter, they now demand that the Maravillas mines be returned to both González and the heirs of Stoppelli. The latter did not claim *the whole* property, as they based their claim on the 25 per cent interest of Mr. S. Stoppelli. And the fact that the courts gave the heirs of Stoppelli *all* the mine (more than they demanded) is a juridical heresy unheard of by Mexican lawyers. The complaint also shows that the plaintiffs did *not* claim that Stoppelli "did not sell or transfer his ownership" in the mines, as Mr. Kelly asserts. Not even the courts support that statement.

Mr. Kelly further states: "They (the plaintiffs) quote the *Commercial* code to show that a protest against an action in bad faith may be brought by the interested person or his estate at any time, no matter how long after the action of which the complaint is made." The uninformed reader may think that bad faith on the part of the company was alleged. No charge whatever of bad faith is there in the complaint. It is based solely upon those formal defects in which González and Stoppelli themselves concurred, and the article quoted is from the *Civil Code*, which does not mention actions in bad faith.

In 1904 the executor of the will of Santiago Stoppelli, duly represented by an attorney, brought an action against the Naica company for the payment of dividends on certain shares which had been declared forfeited under the bylaws of the company, thus recognizing the existence and validity of the company. A compromise was made; the estate, acknowledging the legitimacy of the declaration of forfeiture of those shares, waived all rights to raise further questions on the matter, and received in consideration thereof 30,000 pesos. The law of Mexico prohibits attacking the validity of a compromise until the return of the money received in consideration of it is secured. The plaintiffs never gave such guarantee nor brought any action to invalidate the compromise.

Mr. Kelly states: "To this charge the claimants reply that the former suit was brought by María Stoppelli, not by the heirs, as the majority of them were minors in 1905." That is not true. The claimants raised the objection that the executor could not delegate his power to the attorney who acted for the estate in the compromise, and that such attorney exceeded his authority. Whatever the merits of this objection, the fact is that after more than ten years the statute of limitations barred the heirs of Stoppelli, minors included, from attacking such agreement. Its validity was not one of the issues in the suit, and the courts had no jurisdiction to declare the compromise void and overrule the defense based upon it.

It has been necessary to enter into these details to show that the laws of Mexico have been disregarded in many respects; that the courts, for reasons that I do not wish to discuss, have overridden principles heretofore considered as being the base of our social order, have even exceeded the claims of the plaintiffs, and have given one party more than demanded, thus violating the express provision of our codes; have ignored defences based on authentic documents bearing the authority of *res judicata*; have made the fault and negligence of the

plaintiffs in their incorporation of the Naica company the only support of the decision in their favor; and, finally, the courts have decreed an impossibility under the Mexican law, inasmuch as a company which has been declared a nonentity cannot do anything; but they have clothed their decision in impersonal sentences directed against no one, instead of making a direct personal command to the defendant, thus making such decision unenforceable.

It was necessary to enter into these details, because, in the alternative between presenting the courts of Mexico with their full responsibility in this case of Naica, and defending the fairness and equity of our traditional institutions, neither I nor any Mexican could hesitate. The courts reflect the chaos and anarchy which have swept our country. Fortunately they do not make the law, nor even its authentic interpretation, as our institutions are the inheritance of centuries, under which foreigners as well as Mexicans used to find adequate protection. When courts more conscious of their responsibility are established, which I hope will be in the near future, the world may know that Mexico deserves both economic credit and moral respect.

I am not associated in any way with the American Metal Co. nor with the Compañía Minera de Naica, but being familiar with the facts in this case deem it my duty and privilege as a Mexican lawyer to call your attention to the errors in Mr. Kelly's article, as I feel confident that my country can best be served by pointing out the errors of its administrators, so that they can be corrected, thereby justifying our confidence in her inherent justice to all men.

New York.

RAFAEL MARTINEZ CARRILLO.

Loose Construction in Textbooks

Your editorials on the "Correspondence School Mining Engineer" have brought to my mind an idea that I believe would be of considerable help in the proper education of engineers. It is in regard to the proper construction of textbooks. Why is it necessary to have such a great duplication of work along this line? Would it not be possible to publish something besides a compilation of so-called facts, from many sources, with no direct authority back of the publication? Certain state reports on geology are used to a considerable extent as reference works in engineering courses, and in a series of reports, from many states, on one subject about 50 per cent of the material has simply been lifted bodily from the original publication. I wonder if any thought has been given to the great loss of time and money in the use of textbooks that are loosely put together as to facts and grammatical construction, or where a mass of material is presented that has absolutely no value to the future engineer.

The valuable information given below is taken from Government reports and from textbooks:

"In river sands, the grains are angular—in beach sands rounded."

"Mica is obtained in large sheets from Farther India, and is used in the manufacture of lamp chimneys."

"Residual clays may show almost any color, but red and brown are perhaps the commonest. When free from iron oxide or nearly so the material is white, and this variety is termed kaolin."

"Calcite and Iceland Spar are pure crystallized calcium carbonate . . . the former occurs in flat rhombohedrons."

"When sands are cemented by calcite and limonite, they form sandstones and when by silica they form quartzites."

"Kaolin or clay like mica is an orthosilicate."

"Sandstone is composed of sand grains cemented together by clay or by calcium carbonate."

"In assaying, the material carrying the gold is heated with borax and lead in a small crucible (cupel) of bone-ash."

"Cement is made by heating limestone CaCO_3 , clay and sand or a natural rock containing all of them in right proportions."

"The motion (rotary motion of the cement kiln) continually turns over the thin layer and exposes every particle to the heat of the air-blast charged with pulverized coal, burning in the interior."

"Gold mills are always wet stamping."

"When a limestone containing something like 8 to 18 per cent of clay is burned in the ordinary way the product will slake and form a mortar which will set and harden under water and hence is called hydraulic cement. A much better product is made by burning a limestone which contains 20 per cent or more of clay until the carbon-dioxide is driven off. The substance so produced will not slake; but if finely ground and mixed with water will set and harden out of contact with the air. This is known as natural cement. Portland cement is the best hydraulic cement."

It happens that the preceding quotations are from branches of work in which I am directly interested, and I have thought that if I was able to take such statements out of publications that are supposed to be authoritative, perhaps other lines of work might be as badly represented.

ROBERT W. JONES.

West New Brighton, N. Y.

Botany Applied to Mining

The accompanying photograph illustrates a condition in which the lack of vegetation was used as a guide in prospecting and an interesting geological feature.

The marked depression, due to normal faulting, acts as a gutter for the water of the mountain side, and the scrub spruce will not grow in the damp ground of the trough. Prospectors thought the natural clearing was due to rock minerals that would not support vegetation, and hoped to find ore beneath.

The fault is in the mountains northwest of Lillooet,



B. C., near the canyon of Bridge River. From the point at which the picture was taken to the top of the farthest ridge cut by the fault is at least one and a half miles. The trough near the camera station is twelve feet deep. On the far ridge the displacement is fifty feet.

From the camera to beyond the first ridge the fault cuts a granitic rock (Rexmount porphyry). In the far ridge the foot wall is porphyry, and the hanging wall slate. The porphyry is part of the eastern fringe of the coast range; the slate the western border of the interior plateau.

FRED E. NELSON.

Anyox, B. C.

Chloridizing Practice in Sweden

There are a number of interesting points in Mr. Östman's article in *Engineering and Mining Journal* of March 5 under the heading "Chloridizing and Leaching as Practiced in Sweden." It would be quite worth while if Mr. Ramón could be induced to write an article for the *Journal* giving in full the results of his investigations on the theory of chloridizing roasting. The extracts in the article state "The process, in my opinion, depends principally upon gas reactions. . . . It has been proved with a certainty that the mass acts as a contact substance. . . ." It is interesting to note that this is borne out by the fact that the best temperature for the process is close to the temperature found best in practice for making sulphuric acid by the contact method. This fact is also true for sulphatizing roasting, so that it seems probable that the direct conversion (equation 5) as given, $RS + O_2 = RSO_2$, does not take place to any considerable extent.

Some of the mechanical details spoken of in Mr. Östman's article are different from practice in this country, and would appear to have advantages, particularly the method of precipitation. In addition to those mentioned by the author, it would seem that a properly designed drum precipitator would be much less expensive to install and operate than a tank system, due not only to reduction in labor but also to increased speed of precipitation and consequent larger capacity.

It would have been interesting to have a comparison in some detail as to cost and other factors of the method of briquetting and burning as against sintering.

No mention is made of how the cement copper produced is treated. In this country cement copper from chloridizing plants is not looked on with enthusiasm by the refiners, and is not so readily salable nor at so good a price as other forms of copper. A suitable method for treating cement copper in considerable amounts is an important practical problem at present unsolved in this country, and it would be interesting to know if the methods used for this purpose in the installations described differ materially from those in use here.

Los Angeles, Cal.

G. D. VAN ARSDALE.

Answering Mr. Van Arsdale's letter:

1. We beg to refer to the article written by Prof. P. Klason which appeared in the *Mining Magazine*, December, 1918, and which goes at length into the theory of chloridizing roasting.

2. Sintering of the purple ores has been done, and this process has worked out very well. I am, however, unaware of the difference in cost between such sintering, and briquetting and burning.

3. *Treatment of cement copper.* As practiced in Sweden, the cement copper is smelted and refined in a common refining furnace and the final refining is carried out by the Sundberg process. This consists in blowing soda ash, plus pulverized charcoal, into the molten bath at the moment it begins to "throw the worm." The alkali combines with the impurities present and rises to the surface as slag, which is rabbled off. This refining process, however, would not apply for any cement copper containing precious metals.

Electrolysis of the copper solutions has been tried, but with no marked success. There is no doubt that if a suitable electrolytic process can be developed, it will be readily taken up by the European works, as they have trouble in getting a fair return on all such cement copper which contains gold and silver.

Some of the cement copper produced these analyses:

| | | | |
|---|-----------------|----------------------------|-----------------|
| Cu | 65 per cent | Cl | 0.8 per cent |
| Fe, Zn, etc. | 5 to 8 per cent | O | 5 to 7 per cent |
| Ag | 120 oz. | H ₂ O | 10 per cent |
| Na ₂ SO ₄ ·10H ₂ O | 15 per cent | | |

It is obvious that this cement copper can be handled by electrolytic plants only and will be heavily penalized. It may be possible, however, to convert it abroad into blister copper and sell it as such. If the cost of such converting would be less than or equal to the penalty applying to the crude cement copper, it would be an advantage, as the saving in freight on the blister copper would be considerable.

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Costs at Las Dos Estrellas Mill

"Side Lights on the Cyanide Process," by Alfred James, in the *Engineering and Mining Journal* of Jan. 15, 1921, contains a paragraph dealing with present-day milling costs at Dos Estrellas, Mexico. The paragraph states that the total cost during 1919 averaged 3.20 pesos per dry metric ton, but the items composing said paragraph add up to but 2.646 pesos. Obviously some additional information must be forthcoming to give the statement its due importance, and I take pleasure in furnishing a complete cost sheet showing itemized costs in the Dos Estrellas mill during 1919 and 1920.

Year 1919.

Amount of ore treated, 361,878 dry metric tons.
Total milling and treatment costs, 3.203 pesos per ton.

Year 1920.

Amount of ore treated, 366,821 dry metric tons.
Total milling and treatment costs, 3.0506 pesos per ton.

During October, 1920, operations in the mill were suspended for twenty-five days owing to labor troubles.

A perusal of the accompanying statement and comparison with the incomplete figures given in Mr. James' article will be interesting. The economy effected by zinc dust plus Crowe vacuum over zinc thread will be seen to amount to 29 centavos per ton during 1919 and somewhat in excess of this during 1920, but lower first cost of zinc is of course responsible for a small proportion of the reduced costs.

T. SKEWES SAUNDERS.
Minera de Dos Estrellas, Michiacan, Mexico.

COMPANIA MINERA "LAS DOS ESTRELLAS," S. A.
Comparison of Milling and Cyaniding Costs for the Years 1919 and 1920

| | Costs per Ton— | |
|--|-----------------|-----------------|
| | 1919 | 1920 |
| Milling department: | | |
| Superintendence | \$0.0313 | \$0.0340 |
| Handling ore in bins | .0159 | .0377 |
| Gyratory crushers | .0670 | .0520 |
| Conveyor belts | .0613 | .0558 |
| Automatic sampling and weighing | .0057 | .0129 |
| Batteries | .2814 | .2781 |
| Tube mills | .5987 | .2829 |
| Classifiers | .0839 | .1043 |
| Handling of tube-mill rock | .0208 | .0170 |
| Conservation and innovations to plant and buildings | .0229 | .0043 |
| Sampling and assaying | .0129 | .0303 |
| Cyaniding department: | | |
| Superintendence | .0311 | .0348 |
| Thickeners (Dorr) | .0170 | .0144 |
| Agitation | .1301 | .0903 |
| Handling of slimes | .0587 | .0557 |
| Handling of solutions | .0684 | .0721 |
| Handling of water (purchased from an adjacent company) | .1496 | .1462 |
| Clarifiers | .0215 | .0213 |
| Filters (Butters) | .1570 | .1870 |
| Precipitation: | | |
| January to July, 1919, with zinc thread: 220-150 tons at 0.46 centavos per ton | Average | .1417 |
| August to December, 1919, with zinc dust and Crowe vacuum: 146,671 tons at 0.17 centavos per ton | | |
| Smelting | .0879 | .0982 |
| Maintenance of solutions | .7956 | .7619 |
| Experimental work | .0122 | .0244 |
| Conservation of buildings, tanks, and innovations | .0795 | .0495 |
| Sampling and assaying | .0233 | .0256 |
| Recuperation plant | .0141 | .0141 |
| Concentration | .0253 | .1041 |
| Total | \$3.2031 | \$3.0506 |

The Construction and Operation of a Cyanide Plant in Ecuador

Mill of About 280 Tons' Daily Capacity, Treating Ore and Tailings From The Zaruma Mines, Includes Stamps and Tube Mills, Dorr Classifiers and Tanks, Butters Filters, Merrill Apparatus, and Crowe Vacuum Equipment

BY PAUL C. SCHRAPS*

Written for *Engineering and Mining Journal*

THE ZARUMA MINES of the South American Development Co. are situated in the district of Zaruma, Province of El Oro, Ecuador, about forty-six miles by mule trail from the river port of Santa Rosa, which, in turn, is fifteen miles by launch or river steamer from the Pacific port of Puerto Bolivar.

The veins carry gold and silver in the proportion, at present, of about 1 to 3.75 by weight. The higher recovery obtained on the gold, however, leaves the silver relatively unimportant, and operations are conducted on a gold basis. The largest and most important orebodies are situated in a main north-and-south fissure system. Smaller veins connecting at sharp angles with this fissure system also carry ore. The orebodies in the main fissuring have a gangue of quartz and calcite, with some country rock and only a small percentage of sulphides.

The ore from the branch veins has a quartz and country-rock gangue with little or no calcite, and carries a high proportion of pyrite, chalcopryrite, sphalerite, and galena. Both classes of ore carry tetrahedrite, with which the gold and more especially the silver are closely associated. The ore from the main fissuring is much more amenable to treatment, but the presence of the calcite renders it more difficult to settle after fine grinding. Previously the mine produced a higher percentage of the baser ore than it does at present.

REMOTE LOCATION INVOLVES TRANSPORTATION DIFFICULTIES

One of the principal problems met in operating the mine is the inadequate and expensive means of transportation available. Most of the supplies, with the exception of timber, are purchased outside of Ecuador and delivered by ocean steamer to the ports of Guayaquil and Puerto Bolivar. Thence they are transported in small craft to the river port of Santa Rosa, whence they are packed into the property on mules or by men. As previously stated, the mule trail is forty-six miles long and crosses a divide at 6,500 ft. The elevation of the mine is about 2,000 ft. Previously this trail in the rainy season became almost impassable. In the last few years extensive cobblestone paving has transformed it into a reasonably good all-year-round trail.

The net effect of the difficult transportation is to increase the cost of all construction and the cost of supplies for operation. Furthermore, the necessity of sectionalizing all machinery to the lowest possible weight limit increases its cost and reduces its strength.

Previous to the spring of 1919 the ore was treated by a combination of amalgamating and cyanide leaching.

*Mr. Schrap's original manuscript contained much additional matter which we were compelled to omit owing to limitations of space. This included details of excavation and concreting, sand and slime tailing transportation, and construction costs.

The mine product was crushed through 30 mesh and passed over amalgamating plates on which about half of the gold was retained. During 1917 and 1918, when the ore was of unusually good grade, the recovery on the plates was a little under 55 per cent. The tailings from the plates were sluiced to masonry tanks, where, by means of a gooseneck, a rough classification into sand and slimes was made. The sands, which constituted about 75 per cent of the stamp-mill tailings, were leached with cyanide solution, and a further recovery was obtained of nearly 25 per cent of the original contents of the entire tonnage.



GENERAL VIEW OF PLANT BEFORE COMPLETION

Including the extraction by cyanide, the total recorded gold recovery during 1917 and 1918 was just under 80 per cent. These recoveries, however, are based on assays of tailings and product shipped and take no account of loss and theft. The absolute recovery probably was not much more than 75 per cent, even during these periods of extraction of high-grade ore.

During recent years the leached sands have been stored. The gold and silver are not evenly distributed through the storage dump, a considerable concentration having taken place near the discharge of the pump which was used to elevate them. Their value at this point is about \$5 gold, whereas at the extreme margin of the dump it is only about \$1.25. The slime, so-called, from the gooseneck overflows was sluiced and stored below the sand dump. It consisted chiefly of true slime, but contained, also, a fair proportion of very fine sand. The storage of this material was begun before the storage of the sand. The average value of the slime treated to date in the new plant is \$4.72 gold and \$2.06 silver. Concentration also took place to some extent in the storage of this material, but less markedly than in the storage of the sand.

The problem of erecting a more modern and efficient plant was studied for a number of years, and various experiments were conducted to obtain data on settling, concentration, extraction, and complementary operations. The operators desired to treat a larger tonnage and to obtain a higher recovery, and at the same time, by eliminating amalgamation, to reduce the loss by theft. A thorough study indicated that the new installation should be based on the Dorr counter-current decantation system, and the Dorr Company, in 1915, was appointed consulting engineers.

OUTLINE OF DESIGN OF NEW PLANT

The plant as designed included the use of the old stamp-mill crushing equipment, i.e., crushers, bins, grizzlies, batteries, and the like; the alternative of using or discarding the amalgamating plates; regrinding in three tube mills after classification in closed circuit with three Dorr classifiers; thickening in one 12 x 39-ft. Dorr thickener; agitating in four 12 x 28½-ft. Dorr agitators; decanting in five more Dorr thickeners; clarifying, and precipitation by the Merrill zinc-dust method and Crowe vacuum apparatus. In addition, sand- and slime-handling plants were designed and built locally. A further addition was a rectangular masonry sump constructed below the last tank, at the edge of the river. The original design called for a steel-frame building covering the entire new plant. Because of freight congestion on the trail this is still stored at the coast. It will facilitate operations when finally erected. The use of amalgamating plates has been discontinued entirely.

The unsuitability of local lumber led to the decision to use steel superstructures on all the tanks and to build the tanks themselves out of reinforced concrete. Concrete floors have also been laid throughout the plant, so that all solution which may leak or splash is drained either into wells or into a catch-all sump at the bottom of the plant.

About the only available location for the new treatment plant was between the old stamp mill and the Amarillo River, a small but rapid stream flowing by

TABLE I. REINFORCEMENT REQUIRED FOR ONE THICKENER TANK

| | Lin.Ft. | Pounds |
|--|---------|--------------|
| Wall, vertical bars, ½-in. twisted | 2,640 | 1,262 |
| Wall, horizontal bars, ½-in. twisted | 3,450 | 1,649 |
| Floor, bars, ½-in. twisted | 9,445 | 4,515 |
| Wall, horizontal bars, ½-in. twisted | 1,830 | 388 |
| No. 5 triangular mesh fabric (sq.ft. 1,313) | | 442 |
| No. 7 triangular mesh fabric (sq.ft. 1,800) | | 378 |
| Total | | 8,634 |
| Tons | | 4.317 |
| Contract price for placing reinforcement for one tank was | 110.00 | sucre |
| The bars were delivered rolled up, for mule-back transportation. For straightening them contract was as follows: | | |
| Each 10-ft. x ½-in. twisted bar | 0.022 | sucre |

the property. The mortars of the batteries are about 50 ft. above the level of this river, giving a drop ample for all gravity flow required. A power canal, however, was situated near the mill, between it and the river. This canal had to be maintained, as its water furnished the motive power for the mine compressors. It also had to be reconstructed in a more substantial form before even the excavation for the tanks could be begun. This caused a delay of several months in beginning construction operations on the plant proper. The reconstructed power canal was so placed that the tube mills and classifiers could be set between it and the batteries. The rest of the plant was set below the canal.

Shipments of machinery began to arrive in Ecuador in the winter of 1915-16. The plant was put into opera-

tion in April, 1919. The long period of construction was due chiefly to the inadequate system of transportation from the coast, complicated by two very bad rainy seasons, in part to the naturally dilatory spirit of the country, and, finally, to the delay involved in awaiting construction of the concrete power-canal.

DETAILS OF CONCRETE TANK CONSTRUCTION

The method of making the concrete tanks will be of interest to many. Inasmuch as there were to be six thickener tanks, all of one size, and four agitators, also all of one size, wooden forms were made in sections for each size of tank, so that they might be used over again. The outside forms were continuous for the full height of the tank; the inside forms consisted of sections extending for a little over half the height of the tank. The cycle of tank construction consisted in standing, centering, and placing the wall forms, placing the wall and floor reinforcement, pouring the bulk of the floor and the lower half of the walls, raising the inside wall forms after twenty-four hours, pouring the upper half of the walls, and completing the pouring of the floor.

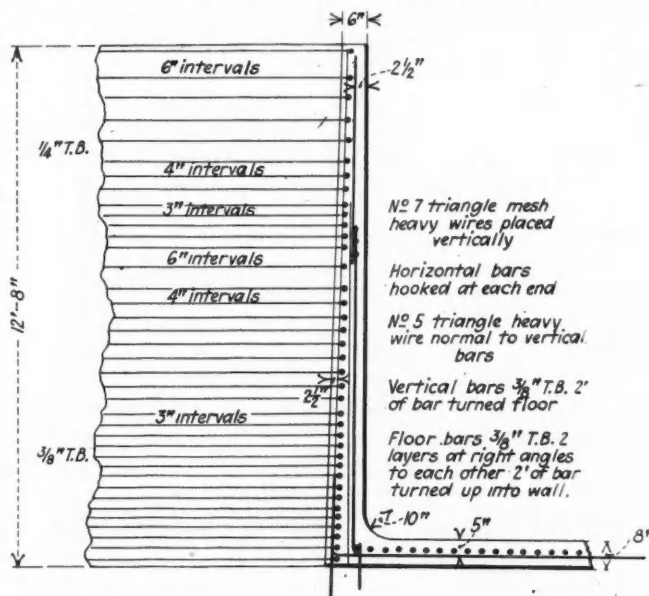
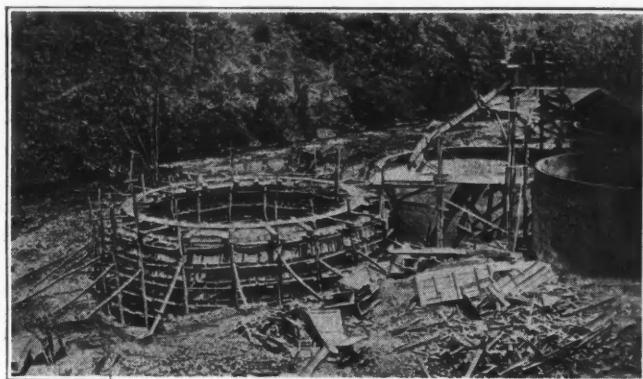


FIG. 1. REINFORCEMENT DETAILS. 39-FT. CONCRETE DECANTER TANK

Vertical Bars: 8 in. c.c. 2 bars tied 5 ft. plus 10 ft. = 15 ft.
 Floor Bars: 4 in. c.c., two layers.
 Horizontal Bars: ½-in. and ¼-in. bars placed in wall spirally.
 No. 5 Triangle Mesh Reinforcement: Tie to vertical bars. Heavy wires placed horizontally. Each width of wire placed as a continuous piece. Place three rows. Overlap, 4 in.
 No. 7 Triangle Mesh Reinforcement: Long wires placed vertically and tied to horizontal bars.

The arrangement of the reinforcement for a thickener is shown in Fig. 1. For the walls it consisted of ½-in. twisted bars 10 ft. long, set vertically on 8-in. centers, 2½ in. from the inside forms, with 2 ft. of each bar turned into the floor of the tank 5 in. below the floor line. To each of these bars was tied a 5-ft. length of ½-in. bar, with a lap of 12 in. reaching to within 8 in. of the top of the tank. No. 5 triangular mesh fabric was then tied to the vertical bars, so that the heavy wire lay circumferentially around the tank. A lap of 4 in. was used in connecting this mesh material, which had a total height of 9 ft. Twisted bars of ½-in. and ¼-in. section were then placed horizontally, as shown. Each of these had a hook in the end, and these and all bars were joined by connecting all these hooks so as to make the horizontal reinforcement as continuous as possible. To the outside of the horizontal bars was tied



FORMS READY FOR POURING CONCRETE

No. 7 triangular mesh with the heavy wire standing vertically.

The $\frac{3}{8}$ -in. twisted bars for the floors were placed on 4-in. centers in two layers at right angles to each other and 5 in. below the finished floor line. Two feet of each bar was turned up into the walls outside of all other reinforcement. No. 18 annealed wire was used for tying the reinforcement.

The only difference between the agitators and the thickeners consisted in a smaller quantity of reinforcement used in the former.

JOINTS AND FINISHING REQUIRED CAREFUL WORK

Considerable care was necessary to make a tight joint between the lower and upper halves of the walls. This was done by removing from the top of the lower half of the first-poured section all the surface concrete that contained laitance and then cutting a groove in the center of the wall 3 in. wide and 3 in. deep. Curved forms were used to make a bevel joint between the bottoms of the walls and the floor. The walls were 10 in. thick at the top of this curve, and were battered on the outside to give a thickness of 6 in. at the top.

In the pouring of the 8-in. floors only the lower 6 in. was poured at first and the last 2 in. was applied after the walls were completed. This arrangement permitted finishing the floors with a skin surface at the same time that the last 2 in. was poured, which was cheaper than pouring the floors originally to their proper thickness and finishing off with cement mortar.

The large quantity of reinforcement in the walls rendered tamping exceedingly difficult, and in consequence the lower halves of the walls on the outside, which were the most difficult to reach with the tamping bars, showed voids when the forms were removed. These had a depth of about 2½ in. extending to the reinforcement from the outside wall. They were patched, and have caused no trouble.

To have the tank walls as impervious as possible, very fine sand screened from the mine material was used to make a rich cement mortar, which was applied with a brush to the walls as rapidly as possible after the forms were removed. If the forms are removed within twenty-four hours, and this paint, made up in small amounts, is applied promptly, it will set with the rest of the concrete and constitute a relatively impervious skin surface. The application of a mortar paint after the concrete has thoroughly dried showed absolutely no beneficial results.

Bolt holes were left in the walls for the overflow launder and the tray supports. Although the tray bolts were specified for 4-in. centers, they were put in on 12-in. centers, and have proved satisfactory.

The units in the new plant as operating, apart from the sand and slime transportation systems, are as follows:

1. Four 10 x 7-in. Fraser & Chalmers sectionalized Blake type crushers.

2. Eight batteries of five 900-lb. stamps each; each battery separately driven; normal drop of stamps, 92 to 100 per minute; height of drop, 6½ in.; screen, 4 mesh.

3. Three 6 x 14-ft. Allis-Chalmers tube mills with Tonopah liners, driven at 28 to 30 r.p.m. through herringbone pinions on a line shaft on which are set two 48-in. double-nozzle pelton wheels; each mill separately clutched.

4. Three 20-ft. duplex Dorr classifiers driven from tube-mill line shaft through countershafting.

5. One 39 x 12-ft. Dorr thickener with one open-type tray driven by a 2-hp. motor.

6. Four 28½ x 12-ft. Dorr agitators; three driven by 2-hp. motors; one by a 3-hp. motor, which also operates a Gould duplex diaphragm pump drawing from the thickener.

7. One 9 x 6-in. belt-driven Ingersoll-Rand class ER-1 compressor driven by a 15-hp. motor furnishing 120 cu.ft. of free air per minute to the agitators at 25 lb. pressure.

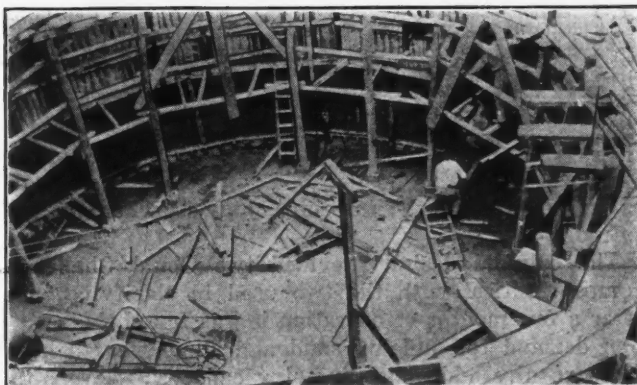
8. Five decanting tanks identical with the thickener, each driven by a 2-hp. motor and equipped with a Gould duplex diaphragm pump, except that for the last two tanks a quadruplex pump is used and the motor on the next to the last, No. 5, is 3 hp.

9. Clarifying equipment consisting of thirty-eight 5 x 8-ft. Butters filter leaves set in a cylindrical concrete tank 14 ft. in diameter by 9 ft. 6 in. deep, connected through a header to two 8 x 6-in. Gould Challenge double-acting piston pumps; each pump actuated by a 3-hp. motor through double reduction gearing.

10. Precipitation equipment consisting of a cylindrical concrete gold tank 14 ft. in diameter by 5 ft. 5 in. deep; three 36-in. frame Merrill presses holding 72 frames; one 6 x 7-in. Aldrich triplex pump with capacity of 150 gal. per minute against a 175-ft. head, belt-driven by a 10-hp. motor; Crowe vacuum equipment, including vacuum receiver and a 6 x 3½-in. Gardner-Rix pump; Merrill zinc-dust feeder; 3-hp. motor-driven vacuum pump and zinc-dust feeder.

11. Refinery consisting of drying furnace, briquet machine, No. 1 Monarch-Rockwell melting furnace, dust flue, slag well, masonry vault, and other necessary equipment.

12. Return-solution pumps, handling solution from the first decanter following the agitators to a concrete tank above the stamp mill, from which it is drawn to



MOVING CONCRETE FORMS

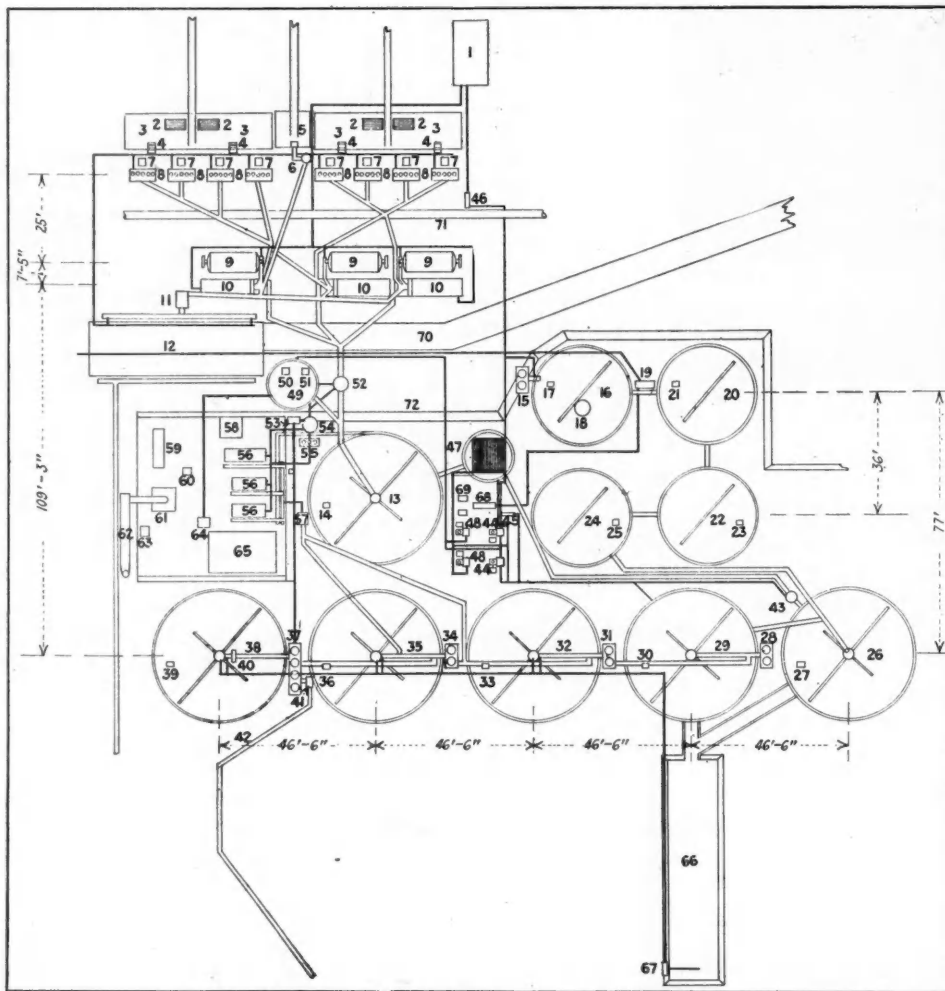


FIG. 2. SCALE PLAN OF THE MILL

- | | |
|------------------------------|--|
| 1. Mill solution tank. | 37. Thickener No. 5 pumps. |
| 2. Four grizzlies. | 38. Thickener No. 6. |
| 3. Mill bins. | 39. Thickener No. 6 motor. |
| 4. Four Blake crushers. | 40. Water meter. |
| 5. Accumulated slime bin. | 41. Tailing sampler. |
| 6. Slime mixer. | 42. Tailing launder. |
| 7. Eight Challenge feeders. | 43. Stand pipe. |
| 8. Forty stamps. | 44. Challenge solution pumps and motors. |
| 9. Three tube mills. | 45. Centrifugal solution pump. |
| 10. Three Dorr classifiers. | 46. Centrifugal solution pump booster. |
| 11. One bucket elevator. | 47. Clarifying tank. |
| 12. Accumulated sand bins. | 48. Challenge vacuum pumps and motors. |
| 13. Thickener No. 1. | 49. Gold solution tank. |
| 14. Thickener No. 1 motor. | 50. Gardner-Rix vacuum pump. |
| 15. Thickener No. 1 pumps. | 51. Motor. |
| 16. Agitator No. 1. | 52. Vacuum receiver. |
| 17. Agitator No. 1 motor. | 53. Zinc feeder. |
| 18. Cyanide dissolving tank. | 54. Emulsifying cone. |
| 19. Air receiver. | 55. Triplex pump. |
| 20. Agitator No. 2. | 56. Three precipitating presses. |
| 21. Agitator No. 2 motor. | 57. Solution meter. |
| 22. Agitator No. 3. | 58. Vault. |
| 23. Agitator No. 3 motor. | 59. Drying furnace. |
| 24. Agitator No. 4. | 60. Briquet press. |
| 25. Agitator No. 4 motor. | 61. Monarch-Rockwell furnace. |
| 26. Thickener No. 2. | 62. Dust flue. |
| 27. Thickener No. 2 motor. | 63. Slag well. |
| 28. Thickener No. 2 pumps. | 64. Sump, refinery. |
| 29. Thickener No. 3. | 65. Office and laboratory. |
| 30. Thickener No. 3 motor. | 66. Mill sump. |
| 31. Thickener No. 3 pumps. | 67. Air pump. |
| 32. Thickener No. 4. | 68. Air compressor. |
| 33. Thickener No. 4 motor. | 69. Air compressor motor. |
| 34. Thickener No. 4 pumps. | 70. Portovelo power-canal. |
| 35. Thickener No. 5. | 71. 30-in. high-pressure water pipe. |
| 36. Thickener No. 5 motor. | 72. 19-ft. retaining wall. |

batteries, sand bins, slime bins, and elsewhere as required.

The original design provided two Gould Challenge pumps identical with the two used in clarifying, but after a few months of operation it was found that solution demand for sluicing sand and slime was so high as to require additional pumping capacity. Two 5-in. centrifugal pumps, which were on hand, were erected,

one for driving by a 25-hp. motor drawing from the first decanter, and the other driven from the battery line shaft, taking the discharge from the first pump and lifting it to the tank above the mill.

13. One rectangular masonry sump catching all drainage from floors and tunnels, from which solution is pumped by a duplex Snow steam pump to thickeners 4, 5 or 6. Crushers, stamps, tube mills, classifiers, elevators and one of the return-solution centrifugal pumps were driven by the pelton wheels, which operate under an average static head of about 155 ft. Compressed air is used for the sump pump. On account of power troubles, and for additional capacity, it has also been found necessary for agitating. The rest of the plant is operated by motors on power from the hydro-electric plant. Interruptions to this power required the setting of a 55-kw. generator for driving from the compressor turbine shaft. The total cost of construction was 427,173 sucres (\$1 = 2.05 sucres normally, but during the war averaged 2.40 to 2.50). Of this amount 70 per cent went for supplies

and 30 per cent for labor. As the plant was built for a daily capacity of 280 tons, the construction cost per ton was 1,526 sucres.

OPERATION OF THE NEW PLANT

After the plant had been thoroughly tried out and was running smoothly it was calculated that it would be possible and advisable to treat about 300 tons of material per twenty-four hours. This was to be made up of 150 tons of mine ore, 60 tons of accumulated sand, and 90 tons of accumulated slime, including a little fine sand. This tonnage it has not been possible to attain to date for more than twenty-four hours' continuous run. The maximum tonnage put through the mill over a period of thirty days was 8,010. It was found that the sand was exceedingly hard to grind and the grinding capacity set a definite limit to the tonnage that could be treated, and inadequate transportation system cut down this tonnage somewhat further. The slime needs practically no grinding, and is limited only by the settling capacity of the plant, but at the end of the period covered by this report it became evident that seventy-five tons of this material was all that could be handled.

Fig. 2 gives a scale plan of the plant, which answers as a flow sheet.

With all crushers and stamps running, almost 200 tons of mine rock per twenty-four hours can be delivered to the classifiers. At times, however, due to various causes, it has been possible to drop only twenty-five stamps, and in such circumstances the crusher jaws have been closed down so as to relieve the work on the batteries. The crusher jaws are set normally at 1½ in. The grizzlies are spaced 2¼ in., and possibly these, when required, will be set closer together, thus throwing more work on the crushers and less on the stamps.

Stamping is carried on in a solution carrying approximately 0.7 lb. of NaCN per ton. At present a 4-mesh screen with 0.178-in. opening and 0.072-in. wire is used on the mortars. It is planned to try some 3-mesh screening in the near future. With the 4-mesh screen the stamp duty averages about 4.9 tons per day, but varies with the number of drops per minute, the weight in the stamp shoes and stems, and the care with which the height of drop and the discharge are regulated.

TABLE II. STEEL CONSUMPTION IN STAMPING

| Tons Stamped | —Total Consumed— | | Consumption per Ton of Ore | |
|--------------|------------------|-----------|----------------------------|-----------|
| | Shoes, Lb. | Dies, Lb. | Shoes, Lb. | Dies, Lb. |
| 33,847 | 9,664 | 4,130 | 0.2855 | 0.1220 |

Adamantine chrome-steel dies and shoes are used. Table II gives consumption of steel in shoes and dies over a period of ten months. Worn shoes and dies are recast in the local foundry into tube-mill liners. Locally cast shoes and dies have been used in times of emergency, but their short life does not justify their adoption for routine operations.

CLASSIFIERS AND TUBE MILLS

From the batteries the pulp flows to the classifiers, as do the sand and slime sluiced from their respective bins. The specific gravity of the classifier overflow is maintained at approximately 1.1, or a solution ratio of 5.5 to 1. Of the classifier overflow, 80 per cent is minus 200 mesh. The classifiers work in closed circuit with the tube mills. The classifier oversize flows to the tube-mill scoop-box, and is picked up by a 30-in. scoop.

The feed to the tube mills is diluted with mill solution to a specific gravity of 1.58, equal to about 40 per cent moisture. In practice this moisture content of the mill feed varies as much as 5 per cent either way. About 135 lb. of cyanide is added to the tube-mill feed daily. The launders to the classifiers from batteries, slime mixer, and sand elevator are so arranged that any mill can be run on almost any combination of batteries. It has been found most satisfactory to divide the three products—i.e., battery crush, sand, and slime—equally among the three mills, although this division is only approximate, as no distributor is installed.

Various kinds of rocks have been used for tube-mill pebbles. At the beginning, large chunks of hard quartz were tried, but they did not grind satisfactorily, nor did broken pieces of an extremely hard siliceous rhyolite, nor scrap iron. Finally, river pebbles were adopted as the most satisfactory medium available at the time. These vary greatly in hardness, but it has been found impracticable to select only the best, and about the only specification insisted upon is that they be chiefly of a size which can be fed through the scoop. Consumption of these pebbles is exceedingly high, about 110 lb. per ton of ore ground. Their cost is about 5.07 sucres per ton, which, at the current rate of exchange of 2.16,

corresponds to \$0.129 per ton of ore ground. The price of these pebbles is rising, as they are being packed from greater distances. Lumps of run-of-mine ore, after rough sizing and cobbing, were tried for grinding, but it was found that the soft calcite wore so rapidly as to render their use impracticable.

Tests are under way for using the hard vein quartz, more carefully sized and cobbed, and also the hard rhyolite prepared similarly. In all probability one of these materials will be eventually adopted for grinding. Heavy freight charges make the use of Danish pebbles or iron balls impracticable.

Tube-mill shell liners, which are of hard white iron, have shown a life of approximately eight months. The river pebbles will not wedge in the liners, and consequently the iron has to take all the wear of the charge. By selecting the least-worn sections in a mill for relining, it is probable that the average life of a set of liners can be prolonged to one year. The end liners have shown a life of only about four months. It is planned to make these about twice as thick, so that their life will correspond more closely to that of the shells.

Performance in the grinding is shown in Table III. The percentage of moisture in the classifier drag was 22.12. Samples were taken from mill No. 2 when mine ore, sand, and slime were being fed to all three mills evenly divided, and the time for taking samples was four hours. When the last sample was taken a higher proportion of sand had been turned into mill No. 2, and the rakes of the corresponding classifier were heavily loaded.

TABLE III. SCREEN ANALYSIS

| Mesh (Tyler Standard) | Sand Feed (Cum. %) | Slime Feed (Cum. %) | Battery Discharge (Cum. %) | Classifier Drag (Cum. %) | | Tube-Mill Discharge (Cum. %) | |
|-----------------------|--------------------|---------------------|----------------------------|--------------------------|------|------------------------------|-------|
| | | | | % | % | % | % |
| On 4 | ..... | ..... | ..... | 0.2 | 0.2 | ..... | ..... |
| On 6 | ..... | ..... | 2.9 | 2.9 | 1.5 | 1.7 | ..... |
| On 8 | ..... | ..... | 7.1 | 10.0 | 3.8 | 5.5 | ..... |
| On 10 | ..... | ..... | 6.9 | 16.9 | 4.3 | 9.8 | ..... |
| On 14 | ..... | ..... | 5.0 | 21.9 | 3.6 | 13.4 | ..... |
| On 20 | ..... | ..... | 7.4 | 29.3 | 5.5 | 18.9 | ..... |
| On 28 | ..... | ..... | 6.4 | 35.7 | 5.0 | 23.9 | ..... |
| On 35 | 3.8 | 3.8 | 6.0 | 41.7 | 6.6 | 30.5 | 0.4 |
| On 48 | 23.6 | 27.4 | 6.6 | 48.3 | 12.7 | 43.2 | 0.6 |
| On 65 | 24.2 | 51.6 | 6.8 | 55.1 | 11.5 | 54.7 | 2.0 |
| On 100 | 23.8 | 75.4 | 8.2 | 63.3 | 18.9 | 73.6 | 10.2 |
| On 150 | 13.4 | 88.8 | 6.4 | 69.7 | 14.4 | 88.0 | 20.0 |
| On 200 | 3.6 | 92.4 | 2.2 | 72.0 | 3.6 | 91.0 | 6.4 |
| Through 200 | 7.2 | 99.6 | 97.8 | 100.0 | 8.4 | 100.0 | 60.4 |

The drive of the tube mills has not proved altogether satisfactory. Flexible couplings were provided to relieve the herringbone gears from the effects of the float of the mill. Either the eccentricity of these or improper setting of the collars on the line shaft, or some other unknown cause, broke three of the concrete piers carrying the line-shaft bearing. The flexible couplings were discarded, and to date no bad effects on the herringbone gears have been observed. The clutches are also a source of trouble. When a mill is thrown out, the wooden clutch blocks are not entirely disengaged, and char rapidly unless a stream of water is played on them.

AGITATING

From the classifiers the overflow goes to the thickener, called No. 1. This thickener underflow is elevated to agitator No. 1 by Gould diaphragm pumps, where it is diluted with mill solution to a ratio of 1 to 1. In this agitator about 270 lb. of NaCN and 1,000 lb. of local lime are added daily. The local lime is quarried and burned near the property and is of extremely low grade, about 35 per cent CaO. Agitation continues through the four agitators, and the average time of agitation is approximately fifty hours. As noted, for

the present tonnage, which is higher than the design called for, it has been necessary to draw on the mine compressors for agitating air. This was secured by running a 1-in. air line from the high-pressure compressed-tir main leading to the mine.

AGITATOR TROUBLES DUE TO INTERMITTENT SUPPLY OF POWER

At the beginning of operations some mechanical difficulties were experienced with the agitators. The mechanism was designed originally for a 10-ft. tank, and later the depth of the tank was increased to 12 ft., requiring the addition of a 2-ft. section to the elevating column. The rakes are attached to this section, which is screwed to the bottom of the original 10-ft. section of the column. At the time of starting operations failures of power were rather common occurrences, and overloads resulted in the agitators. The rakes, bedded in the settled material, would stick, and the lower section of the column turned on the upper and wrapped around the top of the column the ropes by which the rakes are suspended. It was difficult to find a breaking pin of just the right strength to take care of these overloads. One of the bevel crown gears was broken in this way. After a continuous power supply was provided and the operators became more familiar with the machinery these difficulties disappeared, and the four agitators have been in continuous operation for ten months without repair. Since the time of this installation the Dorr Company advises that rakes are designed to be pinned to the column, which obviates trouble such as that noted.

DECANTING

The overflow from agitator No. 4 joins the overflow from the second decanter, called thickener No. 3, and flows to the first of the series of decanter tanks, called thickener No. 2. The overflow from No. 2 is pumped to the mill storage tank, as previously noted. Through the series of thickeners Nos. 2, 3, 4, 5, and 6 the work is straight counter-current decantation. The underflow from No. 6 is discarded to the river. The barren solution from the presses is added to No. 4. Adding it to No. 5 has the effect of lowering the dissolved gold loss but of increasing the mechanical loss of cyanide, and it has been found that by adding it to No. 4 the commercial efficiency at present prices is higher.

Serious mechanical troubles occurred with the thickener mechanism at the beginning of operations. Power interruptions caused overloads, but even while the power supply was steady, overloads kept developing suddenly in the whole series of thickeners. This is believed to have been caused by the fact that the trays were not set up to a perfect cone, but contained swells and depressions, and these caused accumulations of loose material, which would slip suddenly and bury the rakes. Several worm gears were broken in this way, and on one occasion the 2-hp. motor even wrenched the superstructure anchor bolts loose from the edge of the tank. A further cause of overloads was the fact that the spacer pipes between the spiders of the upper and lower rakes were not shipped with the mechanism, and their absence was not noted by the erectors. This allowed the upper-rake spider to slip on the stirring shaft, so that the rakes caught on the tray. These difficulties, which were not due to inherent faults in the design of the equipment, were finally overcome, and the mechanism has been running without accident for a number of months.

Table IV gives theoretical calculations for the mill flow sheet, assuming certain fixed conditions.

TABLE IV. THEORETICAL CALCULATIONS OF MILL FLOW SHEET

| Tonnage: | | | | | | |
|--|----------|-----------|-----------|-----------|----------|-------------------|
| 140 tons of mine rock at \$7.86 per ton | | | | | | \$1,100.40 |
| 60 tons of accumulated sand at \$4.91 per ton | | | | | | 294.60 |
| 100 tons of accumulated slime at \$4.65 | | | | | | 465.00 |
| Total | | | | | | \$1,860.00 |
| 50 per cent dissolved in crushing | | | | | | 930.00 |
| 50 per cent dissolved in agitation | | | | | | 930.00 |
| Barren solution precipitated to \$0.02 enters thickener No. 4; 37.5 per cent moisture in all thickener discharge pulp. | | | | | | |
| 50 tons of water enters the mill at the classifiers. | | | | | | |
| 130 tons of water enters the mill at thickener No. 6. | | | | | | |
| Value of solution leaving decanters with a variable tonnage of solution precipitated: | | | | | | |
| Solution Precipitated | No. 1 | No. 2 | No. 3 | No. 4 | No. 5 | No. 6 |
| 200 | \$8.6911 | \$7.18974 | \$3.55263 | \$1.56864 | \$1.2040 | \$0.69910 |
| 400 | 4.6034 | 3.28300 | 1.07984 | .33163 | .25454 | .15000 |
| 600 | 3.103 | 2.0414 | .5058 | .1271 | .097 | .05631 |
| 800 | 2.338 | 1.4638 | .295 | .06841 | .0525 | .03048 |

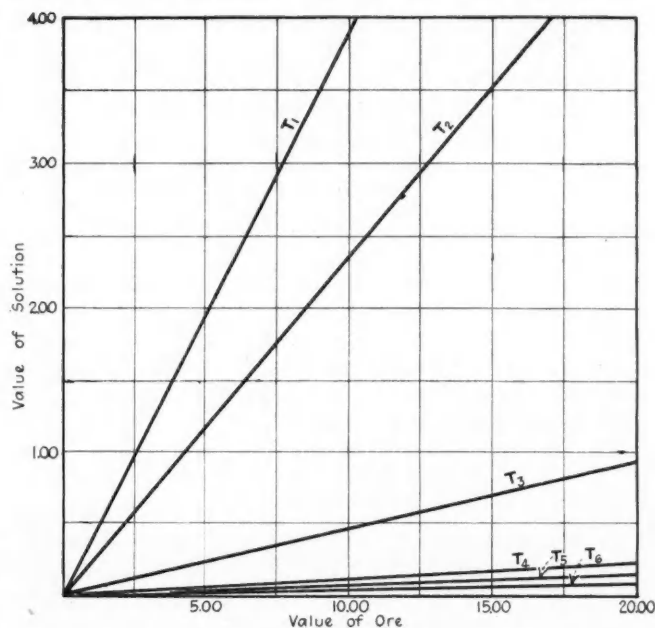


FIG. 3. VARIATIONS IN VALUE OF SOLUTION LEAVING THICKENERS

When the solution in the crushing department is kept at 0.7 lb. of cyanide, and that in the agitators at 1 lb., the cyanide strength of the solution overflow in the thickeners is as follows:

- | | |
|----------------|----------------|
| 1. 0.7 lb. | 4. 0.6727 lb. |
| 2. 0.78358 lb. | 5. 0.51632 lb. |
| 3. 0.69464 lb. | 6. 0.29980 lb. |

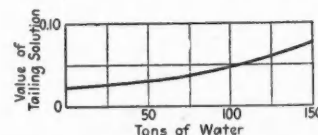


FIG. 4. EFFECT OF WATER ENTERING MILL AT CLASSIFIERS

Fig. 3 shows the variations in the value of the solution leaving the thickeners as the value of the ore and other materials varies. Fig. 4 shows the value of the tailing solution as the amount of water entering the mill at the classifier varies.

Table V shows actual performance of the decanting system over a number of months. Dissolved gold-silver loss is higher in practice than the theoretical, although the percentage of moisture in the thickener discharge is lower than that used in the calculation. This dis-

crepancy is due to the dissolving action that takes place in the decanting. Mechanical loss of cyanide is also slightly higher than the theoretical figure. A value of \$1 per oz. has been used in the silver calculations.

CLARIFYING

Overflow from the thickener, No. 1, flows to the clarifying tank. Here the two Challenge pumps take out about 750 tons of solution per day and deliver it to the

TABLE V. VALUES OF TAILINGS

| Month | Moisture Content of Tailings | Soluble Loss per Ton Dry Tailings | Total Loss per Ton Dry Tailings | | | Consumption NaCN per Ton Ore Lb. |
|-----------|------------------------------|-----------------------------------|---------------------------------|--------|--------|----------------------------------|
| | | | Go'd | Silver | Total | |
| May | 49.0 | \$0.26 | \$0.68 | \$1.10 | \$1.78 | 1.338 |
| June | 41.40 | .13 | .53 | .88 | 1.41 | 1.81 |
| July | 42.33 | .20 | .66 | .97 | 1.63 | 1.13 |
| August | (a) | (a) | (a) | (a) | (a) | (a) |
| September | 48.0 | .20 | .70 | 1.05 | 1.75 | 1.70 |
| October | 42.0 | .33 | 1.27 | .80 | 2.07 | 1.44 |
| November | 36.75 | .12 | .72 | 1.15 | 1.87 | 1.29 |
| December | 35.50 | .07 | .46 | 1.13 | 1.59 | 2.36 |
| January | 34.07 | .07 | .43 | .98 | 1.41 | 2.80 |
| February | 33.59 | .05 | .52 | 1.01 | 1.53 | 1.26 |
| March | 34.55 | .12 | .57 | .99 | 1.56 | 1.726 |
| Maximum | 49.0 | .33 | 1.27 | 1.15 | 2.07 | 2.80 |
| Minimum | 33.59 | .05 | .43 | .80 | 1.41 | 1.13 |

(a) Not operating.

gold tank. The rest of the solution overflowing the thickener is short-circuited back to the mill storage tank.

The clarifying leaves, after a year's use, remain in good condition and should be available for another six months or more. No acid was used in cleaning them for a period of nine months, but two leaves were removed from the tank daily and were washed and scrubbed with a stiff brush. Solution from the gold tank after subjection to vacuum in the Crowe apparatus flows to the suction of the press pump. The zinc feeder discharges into the de-aerated solution in the press-pump suction line about 3 ft. from the pump. From this point to the presses the distance is between 40 and 45 ft.

The screw type of zinc feeder has not proved entirely satisfactory, because the zinc, although put into the hopper practically bone dry, absorbs moisture in the rainy season, forms a chimney, and thus gives an irregular feed, requiring constant attention as the humidity varies.

The Crowe equipment caused no trouble after it was once adjusted. The excellent results from this equipment in the saving of zinc are shown in Table VI. The consumption of zinc shavings in the old sand-leaching plant was 0.8 lb. per ton of sand leached. It is calculated that the vacuum equipment reduces the cost for merrillite by about \$3,800 per year.

On the Merrill presses the filtering medium used is No. 10 duck covered with one layer of sheeting. The presses are cleaned up once a month, when the sheeting is removed and clean sheeting put on the frames. The sheeting is washed thoroughly and used four or five times before being burned. The duck lasts about six months. Operation of the presses has been entirely satisfactory, although preliminary test with one press on solution from the old sand-leaching plant had proved unsatisfactory, because precipitate, probably carbonate, formed on the sheeting, and it was impossible to run a press for more than three or four days, even when no zinc dust was added. In the new plant this carbonate precipitation has been eliminated. It has been found that the gold solution must carry a minimum of

0.4-0.5 lb. of free cyanide per ton to secure satisfactory precipitation.

Table VII shows the extraction of the gold in the several stages of beneficiation, the total extraction of the silver, and the actual gold recovery based on product

TABLE VI. PERFORMANCE OF VACUUM APPARATUS

| Month | Vacuum | Merrillite per Ton Ore, Lb. | Consumption per Ton Solution Precipitated, Lb. | Per Ounce Doré, Lb. | Gold Solution | Barren Solution |
|----------------|--------|-----------------------------|--|---------------------|---------------|-----------------|
| June, 1919 | No | 0.4405 | 0.1539 | 0.3412 | \$3.98 | \$0.24 |
| Feb., 1920 | Yes | 0.2150 | 0.0640 | 0.2640 | 1.87 | .03 |
| March, 1920(a) | Yes | 0.263 | 0.0920 | 0.305 | 2.41 | .14 |
| April, 1920(b) | Yes | 0.206 | 0.0770 | 0.239 | 2.12 | .01 |
| May, 1920(a) | Yes | 0.235 | 0.0890 | 0.248 | 2.12 | .01 |

(a) During March precipitating trouble developed due to low cyanide content of gold solution.

(b) Precipitate for May contained 21.71 per cent copper; 351.46 lb. precipitated during the month.

TABLE VII. EXTRACTION

| Month | Gold Extraction | | | Consumption Cyanide per Ton of Ore, Lb. |
|----------|-----------------------|------------------------|---------------------|---|
| | In Crushing, per Cent | In Agitation, per Cent | Decanting, per Cent | |
| November | 46.47 | 46.59 | 93.06 | 1.29 |
| December | 55.04 | 37.15 | 95.59 | 2.36 |
| January | 56.69 | 32.51 | 95.07 | 2.80 |
| February | 27.84 | 56.29 | 92.96 | 1.26 |
| March | 23.86 | 65.48 | 93.60 | 1.73 |

| Month | Silver Extraction | | Gold Recovery |
|-----------------------------------|------------------------|---------------------|---------------|
| | In Agitation, per Cent | Decanting, per Cent | |
| November | 32.29 | 91.97 | |
| December | 41.07 | 94.80 | |
| January | 43.32 | 94.09 | |
| February | 33.83 | 92.22 | |
| March | 35.63 | 91.91 | |
| Maximum gold recovery, June, 1919 | | 97.52 | |

shipped and assay of the tailings. The silver extraction is extremely low. The ore is known to contain tetra-hedrite, which is not easily amenable to cyanidation, and the silver is contained largely in this mineral. Further-

TABLE VIII. OPERATING COSTS

Costs are all given in sueres and are averages over a period of five months, December, 1919, to April, 1920, during which time the following tonnages were treated:

| | Tons | | | Cost per Ton of Tailings |
|---|------------------|---------------------------|-------------------|--------------------------|
| | Mine ore stamped | Accumulated sand and slag | Accumulated slime | |
| Mine ore stamped | 21,211 | | | |
| Accumulated sand and slag | 8,027 | | | |
| Accumulated slime | 8,521 | | | |
| Total | 37,759 | | | |
| Total tons tube milled (ore, sand, slag and oversize slime) | 29,459 | | | |

| Department | Supplies | Labor | Total | Cost per Ton of Tailings |
|---|------------|-----------|------------|--------------------------|
| Crushing and stamping | 8,855.59 | 6,837.06 | 15,692.65 | 0.41560 |
| Grinding and classifying | 11,565.17 | 7,917.25 | 19,482.42 | 0.51597 |
| Decanting and thickening | 1,661.24 | 3,687.42 | 5,348.66 | 0.14165 |
| Agitation | 630.25 | 1,816.23 | 2,446.48 | 0.06479 |
| Clarifying | 479.07 | 1,969.09 | 2,448.16 | 0.06483 |
| Precipitation | 5,177.68 | 1,210.80 | 6,388.48 | 0.16922 |
| Return solution pumps | 2,130.59 | 1,391.52 | 3,522.11 | 0.09328 |
| Preparing precipitates for shipment | | 281.38 | 281.38 | 0.00745 |
| Incidentals (tools, hardware, pipe and fittings, lumber, office and laboratory, extraordinary structural repairs, extraordinary machinery repairs, cement, paint, carbide and other supplies, toolroom boy) | 3,996.58 | 807.15 | 4,803.73 | 0.12722 |
| Total less chemicals | 34,497.17 | 25,917.90 | 60,415.07 | 1.60002 |
| Chemicals: | | | | |
| Cyanide | 63,799.74 | | 63,799.74 | 1.68966 |
| Lime | 14,860.17 | | 14,860.17 | 0.39355 |
| Lead | 854.54 | | 854.54 | 0.02263 |
| Total less sand and slime handling | 114,011.62 | 25,917.90 | 139,929.52 | 3.70586 |
| Handling accumulated sand | 829.10 | 4,133.57 | 4,962.67 | 0.61825 |
| Handling accumulated slime | 80.13 | 9,468.60 | 9,548.73 | 1.12053 |
| Final total | 114,920.85 | 39,520.07 | 154,440.92 | |

more, the accumulated sand had already been twice treated and the accumulated slime once, and the more easily recoverable gold and silver thus removed.

During the last of December, 1919, and all of January, 1920, a test was run on silver extraction with the cyan-

ide solution about 2½ times as strong as that used previously. This practice, however, at current prices of silver and cyanide, was found to be uneconomical.

Table VIII shows the operating cost over a period of five months, December, 1919, to April, 1920, inclusive, and Table IX shows the cost of handling the three products treated.

On account of the experiments performed with strong cyanide during December and January, the average consumption for the two months is high. The cyanide

TABLE IX. UNIT COSTS BY PRODUCTS

| | Sucres |
|-------------------------------------|---------|
| Treatment of Mine Ore: | |
| Crushing and stamping | 0.73983 |
| Grinding and classifying | 0.66134 |
| Decanting and thickening | 0.14165 |
| Agitation | 0.06479 |
| Clarifying | 0.06484 |
| Precipitation | 0.16923 |
| Return solution pumps | 0.09327 |
| Preparing precipitates for shipment | 0.00746 |
| Incidentals | 0.12722 |
| Chemicals (a) | 1.50310 |
| Total per ton | 3.57273 |
| Treatment of Accumulated Sand: | |
| Grinding and classifying | 0.66134 |
| Decanting and thickening | 0.14165 |
| Agitation | 0.06479 |
| Clarifying | 0.06484 |
| Precipitation | 0.16923 |
| Return solution pumps | 0.09327 |
| Preparing precipitates for shipment | 0.00746 |
| Incidentals | 0.12722 |
| Chemicals (a) | 1.50310 |
| Total | 2.83290 |
| Transportation | 0.61825 |
| Total | 3.45115 |
| Treatment of Accumulated Slime: | |
| Decanting and thickening | 0.14165 |
| Agitation | 0.06479 |
| Clarifying | 0.06484 |
| Precipitation | 0.16923 |
| Return solution pumps | 0.09327 |
| Preparing precipitates for shipment | 0.00746 |
| Incidentals | 0.12722 |
| Chemicals (a) | 1.50310 |
| Total | 2.17156 |
| Transportation | 1.12053 |
| Total | 3.29209 |

(a) 1.3 lb. of cyanide per ton of ore.

consumption should not have been more than 1.3 lb. per ton of tailings, which would give a total consumption of 52,387.4 lb. at a cost of 43,813.15 sucres. This reduces the cost for the chemical to 1.087 sucres per ton of tailings. This cost, also, is not correct, because the cyanide was bought in England, and the saving on exchange between the ruling ratio of pound to dollar of less than 4.00 and the normal of approximately 4.86 was not credited to the cyanide price but was taken into an exchange account. The same is true of the saving on sucre exchange for payments made inside of Ecuador.

Experiments in the Use of Dolomite Refractories*

LARGE quantities of magnesite are used for furnace linings in the metallurgical industries. Until the war began, substantially all the magnesite used for the manufacture of refractories came from Austria and Greece. When Austria entered the war, the exportation of magnesite from that country was shut off, and soon afterward the exportation of the Grecian product stopped. The American refractory manufacturers were, therefore, compelled to draw upon the American magnesite deposits, which are said to be inferior to the foreign magnesite for refractory purposes. These deposits are situated in the states of Washington and California, whereas most of the metallurgical industries utilizing magnesite refractories, notably steel, are cen-

tered chiefly in states east of the Mississippi River. Owing to cheap labor in Austria and Greece, and water transportation, the foreign magnesite in normal times can be delivered to points east of the Mississippi River cheaper than the magnesite from the Pacific Coast. During the war, the selling price of magnesite brick quadrupled.

Dolomite, the double carbonate of lime and magnesia, is widely distributed throughout the United States and occurs in large masses. The State of Ohio contains thousands of acres of dolomite with very little or no overburden. Its principal use is for crushed rock in surfacing roads and in concrete work. It also finds a limited use in the manufacture of "dolomitic lime." Before dolomite can be successfully used as a refractory for furnace linings, it must be calcined at a high temperature to remove its shrinkage and to place it in a "stable" or "dead-burned" condition. The lime content is the troublesome ingredient; it may cause the calcined dolomite to "slake" or "disintegrate" when stored in the open air.

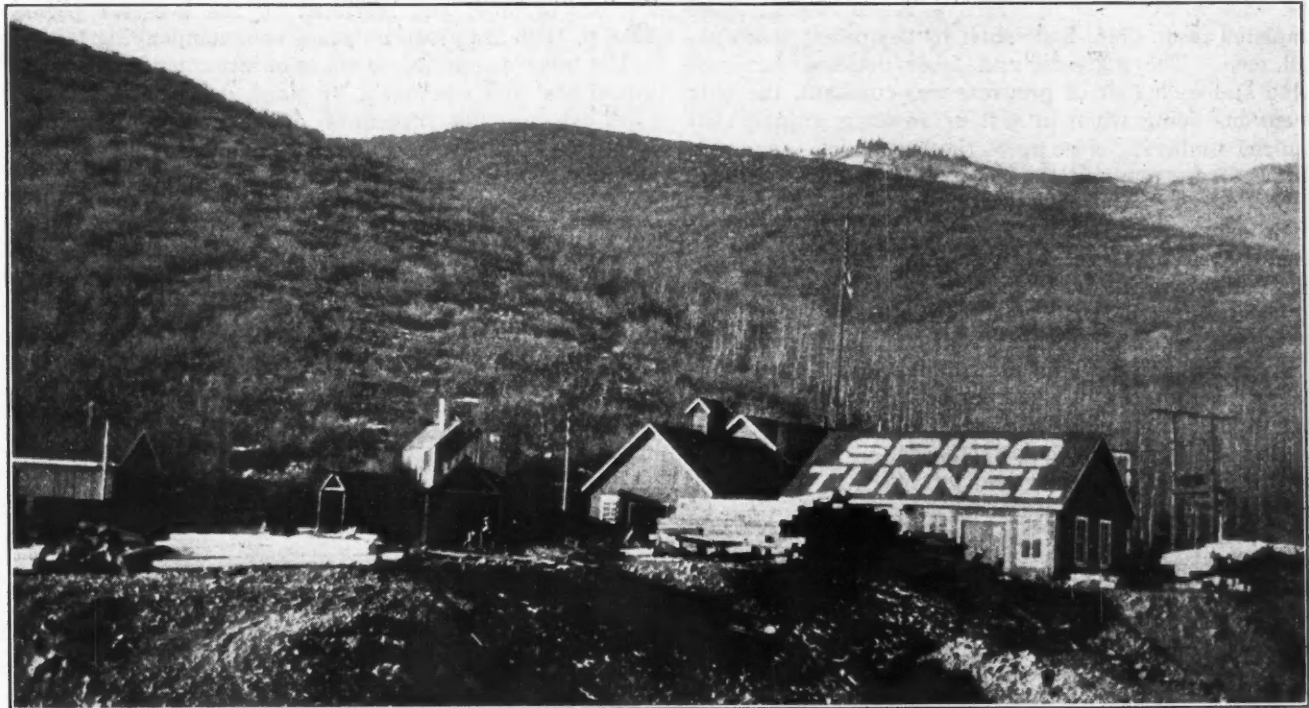
To prevent slaking of the calcined product, there must be added to the dolomite a suitable material which will combine with the lime and place it in a condition in which it will not disintegrate. The substance added to the dolomite to bring about a dead-burned condition is called a "dead-burning agent." It must be of such a nature that it will not lower the melting point of the dolomite to such an extent as to render the latter useless as a refractory, and the dead-burning agent must also be inexpensive. Several patents have been granted on methods of dead-burning dolomite for refractory purposes, and three or four firms have placed the product on the market under different trade names. It is sold in lump or granular form, and is mixed with slag and tar and tamped in the bottoms of furnaces. It is also used for temporary patches for furnace walls.

Magnesite brick will stand storage indefinitely without disintegration, but up to the present a firebrick made from dolomite which can be stored indefinitely without crumbling to powder has not been produced. The different patented processes of preparing dolomite for refractory purposes were investigated by the ceramic experiment station, and it was found that all such products would show signs of disintegration within one week to six months.

Other methods of dead-burning dolomite were devised and tried by the ceramic station. The briquets made from the different calcined dolomites are stored in the open air and observed every week. Two of the samples prepared from calcined dolomite have been under observation for more than a year. They still appear to be sound and show no signs of disintegration. Further tests on these promising dead-burned dolomites are to be made, and if it can be demonstrated that firebrick can be made from dolomite which will compare to magnesite firebrick and will stand storage indefinitely without crumbling, it will be the means of developing a new industry of far-reaching importance.

About 80 per cent of the firebrick is used in the iron and steel industries. Ohio ranks second to Pennsylvania in the production of iron and steel. The work of the ceramic station on the preparation of dolomite for refractory purposes has been done on Ohio dolomites. Ohio, with its thousands of acres of dolomite to furnish the raw material for firebrick, and its vast iron and steel industry to utilize them, would profit more than any other state by the work on refractories.

*U. S. Bureau of Mines, Reports of Investigations.



ENTRANCE TO SPIRO TUNNEL OF SILVER KING CONSOLIDATED MINING CO. NEAR PARK CITY, UTAH

Tunnel Driving in War and Peace

Comparative Costs of Labor and Supplies on Spiro Tunnel Project, Near Park City, Utah, During Five-Year Period 1916-1920 Show Effect of Changes in Economic Conditions Caused by the War

BY HARRY A. LEE

Written for *Engineering and Mining Journal*

THE WORLD WAR brought many evils in its train to metalliferous mining. Prior to the war, operating costs of mining and results attainable could be determined with a fair degree of accuracy. Following the year 1916 the constant increase in the costs for material and labor, shortage of skilled labor, and consequent necessity of employing inefficient help proved a combination that almost drove to distraction operators who were accustomed to gaining results in proportion to cash outlay.

To determine the effect of the changed economic conditions produced by the war, and to demonstrate the increased cost of material, the increased cost of labor and the inefficiency of labor, an enterprise operating prior to and after the beginning of the war must be selected. Of equal importance is the selection of an enterprise wherein the material and labor demands are constant factors throughout the operating period. The driving of a drainage and transportation tunnel is almost monotonous in its demands, and comes as near meeting the requirements as it is possible to find in mine development.

PROGRESS OF WORK ON THE SPIRO TUNNEL

The Spiro tunnel of the Silver King Consolidated Mining Co., of Utah, is selected as a type of mine development meeting the necessary requirements for comparison. The tunnel is situated near Park City, Utah, and was named after Solon Spiro, the president of the

company. Work was started during the summer of 1916, and has been continuously prosecuted since that time. The breast is now 14,400 ft. from the portal. The period of time comprised in this review is four years, extending from July 1, 1916, to July 1, 1920, and the length of bore considered is 12,944 ft.

TABLE I. LABOR COST

| Year | Feet Progress of Tunnel | Average Wage (a) Per Shift | Cost per Ft. (Average) | Increased Cost per Foot Over 1916, per Cent | Wage Increase, per Cent | Increased Cost Due to Add. Timber Haulage, Ditch Work, Rubber Bonus and Comp. Insurance, per Cent | Labor Inefficiency, per Cent |
|------|-------------------------|----------------------------|------------------------|---|-------------------------|---|------------------------------|
| 1916 | 1,461 | \$3.857 | \$8.157 | Base | | | |
| 1917 | 3,539 | 4.294 | 16.0315 | 96 | 11.30 | 17.0 | 67.70 |
| 1918 | 4,001 | 5.006 | 17.9782 | 120 | 29.79 | 14.25 | 75.96 |
| 1919 | 2,622 | 5.403 | 21.9475 | 169 | 40.08 | 25.20 | 103.72 |
| 1920 | 1,321 | 5.757 | 22.975 | 182 | 49.27 | 33.20 | 99.53 |
| | 12,944 | | \$17.65 | | | | |

(a) Average wage per shift paid underground and surface employees.

The Spiro tunnel starts at the base of the mountain and is driven on a tangent, with a grade of 0.3 per cent. Starting in the limestones of the Thaynes formation, it passes into the Woodside shale, Park City limestones, and the Weber quartzite, in the order named. These formations have an average dip of 25 deg., and the bore cuts the beddings at an acute angle.

The hardness of the rock is of little moment in driving a tunnel. A shift's work in the heading consists of drilling and firing a round. In the 12,944 ft. no

rock was encountered in which a round could not be completed in an eight-hour shift by competent machine-drill men. The material and labor demand for each round and each foot of progress was constant, the only exceptions being when in soft or swelling ground that required timbering close up to the breast following each blast before it was practicable or safe to start the next round and when the haul was longer.

The machine drills were operated under 100-lb. pressure. Each machine man had his own drill, and following each shift the drill was trucked out, cleaned, oiled, tested, and, if necessary, repaired. This method insured a machine that worked perfectly when placed on the bar and obviated the claim so commonly made that the man on the previous shift had left a "bum" drill. It also proved a big saving in drill repairs.

The average sizes of timber used were: Sills, 6 x 10; legs, 8 x 8; caps, 8 x 10; and lagging, 2-in. rough. These sizes were varied somewhat to suit heavy or swelling ground. The sets were placed 5 ft. from center to center on the average, and where timber sets were not required the sills were placed on grade at 5 ft. centers and hitched into the walls for the entire distance.

The surface plant is modern, with a well-equipped blacksmith shop, a machine shop, a carpenter shop, a change room, magazines, and adequate storage rooms.

DETAILS OF SPIRO TUNNEL FOR 12,944 FT.

- Location, Park City, Utah.
- Purpose, Development, drainage, transportation.
- Character of rock penetrated, Limestone, shale, quartzite.
- Size broken, 8 x 9 ft.; ditch on side, 3 x 4 ft.
- Cross-section, 84 sq.ft.
- Grade, 3 ft. rise in 1,000 ft.
- Power, Purchased electric current.
- Air pressure, 100 lb., generated by electrically driven compressor.
- Air line, 4-in. O. D. casing.
- Ventilator pipe, 18-in. steel, dipped.
- Water line to drills, 1½-in. black pipe.
- Drills, Pneumatic hammer.
- Drill mounting, Horizontal bar.
- Explosives, 50 per cent gelatine dynamite in cuts; 35 per cent in sides.
- Number of holes per round, 16 to 24.
- Average depth drilled, 5 to 8 ft.
- Cars, 20 cu.ft., roller-bearing.
- Type of haulage, Horse.
- Track of switches, 30-lb. rail, 18-in. gage.

Costs of labor and material for the five-year period 1916 to 1920 are given by years in accompanying tables.

The tables presented do not take into consideration the initial cost and equipment of plant, depreciation, taxes, legal expense, fire insurance, office expense, or administration. The daily wage is the average of all employees, both underground and upon surface, including



INTERIOR VIEW OF SPIRO TUNNEL, SHOWING CONSTRUCTION

bonuses, averaged for the year from monthly and semi-monthly payrolls. The figures illustrate plainly the effect of increased cost for material and labor and the inefficiency of labor; also that an increase in wages produced no improvement in results.

By reason of the fact that a shift's work per man was practically fixed at the Spiro tunnel, and that the same wage could be had at other properties in the district,

TABLE III. COMBINED LABOR AND MATERIAL COSTS

| | Cost per Foot | | | | | Per Cent Increase Over 1916 | | | |
|----------------|---------------|----------|----------|----------|----------|-----------------------------|-------|-------|-------|
| | 1916 | 1917 | 1918 | 1919 | 1920 | 1917 | 1918 | 1919 | 1920 |
| Labor... | \$8.157 | \$16.032 | \$17.978 | \$21.947 | \$22.975 | 96.0 | 120.0 | 169.0 | 182.0 |
| Material | 7.912 | 10.384 | 12.09 | 15.089 | 17.08 | 31.2 | 52.8 | 90.7 | 128.5 |
| Totals.. | \$16.07 | \$26.42 | \$30.07 | \$37.03 | \$40.06 | | | | |
| Averages | | | | | | 64.4 | 87.1 | 130.4 | 149.3 |

wherein a shift's work could not well be measured, it is possible that the inefficiency of labor at other properties may not have been so marked. Conditions have been improving, but normal routine is still to be achieved.

TABLE II. MATERIAL COSTS

| Article | Cost per Foot | | | | | Per Cent Increase Over 1916 | | | |
|--|---------------|----------|---------|----------|---------|-----------------------------|----------|--------|--------|
| | 1916 | 1917 | 1918 | 1919 | 1920 | 1917 | 1918 | 1919 | 1920 |
| Explosives..... | \$2.547 | \$3.54 | \$4.504 | \$5.27 | \$5.537 | 38.83 | 75.50 | 106.70 | 116.90 |
| 30-lb. T-rail (complete)..... | .41 | .517 | .749 | .73 | .743 | 27.0 | 83.0 | 79.0 | 78.1 |
| 4-in. O.D. casing and 1½-in. iron pipe..... | .332 | .46 | .63 | .80 | .806 | 38.6 | 89.8 | 141.6 | 142.8 |
| 18-in. steel vent and pipe..... | .95 | 1.25 | 1.67 | 1.60 | 1.75 | 31.6 | 75.8 | 68.5 | 84.3 |
| Machine drills, repairs and couplings..... | .58 | .75 | .79 | 1.19 | 1.50 | 29.4 | 36.3 | 105.2 | 158.7 |
| Timber (per ft. timbered)..... | 1.71 | 1.74 | 2.14 | 2.589 | 2.20 | 1.8 | 25.2 | 51.2 | 28.7 |
| Electric power..... | 1.56 | 1.099 | 1.26 | 1.964 | 2.16 | (a) 30.2 | (a) 19.3 | 25.7 | 38.5 |
| Drill steel..... | .245 | .489 | .308 | .47 | .75 | 104.2 | 29.2 | 96.0 | 212.5 |
| Illuminants..... | .09 | .244 | .179 | .26 | .288 | 166.0 | 100.0 | 188.0 | 210.0 |
| Tools, electrical supplies and general hardware..... | .158 | .094 | .133 | .38 | .363 | (a) 43.7 | (a) 18.7 | 137.0 | 125.0 |
| Lubricants..... | .35 | .038 | .064 | .135 | .187 | 33.0 | 100.0 | 333.0 | 500.0 |
| Horse feed, shoeing, etc..... | .117 | .254 | .46 | .886 | 1.305 | 108.0 | 283.0 | 633.0 | 990.0 |
| General repairs and plant maintenance..... | .07 | .14 | .236 | .30 | .379 | 92.0 | 223.0 | 311.0 | 419.0 |
| Coal and coke..... | .025 | .13 | .131 | .274 | .38 | 550.0 | 550.0 | 1350.0 | 1900.0 |
| Averages..... | \$7.912 | \$10.384 | \$12.09 | \$15.089 | \$17.08 | 31.2 | 52.8 | 90.7 | 128.5 |

(a) Denotes decrease.

Hon. A. B. Fall Secretary of the Interior

BY PAUL WOOTON

Written for *Engineering and Mining Journal*

CABINET REPRESENTATION for the prospectors has been attained in the selection of Albert Bacon Fall as Secretary of the Interior. This department has jurisdiction over practically all work done by the Government in the interest of mining.

The new Secretary has worked in and has operated metal mines, is an experienced prospector, and is closely abreast with the needs of the industry. He promises to leave undone nothing within his power to relieve the depression now gripping mining. Secretary Fall's first mining experience was in Mexico. From boyhood the rôle of prospector had appealed to him, so at the age of twenty-one, with such knowledge of mining as he could acquire from books, he ventured into Mexico. That was in 1882. He began at a mine near Nieves, Zacatecas, where for three years he worked as a mucker, as a timberman, and as foreman. He served his apprenticeship on the hoist and in the operation of pumps. He sorted ore, built roads, and sharpened drills. When the Mexican Central, in 1884, ran its first through train from Mexico City to El Paso,

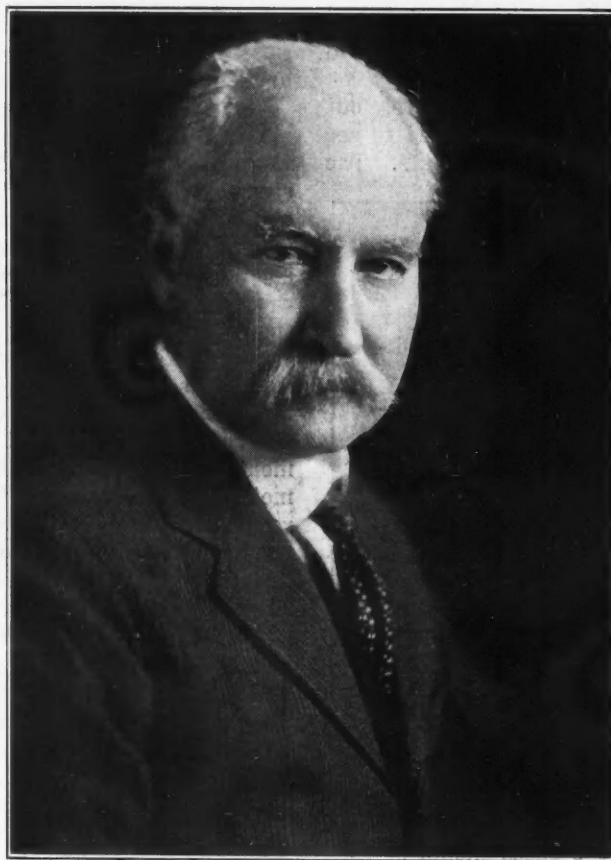
young Fall returned to the United States with enough practical experience, he believed, to undertake operation on his own account. During 1885, 1886, and 1887 he prospected through the back range of the Sierra, in Grant County, N. M. He located a number of properties and undertook the development of several. While in Mexico, he had acquired some prospects in that country, and these he developed with the aid of associates, together with his New Mexico activities. Finally, in 1907, he sold his holdings in Mexico. In discussing his mining experience Secretary Fall said that there are numerous monuments to bad fortune in the wake of his mining experience, but he admitted that there are a few monuments to good fortune as well.

One of the prospect holes which Mr. Fall dug came near being his grave. He was doing a little double-hand hammer work in the bottom of a 25-ft. shaft while his partner was hoisting the used drills. One of these slipped through a hole in the rawhide bucket and landed on Mr. Fall's head. The resulting injury was a severe

one, and even yet he carries a conspicuous scar as a reminder of this episode.

Twice during his experience in Mexico Mr. Fall barely escaped death. While exploring an old Spanish working bad air was encountered by two of his Mexican workmen. One managed

to reach the surface, more dead than alive, but he was unable to bring out his companion. Thereupon Mr. Fall went into the hole himself, found his workman at the bottom of a winze, and managed to carry him up the chicken ladder and the crude roadway to the surface. His heroism was in vain, as it developed that he had brought a corpse out of the mine. The other narrow escape he had in Mexico resulted from the proclivity of chicken ladders to turn over. Incidentally, Secretary Fall does not think much of chicken ladders. Mr. Fall was born in Frankfort, Ky., Nov. 26, 1861. His father was William Fall, who was a member of the staff of Gen. Nathan B. Forrest, of the Confederate Army, during the Civil War. His mother was Miss Edmonia Taylor, of Kentucky. The then future Secretary of the Interior earned his first money



HON. A. B. FALL

as an operative in a cotton factory in Nashville, Tenn. Later he returned to Frankfort, where he taught school and read law under Judge William Lindsey. In 1879 he went to Indian Territory and later moved to Clarksville, Tex. On returning to New Mexico from Mexico Mr. Fall made his home in Las Cruces. He took an active interest in territorial politics and served as a member of the Constitutional Convention. He was sent to the state Legislature for several terms.

Prior to 1902 Mr. Fall was affiliated with the Democratic party. In 1892 he was appointed an associate justice of the Supreme Court of New Mexico by President Cleveland. In 1896 he was appointed by the Democratic Governor as Attorney General. In 1902 he was elected to the state Senate as a fusion candidate. He was elected to the United States Senate as a Republican by the New Mexico Legislature March 27, 1912. He was re-elected for the term ending March 3, 1919, and again was re-elected for the term which will end on March 3, 1925.

Fan Equipment for Metal-Mine Fires

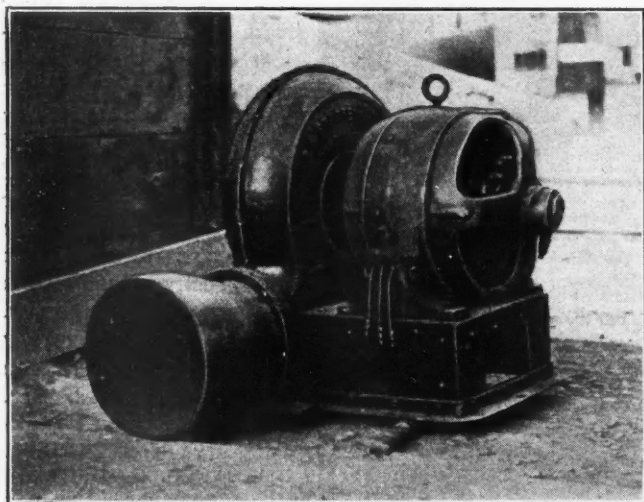
Uses of Portable Direct-Connected Blower and Disk-Fan Units Described—Ventilation Fans Render Valuable Aid Where Already Installed—Function of Air in Fire Fighting Sometimes Misunderstood

BY T. H. ARNOLD

Written for *Engineering and Mining Journal*

FIRES UNDERGROUND must be handled in a different manner than that applicable to those on the surface. In fighting some underground fires water can be used, but in the larger mines this method is almost always impracticable for various reasons. The method most generally used is to isolate the fire and smother it in its own gases.

The first thing to be done is to get the men safely out of the working places, and their names checked to see that all are out, before changing any air currents. The



NO. 4 BLOWER UNIT PURCHASED COMPLETE

chief danger, except in fighting a shaft fire, is that carbon monoxide gas will spread through the mine. A very small percentage of this gas will render the air deadly.

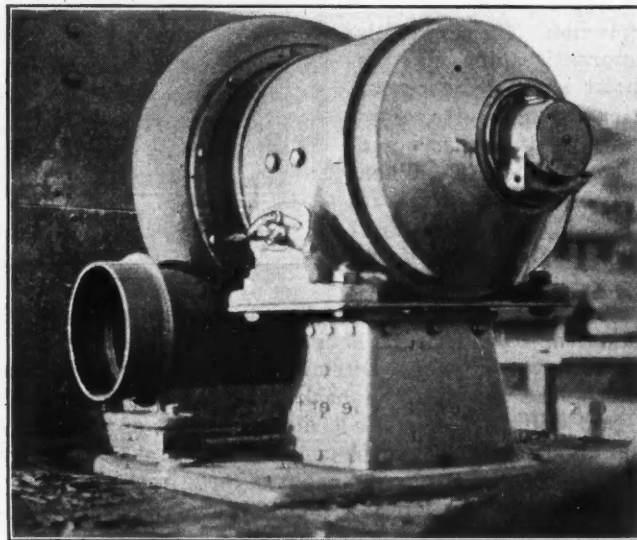
After the men are removed, the gases should be confined to the smallest possible area and the necessary bulkheads built to keep them there. This work must be done with the greatest dispatch. Prompt and efficient handling in the early stages of a fire will frequently limit the damage and save weeks or months of time in opening the parts of the mine affected. To accomplish these results the mechanical and electrical forces must co-operate with the mining forces by maintaining an adequate equipment of fans, blowers, and motors for handling the gases. Men should be trained to install these quickly.

IMPORTANCE OF BLOWERS AND FANS NOT ALWAYS FULLY REALIZED

The importance of helmets and a properly trained helmet crew is recognized by many of the larger mining companies, which have gone to considerable expense to maintain such crews. The necessity of providing fans and blowers does not appear to be so well realized. Fans for this use may be divided roughly into three classes, each of which fills a different requirement. The direct-connected unit is the best for rapid handling and installing. No time is consumed in lining up. A belt

may run off or break at a time when the consequences may be counted in men's lives. Less room is required, and room may be at a premium. These factors become important during the disruption of normal operations due to a fire. It is entirely possible to have a fan of this class running within ten minutes after it has been brought into position.

The No. 4 blower, direct-connected to a 2- or 3-hp. motor, forms a very compact and useful unit. These fans are commonly used for ventilating individual stopes, and may be standardized with the regular mine equipment. They should be reserved for special service and kept ready for use at all times. These units are small enough to be loaded intact on the average cage, and can be readily handled on push cars or slipped along the track. They can be operated without being bolted down, and either with or without a discharge pipe, as conditions warrant. Their chief use is in forcing back the gases to permit the building of bulkheads where the source of good air is not too far distant. The employment of timbermen for this purpose instead of the helmet crew will release the latter for other duties, and will result in much quicker work. These units may also be used for holding back the gases in a drift until the material and labor can be collected to build the bulkhead. They are used to blow between two bulkheads to prevent gases leaking around through broken ground. They

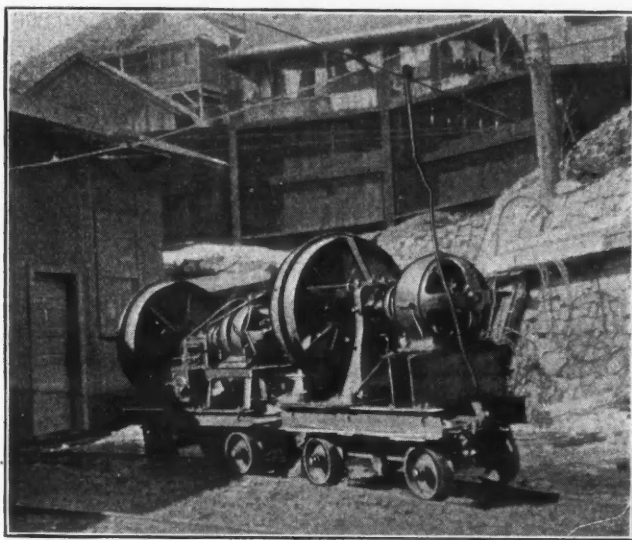


DIRECT-CONNECTED NO. 4 BLOWER UNIT MADE BY REMODELING BELTED BLOWER

are also used to clear small areas behind the bulkheads for exploration.

The second type is the disk fan in sizes from 36-in. to 60-in. Smaller sizes are not of much use, and larger ones cannot be handled in the average mine. These should be provided with a 5- to 10-hp. motor of variable speed and should be capable of running at rather higher speeds than those usually recommended.

During a fire, if a little more air is needed, the tendency is to speed the fan up until the required amount is obtained. Disk fans of this type are used where a larger quantity of air is required. They may conveniently be mounted on a truck, but should be so designed that they may be readily taken apart if it is necessary to handle them through a shaft or raise. Where electric haulage is in use, they may be wired in such a manner that merely by placing a hook on the trolley wire they will be ready to start when in position. A canvas brattice should be provided around the fan, which can be extended to close off the drift completely; otherwise much of the air will be reflected back and cause eddies. This fan is used in forcing back the gases in long drifts or for changing air currents in larger sections of the mine. For this reason it is usually installed in one of the main haulageways.



TWO 36-IN. DISK-FAN UNITS AND TRUCKS CONSTRUCTED IN MINE SHOPS. NOTE HOOK ON TROLLEY WIRE FOR POWER CONNECTION

The third type is the mine-ventilation fan which is designed to furnish air for all or for a large part of the mine. These are not fire fans primarily, and, as their installation requires a considerable amount of time, they cannot in general be used unless they have been installed prior to the occurrence of the fire. Where they have been available their aid has been invaluable. The absolute control of the air to be obtained with a fan of this type will frequently allow work which would be impossible under any other conditions.

In one mine fire a fan of this type saved months of work and more than the entire cost of the installation. The fire occurred in a raise driven from a timbered drift in heavy ground. The fan was operated with restricted opening till the gases were held a short distance from the raise. The red-hot material falling down the raise was quenched as it fell by playing a stream of water on it from a hose. The material continued to fall till it had filled the drift and a considerable distance up the raise. When the caved material had been removed it was found that the timbers, although somewhat charred, were still strong enough to support the ground. In this instance the entire work of sealing off the fire was done without the use of helmets, although the place was about 900 ft. from the shaft supplying fresh air.

The exact function of the air as used in attacking a mine fire does not appear to be clearly understood, and

the objection is raised that the fans only tend to feed the fire. This may occur unless the air is properly handled, especially in the early stages while the bulkheads are being constructed. However, an effort should be made to use only such air as is necessary to produce the desired results. A fan in a drift or raise may be regulated to neutralize or even to slightly reverse the draft without forcing an appreciable amount of air through the drift.

Where a fire occurs in a confined space, large quantities of gases are given off. These gases must find an outlet and will build up pressure if necessary till they overcome the natural draft and air currents. In this manner they may work back through the mine or they may work their way through crevices and broken ground and appear on the surface or in some other section of the mine. The general purpose of the fans is to build up local pressure and hold back the gases at certain points.

Though the current of air may eddy and mix with the gases near the fan, where the velocity is high, a short distance away the action is more in the nature of a piston, and a sharp line of demarcation exists, with little intermixing. This is quite visible where smoke or dust is present. It is thus entirely possible to force the gases back several hundred feet and maintain them within the working distance of a fire without appreciably feeding the fire with fresh oxygen.

To do this, adequate equipment is necessary to control the air pressure accurately. The factors which account for the air delivered by the fan are the counter pressure of the gases, the air friction in the drift, and the air dissipated by leakage. As a matter of fact, the fan is adjusted to furnish only the number of cubic feet of air which will leak back at the pressure necessary to maintain the gases at a certain point. This is a matter of proper equipment and careful manipulation, and should not be attempted unless both are available. When work of this character is going on, at least two helmet men should be in attendance to give warning in case of any change in air currents or other occurrence which might endanger the men at work. They should not be called upon to do anything which might distract their attention from these duties. They would also act as a rescue crew if unforeseen contingencies arise.

Work of this character must usually be rushed, and has its element of danger. For this reason the men of the electrical and mechanical forces selected should be as carefully picked as those of the helmet crews. In fact, training along much the same lines should be given, to make them realize the importance of giving the correct amount of air when required.

Sand-Sucker Mining

Operating under license from the Ontario Department of Mines, sand-suckers working on the bars and shoals in the beds of the Great Lakes and rivers in 1920 recovered 1,456,417 cu.yd. of sand and gravel, valued at \$830,634, according to Bulletin 41 of the department. Output of sand and gravel in Ontario increased nearly 100 per cent in 1920 over that of 1919. Revenue to the province from the source noted approximated \$100,000 for 1920.

The use of the sand-sucker in mining operations suggests interesting possibilities of recovery from submerged beaches or ledges that are thought or known to be mineralized.

American Clay in Graphite Crucibles*

Bureau of Mines Finds the Domestic Bond Material Suitable for Crucible Use and Equal to Imported Product

PRIOR to 1914 practically all graphite crucibles manufactured in the United States were made from Ceylon graphite bonded with German Klingenberg clay. It was the general belief among graphite crucible manufacturers and users that good crucibles could not be made from American bond clays and graphites. Graphite crucibles were essential for melting certain alloys and special steels urgently needed for the manufacture of war materials. The demand for such metals was so great that it created an unprecedented demand for graphite crucibles.

After the Great War began no Klingenberg clay could be shipped out of Germany. However, it was fortunate for the crucible makers that they had large stocks of Klingenberg clay on hand. When the stock of Klingenberg clay became exhausted it was necessary for the crucible makers to turn their attention to American clays. There were no data or other information available to guide the crucible makers in the selection of good bond clays for their crucibles. It was necessary for them to select their clays by "guess," which resulted in the period of service or life of graphite crucibles being shortened 15 to as much as 60 per cent.

The ceramic station at Columbus, Ohio, undertook the investigation of American bond clays and graphites to determine their crucible-making properties as compared with foreign raw materials, and to furnish both crucible makers and users with much-needed information. Careful laboratory tests were made on a large number of clays. As a result of these tests the clays were "sifted down" to twenty which appeared to be promising. Eighteen of these clays were domestic, one was an English clay, and one the German Klingenberg clay.

After the laboratory tests were completed, the next step was to apply the results obtained in the laboratory to actual factory practice. Fifteen large-size crucibles were made of each of the twenty clays, using a standard graphite. That the tests might be comparable to actual practice, the crucibles were made in the regular manner at the plant of the Vesuvius Crucible Co., Swissvale, Pa. Ten of the crucibles of each clay were tested under the regular foundry practice for melting brass at the plant of the Detroit Lubricator Co., Detroit, Mich., and five were tested under steel-melting practice at the foundry of the Simonds Manufacturing Co., Lockport, N. Y. Three representatives of the ceramic experiment station were present during the tests and kept accurate records of the performances of the crucibles. The results of the tests on the brass-melting crucibles showed that two American clays tested higher than the German Klingenberg clay and eight tested higher than the English clay. Tests on the steel-melting crucibles showed thirteen domestic clays giving crucibles of higher service than the Klingenberg clay and five testing higher than the English clay.

At present 120 crucibles are being made to test the crucible-making properties of the foreign and domestic graphites. Graphite samples are to be tested from the following localities: Ceylon, Madagascar, Canada, New York, Alabama, Texas, and Montana. The work on the bond clays is finished and the tests on the graphites will

be completed soon. The crucible makers of the United States have been quick to profit by these experiments. In so far as has been determined, no German Klingenberg clay is used in America at present, and it is gratifying to note that some crucible makers advertise that the superior qualities of their crucibles are due to the use of the best American bond clays.

Potash Production 57 Per Cent Greater In 1920

Returns thus far received by the U. S. Geological Survey from the producers of potash in the United States during 1920 indicate that the output amounted to 167,346 short tons of crude potash salts, containing 48,625 short tons of actual potash (K₂O). The stocks on hand amounted to about 30,000 short tons of crude salts. The sales were valued at more than \$7,000,000. This material was produced at 65 plants. In 1919 there were in operation 77 plants, which reported an output of 110,243 short tons of crude salts, containing 30,845 tons of actual potash. In 1918, 128 plants were in operation and made the largest domestic production—207,686 tons of crude salts, containing 54,803 tons of potash.

The table reproduced herewith shows that the bulk of the output in 1920 was obtained from salines, and, as in former years, the Nebraska lakes afforded the largest percentage. The company that made the largest output, however, did not operate on the Nebraska lakes.

POTASH PRODUCED IN THE UNITED STATES IN 1920

| Source | Number of Plants | Crude Material (Short Tons) | Actual Potash (K ₂ O) (Short Tons) | Percentage of Total |
|--|------------------|-----------------------------|---|---------------------|
| Salines: | | | | |
| Nebraska..... | 11 | 85,245 | 20,934 | 43.0 |
| Elsewhere..... | 6 | 46,865 | 17,207 | 35.4 |
| Totals..... | 17 | 132,110 | 38,141 | 78.4 |
| Cement dusts..... | 7 | 10,056 | 1,141 | 2.4 |
| Blast-furnace dusts..... | 9 | 1,503 | 152 | 3 |
| Waste from molasses distilleries..... | 4 | 9,420 | 3,253 | 6.7 |
| Waste water from sugar refineries that use the Steffens process..... | 7 | 9,201 | 3,394 | 7.0 |
| Wood ashes..... | 16 | 294 | 200 | 4 |
| Alunite, silicate rock, kelp, and miscellaneous..... | 5 | 4,762 | 2,344 | 4.8 |
| Totals..... | 65 | 167,346 | 48,625 | 100.0 |

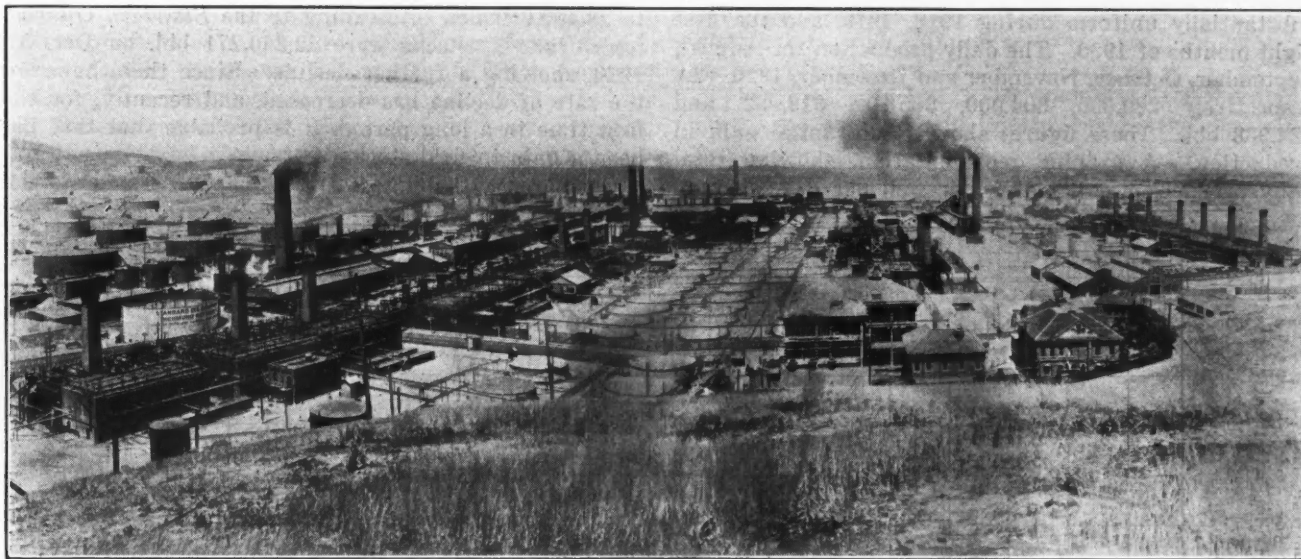
About 200,000 short tons of potash was imported in 1920, and this quantity, with the 48,625 short tons produced in this country, made the available supply about equal to the quantity normally used in each of the five years immediately preceding the war.

Because of the low price received for their produce many of the farmers of the country were unable to take up promissory notes given by them for fertilizer in the spring of 1920 and were also unable to buy the fertilizer they required in the fall. This condition, coupled with the abundance of potash on the market, resulted in a cancellation by the fertilizer-manufacturing companies of orders for domestic potash and greatly reduced the prices of all potash fertilizer materials. As a consequence, all the Nebraska plants were closed by the end of December. Most of the other fifty-four plants reported almost continuous operation during the year.

Another hardship suffered by the Nebraska producers was the unprecedented rainfall early in the summer, which diluted the brines in the lakes so much as to make their concentration more difficult and more expensive. There is still considerable apprehension as to whether the domestic potash industry will be able to maintain its existence in the face of the renewed importation of potash salts.

*U. S. Bureau of Mines, Reports of Investigations.

THE PETROLEUM INDUSTRY



RICHMOND PETROLEUM REFINERY OF STANDARD OIL CO. OF CALIFORNIA

Petroleum in California

Unfavorable Position in August, 1920, Improved by Increased Production at End of 1920 and Beginning of 1921—Activity in Oil Prospecting in Northern Part of the State

Written for *Engineering and Mining Journal*

PRODUCTION of crude petroleum in California comes principally from eleven fields and from an acreage somewhat less than 100,000. The estimated acreage, number of wells, and wells per acre are given in Table I. For comparison, the number of wells being drilled, number of producing wells, and daily production from the various oil fields for December, 1920, are indicated. Production is principally in the hands of large companies, such as the Standard Oil of California, Southern Pacific Land Co. and associated and allied companies, Union Oil Co., Shell Co. of California, General Petroleum Co., American Oilfields and allied companies, Santa Fe R.R. and allied companies, Pan-American Petroleum, Commonwealth and allied

companies, Honolulu Consolidated Oil Co., and Ventura Consolidated Oilfields. There are also many minor producers.

In a report by a special committee of the San Francisco Chamber of Commerce attention was called to the fact that increased yield came from four of the eleven principal fields, the others showing declining production in 1919 as compared with 1916. Increases in the four fields (Coalinga, Santa Maria-Lompoc, Newhall-Ventura and Whittier-Fullerton) amounted to 18,261,064 bbl., and decreases in the remaining fields were 8,861,642 bbl. The difference, 9,399,422 bbl., represents the 1919 gain in production over 1916. The principal gain was in the Whittier-Fullerton field, 13,987,011 bbl.,

TABLE I—ACREAGE, NUMBER OF WELLS, DECEMBER, 1920, AND 1920 PRODUCTION, CALIFORNIA OIL FIELDS

| Field | June 30, 1920 (a) | | | December, 1920 (c) | | | 1920 Production |
|----------------------------|-------------------|------------------|----------------|--------------------|-----------------|--------------------------|--------------------|
| | Aeres | Wells | Acres per Well | Drilling | Wells Producing | Production per Day, Bbl. | |
| Coalinga..... | 13,924 | 1,253 | 11.1 | 30 | 1,293 | 40,817 | 15,464,198 |
| Kern River..... | 7,034 | 2,042 | 3.4 | 46 | 2,152 | 19,980 | 7,456,515 |
| McKittrick..... | 1,580 | 317 | 4.98 | 6 | 352 | 6,786 | 2,607,240 |
| Midway-Sunset..... | 45,585 | 2,369 | 19.2 | 93 | 2,509 | 139,100 | 37,917,010 |
| Belridge-Lost Hills..... | 4,344 | 579 | 7.6 | 16 | 591 | 11,060 | 4,139,767 |
| Salt Lake-Los Angeles..... | 1,014 | 266 | 3.8 | 9 | 666 | 3,590 | 1,311,264 |
| Whittier-Fullerton..... | 5,594 | 913 | 6.1 | 204 | 990 | 81,254 | 28,694,163 |
| Ventura-Newhall..... | 2,374 | 498 | 4.8 | 46 | 513 | 6,022 | 2,122,449 |
| Santa Maria-Lompoc..... | 10,263 | 396 | 25.9 | 17 | 406 | 16,100 | 5,928,060 |
| Sargent..... | 80 | 9 | 89 | | | | |
| Miscellaneous..... | ..... | ..... | ..... | 40 | 149 | 224 | 80,520 |
| Totals..... | 91,792 | 8,642 (c) | 10.6 | 507 | 9,621 | 324,933 | 105,721,186 |

(a) Summary of operations, California oil fields, October, 1920, California State Mining Bureau.

(b) *Standard Oil Bulletin*, January, 1921.

(c) According to the *Standard Oil Bulletin*, August, 1920, there were 9,357 producing wells, having a total production per day of 273,069 bbl.; from the same authority the average production January 1, 1920, to June 30, 1920, was 274,917 bbl. per day.

The independent Oil Producers' Association's report for June, 1920, gives 9,271 producing wells and 272,908 bbl. as the daily average for June. The number 8,642 given in the table is the number for assessment purposes, and probably excludes wells with incidental production.

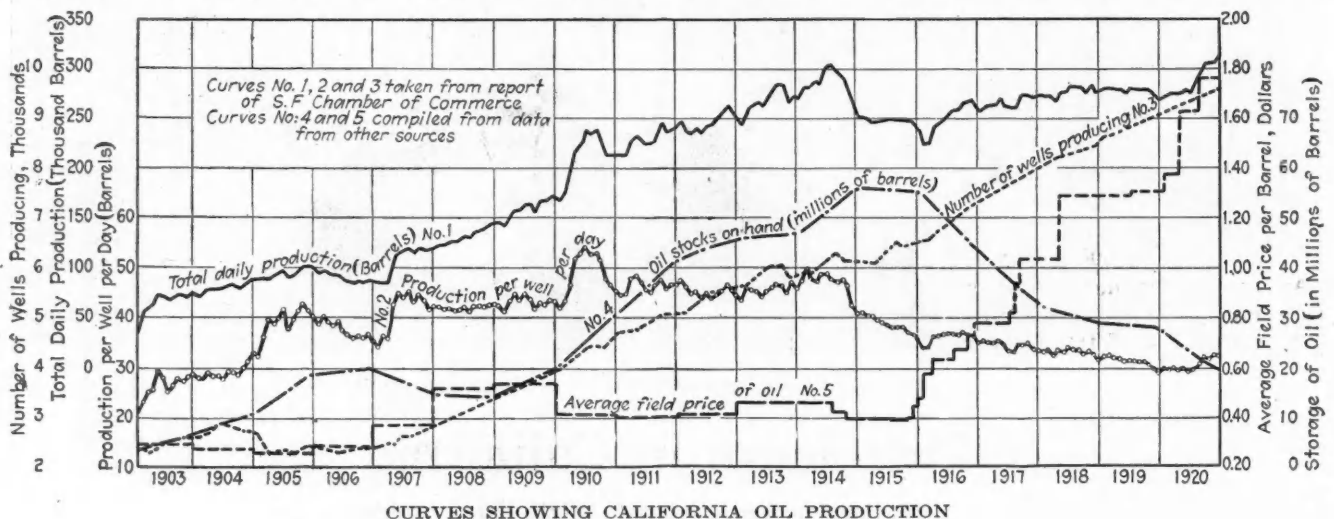
¹A part of the information in this article was taken from this report; the remainder from miscellaneous sources.

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| Cement, lime, etc..... | 5,600 | 2.4 |
| Sugar refineries and plantations..... | 4,800 | 2.1 |
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| Miscellaneous—Government uses..... | 4,000 | 1.7 |
| Total..... | 179,200 | 75.5 |

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There is a well-marked tendency in the oil-refining industry generally toward a greater production of refined products. Whereas formerly the proportion of these products obtainable in refining was almost entirely dependent on the gravity of the oil run, the development of the "cracking process" has changed this situation. In the refining of California crudes, the heavy character of the oils and the nature of the base are such as to increase the proportion of fuel oil. Fuel oil is also extensively used in California, and for a long time was the important market outlet for crude oil. Since 1918, however, the production of kerosene in California has doubled, and approximately 6,000 bbl. per day which formerly remained in the residuum or was sold as engine distillate is now distilled as kerosene.

The "cracking process" will cause an additional drain upon the fuel-oil supplies. Just how much this will be is not accurately known, but it is roughly estimated that it will reach 22,000 bbl. per day by the end of 1921. Assuming that the rates of production and consumption continue as they were during the year ended Aug. 31, 1920, the sum of the actual and potential drafts is at the rate of 50,000 bbl. per day. Adding the potential draft for "cracking purposes" to the total consumption of 303,000 bbl. per day estimated for the period of January-June, 1920, gives 323,000 bbl. per day as a rough approximation of the consumption by the end of 1921. This assumes no increase in consumption other than that provided for "cracking."

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Operating Costs: The cost of producing shale-oil products would be the sum of the costs of each process, as mining, crushing, retorting, fixing ammonium sulphate, and refining. The cost of each process would consist of the following main items: Labor; supplies; supervisory salaries of foremen, superintendents, and other executives; clerical salaries connected with the works; fixed plant charges, as taxes, insurance, interest and depreciation; variable plant charges, as power, water, camp, and other incidentals. In addition there would be added to mining costs, (1) depletion or exhaustion of the property per ton of shale mined, and (2) development or opening up new territory, the total cost of which would probably be a deferred expense, to be amortized against the mined shale.

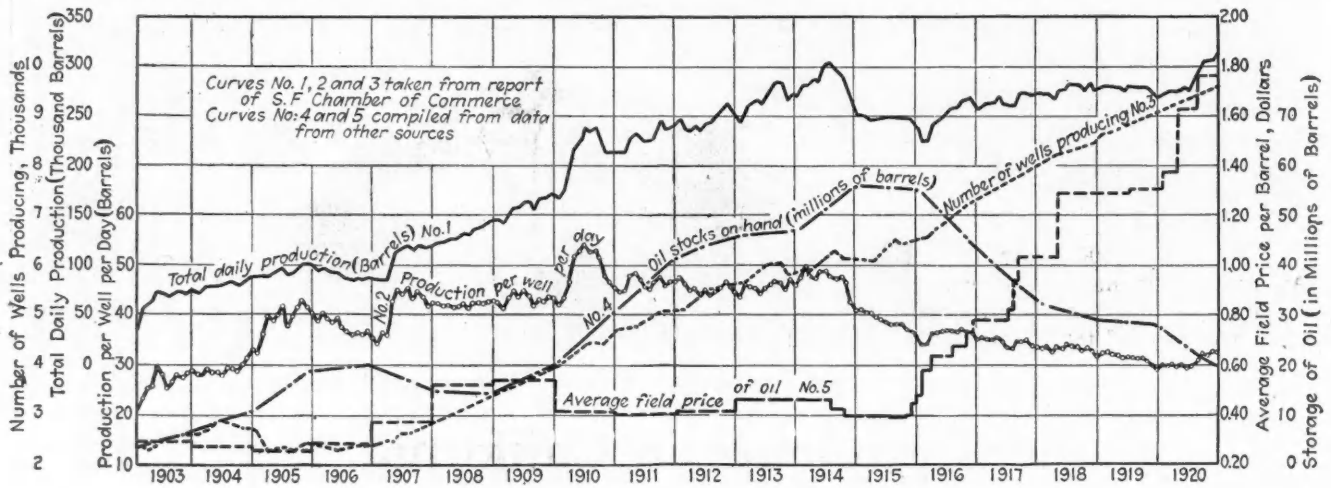
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Book Reviews

Field Methods in Petroleum Geology.

By G. H. Cox, C. L. Dake, and G. A. Muilenburg. Flexible cloth; 5½ x 7½; pp. 305; illus. McGraw-Hill Book Co. Inc., New York. Price, \$4.

This book has been prepared for the purpose of providing a handbook for petroleum geologists similar to those prepared for field work in other branches of engineering. Chapter I describes the instruments commonly used in field work; Chapter II outlines the instrument methods in general use; Chapter III discusses the various geologic standards that are used in correlating beds and identifying structures, and Chapter IV is devoted to the personnel of the field party, to the actual field procedure in reconnaissance and detailing, and to the preparation of the map and final report. A glossary and useful tables are also included.

Copper Refining. By Lawrence Addicks. Cloth; 6 x 9; pp. 211. McGraw-Hill Book Co., New York. Price, \$3.

When copper first was electrolytically refined on a commercial scale, about forty years ago, metallurgical processes were not given the publicity which they today receive. Most plant managers considered themselves the custodians of a great secret, about which nothing should be said for fear a competitor would learn something to his advantage. In those days, we suspect, editors of technical publications must have been particularly *persona non grata*, for, of course, they would describe everything they saw, tell everything they knew, and suspect things which they shouldn't. Gradually, however, this custom has become obsolete, in this country at least (we understand the old idea dies hard in England). It began to be embarrassing to certain officials to find out how far ahead their competitors had progressed, and that their secrets had not only been fathomed, but considerably improved upon. Then came the realization that if any one wanted to find out just what was going on in Mr. Clam's plant, all that was necessary to do was to carry on a little elementary detective work. Also, the individual benefit resulting from a promotion of the general welfare of an industry came to be understood. Now, technically interested visitors to metallurgical works are usually welcome, and they generally leave more than they take.

Unfortunately, as copper refining was developed in the Age of Metallurgical Mysticism, no authoritative work on the subject was written, and nowadays the process seems too old to warrant extended description; technical writers find that such subjects as the electrolytic deposition of zinc are of more contemporaneous interest. Several articles have appeared on this new phase of zinc metallurgy, and a book has also been published on the subject,

which we hope to review next week. Copper refining, however, deserves some attention, and we welcome a volume written by an engineer of Mr. Addicks' discernment and experience. The text does not pretend to cover the subject completely; rather is it a discussion of certain phases of copper refining which came within the personal experience of the author. This is shown by the chapter headings: Metal Losses; Metal in Process; Tank Resistance; Current Density; Current Efficiency; Impurities; Byproducts; Furnace Refining; The Requirements of Refined Copper; Copper From Secondary Material; The Power Problem; Elements of Design; and Application to Other Fields.

The separate chapters were published during 1916 and 1917 by *Chemical & Metallurgical Engineering*. Their assembly in the present volume makes them more convenient and available for reference. The book will be valuable to any one interested in electrometallurgy.

E. H. R.

Powdered Coal as a Fuel. Second edition, revised and enlarged. By C. F. Herington. Cloth; 6 x 9; pp. 338, 124 illustrations. D. Van Nostrand Co., New York. Price, \$4.50.

The first edition of Mr. Herington's book, written in 1917, was so successful, and the progress of pulverized-coal firing practice since then has been so rapid, that three years later it was found advisable to prepare this second edition. The subjects treated include cost comparisons of plants using powdered coal, oil and gas; coals suitable for powdering; the preparation, feeding, and burning of powdered coal; powdered coal in the cement industry, as fuel for reverberatory and other metallurgical furnaces, and for boilers and locomotives; explosions; and suggestions on how to operate a pulverized-coal plant. Tabular matter and a bibliography of twenty pages are appended.

The use of powdered coal under boilers forms the topic of an interesting chapter. Many plants which use pulverized coal in some furnaces retain the older method of firing for their steam boilers, and Mr. Herington's remarks as to how powdered-coal firing may be adapted to existing boiler installations should receive attention. The chapter on powdered-coal firing of reverberatory furnaces is a little out of date now, and, also, there is no mention of the Garred-Cavers process of using this fuel for copper and lead blast furnaces.

Mr. Herington is Chicago district manager of the Bonnot Company, manufacturers of the Holbeck pulverized-coal system, but it is only fair to say that this apparatus is not given undue prominence. The book will be particularly valuable to those who do not use pulverized coal at present, but who are considering the adoption of that fuel. It should not be considered as a treatise on the more efficient operation of present plants.

E. H. R.

Technical Papers

Zinc Smelting Losses—Dr. Otto Mühlhaeuser, smelter superintendent with Georg von Giesche's Heirs, Risdzin, Upper Silesia, has recently collected eighteen papers, written in German, dealing with the sources of loss in zinc smelting, which he contributed to *Metall und Erz*, Halle a. Saale, between 1918 and 1921. The last one, "The Sources of Metal Loss in Zinc Smelting," sums up, tabulates, and concludes the work published in detail during the preceding years. The range of subjects the author has recently discussed in *Metall und Erz*, is shown by the following list of titles: "American Practice in Combining Zinc Ores for Roasting"; Vol. XV, pp. 123-124; 1918, Hft. 15. "The Zinc Content of the Muffle Residue and Its Significance in the Durability of the Muffle"; Vol. XV, pp. 259-265; 1918, Hft. 16. "Zinc Slags"; Vol. XV, pp. 303-305; 1918, Hft. 17. "The Glaze Formed in Zinc Muffles" [when fired with ferruginous coal]; Vol. XV, pp. 393-395; 1918, Hft. 21. "Gases Escaping From Zinc Muffles During the Reduction of Blende"; Vol. XV, pp. 431-436; 1918, Hft. 23. "A Simple Manometer"; Vol. XVI, p. 101-102; 1919, Hft. 5. "The Seger-Aron Differential Manometer"; Vol. XVI, pp. 147-150; 1919, Hft. 7. "The Permeability of Zinc Muffles"; Vol. XVI, pp. 191-195 and 219-223; 1919, Hft. 9 and 10. "Devices for Determining the Volumes of the Gases Escaping From Zinc Muffles"; Vol. XVI, pp. 273-279; 1919, Hft. 12. "Effect of Pressure on the Permeability of a Zinc Muffle"; Vol. XVI, pp. 323-326; 1919, Hft. 14. "The Influence of the Pressure Prevailing Within a Zinc Muffle on the Yield of Metal"; Vol. XVI, pp. 363-373; 1919, Hft. 16. "The Pressure Prevailing Within a Zinc Muffle"; Vol. XVI, pp. 538-544; 1919, Hft. 22. "The Combustion Chamber of the Hegeler Zinc Oven"; Vol. XVII, pp. 1-4; 1920, Hft. 1. "The Determination of the Thermal Conditions of Zinc Ovens"; Vol. XVII, pp. 137-150; 1920, Hft. 6. "The Thermal Analysis of the Charge of a Zinc Muffle During Reduction"; Vol. XVII, pp. 209-212; 1920, Hft. 9. "Determination of the Volumes of Gases Escaping From a Zinc Muffle During Reduction"; Vol. XVII, pp. 415-420; 1920, Hft. 19. "An Experimental Oven for Making Zinc, and the Quantitative Determination of the Resulting Principal, Intermediate and Waste Products"; Vol. XVII, pp. 487-494; 1920, Hft. 22. "The Sources of Metal Loss in Zinc Smelting"; Vol. XVIII, pp. 1-22 and 46-51; Hft. 1 and 2.

Anaconda—"The Anode," published monthly by the Bureau of Safety of the Anaconda Copper Mining Co., Butte, Mont., is running a series of articles describing the company's operations. Weighing, sampling, and concentrating zinc ores is the subject discussed in the March issue.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Taxation Meeting of Mining and Metallurgical Society

R. C. Allen and Others Discuss Problems—Special Committee Appointed To Study Conditions

The New York Section of the Mining and Metallurgical Society of America held a dinner and an animated discussion at the Columbia University Club, on Thursday evening, March 24. Dinner at 6:30 was followed by informal talks and discussion till past 11. The subject of the evening was Mining Taxation. The president of the society, J. E. Spurr, at the request of the chairman of the section, J. A. Church, Jr., opened the discussion by announcing the formation of the society's committee on taxation, consisting of Ralph Arnold, chairman; R. C. Allen, L. C. Graton, B. Britton Gottsberger, H. M. Chance, and H. B. Fernald. The first speaker was Dr. R. C. Allen, recently vice-president of the Lake Superior Iron Ore Association. He explained the broad underlying principles of taxation, pointing out that the problem of the method and rate of mine taxation could be properly evaluated only in connection with the problem of taxation of farms and factories. Dr. Allen was of the opinion that the problems of local and state taxation were of as much importance as Federal taxation and sometimes relatively more important. He called attention to the trend in many states toward practically confiscatory taxation of mines, and pleaded for a broad inquiry into the underlying social theories and their remedy.

Prof. Robert M. Haig, of Columbia University, touched on the principles of taxation, and warned of the tendency which existed toward withdrawing the special consideration of mines existing under the present practice. He outlined the danger that the principle of depletion might be abandoned, in accordance with the English practice.

H. B. Fernald went to the root of the matter by pointing out the total amount of taxes which had to be raised somehow, under our present scale of expenditure. It means that on the average a man has to work two months of the year for taxes, and has only the remainder to support himself and increase the wealth of the country. Mr. Fernald said that under a budget system, carefully adhered to, it was possible to keep down public expenses without serious detriment, and he concluded that the main element of the taxation problem was governmental business management.

The discussion was participated in at length by B. F. Tillson, R. M. Catlin, T. M. Chance, H. M. Chance, L. C. Graton and others. Messrs. Chance and Graton stressed the necessity, to which

Mr. Allen had alluded, of the committee forming itself into a vigilance committee to be on the watch for any loss of the taxation privileges which had been granted mines, and to which mines were rightfully entitled—especially the right of charging a depletion deduction and taking into consideration new discoveries subsequent to March 1, 1913. Mr. Graton maintained that although the right to modify valuation as a consequence of new discoveries was an essential one, it was impossible of execution under the present methods, and he proposed that a system of flat "discovery" allowances should be adopted. This would make unnecessary the evidently impracticable effort to prove by maps and figures each discovery.

Colorado Scientific Society Elects Officers

The Colorado Scientific Society has elected the following officers to serve during the year 1921: President, W. F. R. Mills; first vice-president, William A. Johnson; second vice-president, J. Claire Evans; treasurer, Charles W. Henderson; secretary, Robert W. Gordon. The following have been elected members of the executive committee: Hugh B. Lowden and Thomas L. Wilkinson, whose terms expire Jan. 1, 1924; and L. G. Carpenter, whose term expires Jan. 1, 1922. The annual dinner of the society was held at the University Club, Denver, Col., on March 26, 1921.

Institute of Metals Forms a London Section

A London local section of the Institute of Metals has just been formed, with the sanction and financial assistance of the council. The chairman is Dr. O. F. Hudson, of the Admiralty Engineering Laboratory, and D. Hanson, M.Sc., of the National Physical Laboratory, Teddington, is honorary secretary. Membership is open to persons resident within fifty miles of the London General Post Office. No subscription is required of members of the Institute of Metals, but non-members of the parent body, when elected as associate members of the local section, pay an annual subscription of five shillings.

The first paper to be brought before the London Section was read on Feb. 24, by O. W. Ellis, M.Sc., on "60:40 Brass." On March 31, S. L. Archbutt read a paper on "Aluminium Alloys," and on April 21 Dr. W. R. Ormandy will speak on "Refractories." The London Section already has a membership of over 200, and is proving a valuable meeting ground for metallurgists and engineers who wish to discuss technical problems at more frequent intervals than is practicable in the case of the parent institute.

Saint-Etienne School of Mines To Celebrate Founding Centennial

The national mining school of Saint-Etienne was established by a royal order of Aug. 2, 1816, shortly before the reorganization of the Ecole Supérieure des Mines at Paris. These two schools were intended to replace those of Geislautern and Pesey, which the treaties of 1814 and 1815 removed beyond French boundaries.

The famous school at Saint-Etienne has trained four-fifths of the directing personnel of the mining industry of France, but as its centenary fell in the midst of the Great War an appropriate celebration of the event was postponed. It has now been decided to hold an elaborate official celebration on May 9 and 10. According to *L'Echo des Mines et de la Métallurgie* the arrangements are chiefly in the hands of the Société Amicale d'anciens Elèves and of the school's council. A delegation of engineers, accompanied by the prefect and the senators of the Department of the Loire as well as by the mayor of Saint-Etienne, recently went to Paris to invite the president of the republic and the government to be represented at the festivities.

Jesse Knight Mourned by Utah Chapter of A. M. C.—Officers Elected at Annual Meeting

The Utah Chapter of the American Mining Congress held its annual election of officers on the afternoon of Tuesday, March 14. Arrangements were made to have the chapter represented at the funeral of Jesse Knight, a charter and life member, which took place March 16 at Provo, and a resolution bearing upon the great loss which his death had caused to Utah's mining industry was adopted.

Eight of the twenty-four directors, whose terms had expired, were re-elected as follows: C. E. Allen, Ernest Bamberger, Fred Cowans, R. C. Gemmell, G. W. Lambourne, D. MacVichie, E. J. Raddatz, and V. S. Rood. L. S. Cates and M. R. Evans were elected as directors to fill vacancies. Officers for the coming year are: G. W. Lambourne, president Judge Mining Co., governor; Walter Fitch, president Chief Consolidated Mining Co., first vice-governor; C. E. Allen, general manager U. S. Smelting Co., second vice-governor; J. William Knight, Knight Investment Co., third vice-governor; A. G. McKenzie, secretary and treasurer. The executive committee was named as follows; L. S. Cates, Fred Cowans, Imer Pett, V. S. Rood, and G. W. Lambourne, who was elected chairman.

MEN YOU SHOULD KNOW ABOUT

D. E. Sutherland, of Ironwood, Mich., has returned from a month's vacation in Florida.

P. J. Shambeau has been elected president of the Sonoma Magnesite Co. of California.

C. W. Purington, mining engineer, formerly of Vladivostok, Siberia, has returned to England.

Walter E. Segsworth, mining engineer, of Toronto, Ont., was in New York City last week.

E. P. J. Burgess, mining engineer, of Butte, Mont., is in New York City on professional business.

E. C. Homersham has left England and will represent Minerals Separation, Ltd., in South Africa.

K. K. Kimball, of the U. S. Geological Survey, is doing co-operative work on Tennessee marbles.

Frederick R. Weekes, mining engineer, has returned to New York City from a professional trip to California.

C. Erb Wuensch, mining engineer, who is developing the Eagle mine at Bonanza, Col., is in New York City on professional business.

L. C. Butler, of New York, is examining mining property in the Lordsburg and Pinos Altos districts of New Mexico.

Henry W. Gould and **John Mociac**, mining and petroleum geologists, have opened offices in the Kohl Building, San Francisco, Cal.

David White, chief geologist of the U. S. Geological Survey, is delivering a series of lectures on fossil fuels at the University of Wisconsin.

William McInnis, of Ottawa, formerly directing geologist of the Geological Survey of Canada, is now director of the museum at Ottawa, Ont.

Frank Estes, mining engineer, is in New York City, and will leave for Salvador, in the near future, to reopen the property of El Salvador Silver Mining Co.

George Hanson has been transferred to the staff of the provincial offices of the Canadian Geological Survey branch. His address is 510 Pacific Building, Victoria, B. C.

P. S. Coudrey, who has been in charge of the Le Roi No. 2 at Rosslund, B. C., for the last two years, has gone to Spain to accept a position with an operating company there.

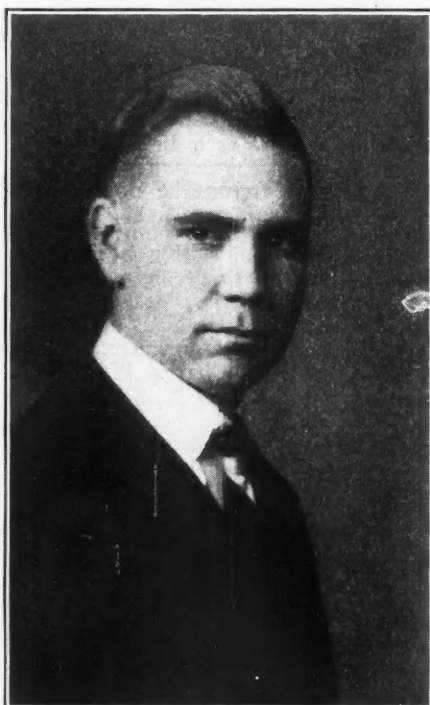
Major-General R. G. E. Leckie, of Vancouver, B. C., has been appointed mining engineer to the British Columbia commission to investigate matters in connection with the price charged for coal in Vancouver.

A. H. Heller, metallurgical engineer, is now associated with **David E. Day** and **Rolland B. Day** in the Day Co., petroleum and oil-shale geologists and

engineers. The firm has offices in the Hobart Building, San Francisco, Cal., and at 715 19th St., N. W., Washington, D. C.

Viscount Tadashiro Inouye, a prominent Japanese engineer and an advisory director of the South Manchurian Railroad, visited the Mesabi iron range last week for the purpose of studying the methods of mining, as similar conditions exist in Japan relative to coal and iron deposits.

R. C. Allen, of the special committees on the taxation of mines established by the National Tax Association and the American Institute of Mining and Metallurgical Engineers, has just been appointed a member of the committee on taxation of the Mining and Metal-



R. C. ALLEN

lurgical Society of America. Mr. Allen was the first speaker on the program at the "Taxation Meeting" of the society in New York City on March 24.

F. G. Clapp, petroleum geologist, who has been lecturing before the geological department of Harvard University, addressed the geological conference in Cambridge, Mass., on March 15. His subject was "A Geologist's Trip Through China," and he illustrated the talk with lantern views taken by himself.

Philip Henry Argall, manager of the Ozark Smelting & Mining Co., Magdalena, N. M., was one of the members of the recently dissolved firm of Philip Argall & Sons. The other members will conduct a general mining business individually, **George Oates Argall** at Leadville, Col., and **Philip Argall** at Denver, Col.

Among mining engineers recently visiting New York City were: **S. H. Zimmerman**, of Murfreesboro, Ark.; **Glenville A. Collins**, consulting engi-

neer, of Vancouver, B. C.; **M. G. Yatsevitch**, of 23 Drayton Gardens, London; **Philip Silverstein**, metallurgist, of Detroit, Mich.; **Benjamin F. Tillson**, of Franklin, N. J. **Kirby Thomas** and **A. E. Hepburn** recently returned from professional trips.

H. F. Bain, director, and **Dorsey A. Lyon**, supervisor of stations, U. S. Bureau of Mines, will leave Washington on April 10, to visit and inspect a number of the Bureau's experiment stations. While on this trip Director Bain will address the graduating classes at the Michigan College of Mines and at the Missouri School of Mines. At Houghton, Mich., the address will be delivered on April 14, and April 29 is the date set for the Rolla, Mo., address. The Bureau's stations and offices at Minneapolis, Minn., Bartlesville, Okla., St. Louis, Mo., and Birmingham, Ala., are included in the itinerary.

SOCIETY MEETINGS ANNOUNCED

The Mining Society of Nova Scotia will hold its twenty-ninth annual meeting at Halifax, N. S., on April 5 and 6.

The American Association of Engineers will hold its seventh annual convention at Buffalo, N. Y., on May 9 to 11, inclusive. National headquarters, 63 Adams St., Chicago, Ill., is the office of Secretary C. E. Drayer.

The Institution of Mining and Metallurgy will hold its Annual Dinner on April 13, in the "Edward VII" Room of Hotel Victoria, Northumberland Ave., London, W. C. 2. The secretary is C. McDermid, 1 Finsbury Circus, E. C. 2. The annual meeting of the Institution will be held on April 21.

The American Chemical Society will hold its spring meeting with the Rochester, N. Y., section in that city on April 26 to 29, inclusive. Rates of one and one-half fares have been granted by all roads except those of the New England and Transcontinental Association. Hotel Rochester, at West Main St. and Plymouth Ave., will be headquarters. The final program will be mailed about April 20, to those requesting it, by C. L. Parsons, secretary, 1709 G St., N. W., Washington, D. C.

The New York Section of the American Institute of Mining and Metallurgical Engineers will meet jointly with the petroleum and gas committee, on April 6, at the Machinery Club, 50 Church St., at 8 p.m. After an informal dinner the meeting will discuss "Petroleum Legislation and International Regulations." Among those expected to speak are **Van. H. Manning**, director of the American Petroleum Institute; **L. H. Woolsey**, of Lansing & Woolsey, ex-solicitor of the U. S. Department of State; and **J. A. L. Henderson**, operator, of London. **E. L. Gruver**, 25 Broad St. (phone Broad 6768) is treasurer.

THE MINING NEWS

LEADING EVENTS

Union Sulphur Sues Texas Gulf For Illegal Removal of Ore

Asks \$6,678,000 Damages — Action Promises To Be Unique Owing To Process Used

On March 21 the Union Sulphur Co., a corporation of New Jersey, filed suit in the United States District Court against the Texas Gulf Sulphur Co. for \$6,678,000, alleging its land in Matagorda County, Texas, has been damaged to this extent by removal of sulphur from it by the defendant. As the sulphur is melted in the ground by hot water approximately 1,000 ft. below the surface and then pumped out through drill holes the attempt to prove that sulphur was removed from underneath the ground of the plaintiff by operations on the ground of the defendant bids fair to be unique in the annals of mining litigation.

Freeport Sulphur Co. Suspends Operations Indefinitely

It was announced on March 24 by C. A. Jones, general manager of the Freeport Sulphur Co., that the plant would be shut down and all operations in the sulphur field suspended on April 1. The shutdown is to be complete, and will last for an indefinite period. The company has two or three hundred thousand tons of sulphur on hand, and can continue to fill orders for some time. It curtailed production to one-third of its total capacity in February. Work on plans for the proposed asphalt plant is being continued.

Engineering Council of Utah Organized

Object To Bring Together Members of Profession Within State

An affiliation of engineering societies in Utah, to be called the Engineering Council of Utah, has been formed to bring together members of the engineering profession throughout the state. It is the purpose of the council to afford the united consideration of matters of common concern to engineers, as well as of matters of public welfare embodying the application of engineering principles, the advancement of engineering practice, and to bring about the correlation of the local activities of the several engineering societies. The council is made up of two representatives from each of the engineering societies functioning in the state. The council, as appointed, consists of Messrs. Plumb, Ashworth, Burt, Brown, Merrill, Adkinson, Zalinski, Berger, Ulrich and Fisher; Hylom T. Plumb is temporary chairman.

WEEKLY RÉSUMÉ

Two events of similar character marked the developments of the Eilers-Guggenheim controversy in the last week. A second stockholders' committee, headed by Henry Evans, of the Continental Insurance Co., announced its intention of conducting an impartial investigation. A proposal made to A. S. & R. officials by Guggenheim Brothers for a similar investigation, and suggesting the selection of Ex-President Taft to conduct the inquiry, was made, and Mr. Taft, when asked, consented to serve. In Arizona the decision in the Tom Reed-United Eastern apex case was handed down in favor of United Eastern on March 28. In Texas the Union Sulphur Co. has brought suit against the Texas Gulf Sulphur Co., claiming \$6,678,000 damages for alleged illegal removal of ore. The Freeport Sulphur Co. shut down on April 1. "Borax" Smith, once dominant in the Pacific Coast Borax Co.'s affairs, has purchased a promising deposit of colemanite discovered near Las Vegas, Nev., in January, an event that may possibly split the control of the borax market. Curtailment by copper companies continues: the Burro Mountain Branch of the Phelps Dodge Corporation has shut down; likewise the Old Dominion, at Globe, Ariz.; Magma Copper Co. has also suspended. Anaconda and the Jackling group of porphyries have suspended operations completely. In the Coeur d'Alenes the Hercules and the Tamarack & Custer (lead) mines have shut down, and the Northport smelter and Pennsylvania refinery are expected to follow. In Mexico the Torreon smelter in Coahuila is expected to close following the recent suspension of operations at the Asarco plant in Durango.

United Eastern Wins

A decision in favor of the United Eastern Mining Co., of Oatman, Ariz., defendant in the Apex suit brought against it by the Tom Reed Gold Mines Co., was handed down on March 28 by Judge Bollinger in the Mohave County Supreme Court.

More Copper Companies Announce Suspension

Announcement was made on March 29 that the Anaconda, Utah, Ray Consolidated, Chino, and Nevada Consolidated copper companies would shut down completely at once for indefinite periods. The Phelps Dodge Corporation suspended all work at its Burro Mountain Branch at Tyrone, N. M., on April 1, and the Old Dominion Copper & Smelting Co., at Globe, Ariz., largely controlled by Phelps Dodge, is also stopping all production.

Taft To Investigate A. S. & R. Co. At Guggenheims' Request

Invited by Present Board, Which Has Pledged Co-operation of Incoming Directors—New Committee To Make Inquiry

Upon invitation by the American Smelting & Refining Co., Ex-President William H. Taft has consented to act as arbitrator to consider all charges made by Karl Eilers against the Guggenheim management, it being Mr. Taft's understanding that the board of directors elected at the meeting on April 6 will invite him to act in this capacity. Mr. Taft's letter, dated March 26, follows:

"I have yours of March 25, in which you inclose a draft of a circular which has been printed announcing that you have invited me to make the investigation requested in the letter of the Guggenheim Brothers. If I understand the proposal, it is that the board of directors, elected at the next election, shall invite me to act in the capacity of an impartial investigator or arbitrator, to consider all the charges made by Mr. Eilers as former vice-president of the company, as to the transactions of the company. I assume you intend that Mr. Eilers shall be given full opportunity to present such evidence of the transaction as he may choose, and that those whom you represent will have equal opportunity, and that my conclusion shall be a judicial one. With that understanding, and with the further understanding that I may have sufficient time, after my present engagements, to do this work, I shall be willing to accept the task and render a decision upon the issues thus made, as a judge.

"(Signed) William H. Taft."

Edgar L. Newhouse, chairman of the board of directors of the A. S. & R., has advised Mr. Taft that all of his conditions are agreeable to the company, and that Mr. Taft should understand that the invitation to him is extended by formal act of the present board of directors, which, in addition, pledges the co-operation of the incoming board.

NEW COMMITTEE TO INVESTIGATE

The efforts of Karl Eilers to oust the Guggenheims from the control of the affairs of the American Smelting & Refining Co. have been followed by the formation of a second stockholders' committee, headed by Henry Evans, chairman of the Continental Insurance Co. This committee, it is said, is not affiliated with either the management of the A. S. & R. company or its critics and will conduct an impartial investigation to ascertain the financial position of the company. A statement issued by the Evans committee for publication on March 25 makes this announcement:

"A committee representing the stockholders of the American Smelting & Refining Co. has been organized for the investigation of the affairs of the company, with special reference to the charges of mismanagement which have recently been made by a former vice-president and director of the company. The committee is entirely impartial and is in no way affiliated either with the management or those who are attacking the management.

"The committee is composed of the following: Henry Evans, chairman of the board of the Continental Insurance Co.; Clarence H. Kelsey, president Title Guarantee & Trust Co.; Henry K. Pomroy, of Denny, Pomroy & Co.; Willis D. Wood, of Ladd & Wood; Henry Whiton, president, Union Sulphur Co.

"Title Guarantee & Trust Co. is the depository for the committee. It is proposed to take immediate and aggressive action, and public announcement of the committee's purposes will be made soon."

Park Sues R. V. Dey Over Grand Reef Claims

Suit for \$1,250,000 was begun in the Supreme Court in New York on March 23 by Thomas Park, a mining engineer and operator, against Richard V. Dey of San Francisco. The plaintiff alleges that in February, 1917, he entered into an agreement to purchase from the defendant his rights in twelve mining claims known as the Grand Reef mines in Graham County, Ariz., for \$750,000. Dey, he alleges, was to receive 10 per cent royalty on the product of the mines and was to advance \$25,000 upon the plaintiff exercising the right of purchase set forth in the agreement, the money to be used to develop the properties.

The plaintiff sets forth that on March 15, 1917, he notified the defendant of his desire to exercise the rights conveyed to him in the contract. The defendant, however, so he alleges, failed and still refuses to do his part, and on March 18, 1920, sold his rights to the Aravapai Leasing Co.

Temiskaming Prospectors Association Holds Banquet

The Temiskaming Prospectors Association has been formed at Haileybury, Ont., with Dr. W. L. Goodwin as honorary president; J. Hill, of the Haileybury School of Mining, president, and T. M. Train, secretary. The association held its first annual banquet at Haileybury on March 20, which was attended by about 100 prospectors and others identified with the mining industries of Northern Ontario. Dr. Goodwin was the guest of honor and gave an account of his work during the winter in holding prospectors' classes at the principal mining centers. Other speakers were M. B. Grover and Fraser D. Reid, two of the pioneers of the Cobalt camp, D. Johns and L. Howey. Indications point to a considerable increase in the number of prospectors at work this summer.

Promising Colemanite Deposit Found in Nevada

"Borax" Smith, Once Dominant Figure in Pacific Coast Borax Co., Buys Property From Discoverers

San Francisco Correspondence

F. M. Smith, familiarly known as "Borax" Smith, once the dominating figure in the affairs of the Pacific Coast Borax Co., now seventy-two years old, on receiving a "hunch" that a promising deposit of colemanite had been discovered, caught the first train to Las Vegas, Nev., and by automobile reached the discovery. The find was made by F. M. Lovell and George D. Hartman on Jan. 23, 1921. Both had been prospecting the Muddy Mountains, Clark County, Nevada, and on inspection of the discovery decided that they had secured a valuable deposit of colemanite. F. M. Smith, on completing his examination, made an offer for the property and arranged an initial deposit of \$50,000 to bind the bargain. A rough contract on a sheet torn from Smith's notebook closed the deal by which the West End Chemical Co. secured the ownership of what promises to split the borax market into two dominating factors, the West End Chemical Co. and the Pacific Coast Borax Co. The American Trona Co., at Searles, also produces borax from its potash plants.

The new colemanite deposit is 18½ miles from the Salt Lake railroad, 46½ miles by automobile from Las Vegas, Nev., and 7 miles from the Colorado River. The Muddy Mountains in which the discovery was made are in an area about which little, until recently, has been known. Shipments will be made from Dyke, Clark County, Nevada, pending the building of a spur line to the property.

Half a dozen intending purchasers were outplayed by F. M. Smith. The West End Chemical Co., of which F. M. Smith is the president, is at present operating a potash and borax plant at Searles Lake.

The two prospectors were both grubstaked, one by a woman in Salt Lake and the other by Peter Buol, of Las Vegas. After several months of fruitless prospecting they entered a narrow canyon and came upon outcroppings of a white mineral resembling quartz. The veins were sizable and occurred in one side of a hill approximately 3,000 ft. in length and 300 to 500 ft. high.

Bureau New Movie Films Ready

The Bureau of Mines now has ready for distribution copies of the films entitled "Story of Sulphur," "Story of Ingot Iron," and "Story of Asbestos." These films have been prepared at a cost of more than \$40,000. They will be furnished without charge to any responsible persons who are interested in making a showing of them. Since the requests for the use of these films cannot all be met promptly, preference will be given to the showings likely to be most largely attended.

Cobalt Arbitrators Propose Wage Cut Effective April 1

Managers Have Agreed, but Action by Employees Is Deferred

The Board of Conciliation and Arbitration, which has been in Cobalt, Ont., investigating the dispute between the operators and the men, has concluded its sittings. The dispute arose over the proposed cut in wages, which was to have been put into effect on Feb. 15, but, on account of the board having been appointed, the cut has not yet become effective. Much evidence regarding operating costs was introduced by the operators, while the men confined themselves to the slight decrease in the cost of living. The board appeared to be unanimous in the opinion that some measure was necessary to permit the mines to continue operations and to give employment to as many men as possible, as the decline in the price of silver and the consequent shutting down of a number of properties has resulted in throwing about 1,500 men out of employment. Before leaving Cobalt the chairman proposed to the representatives of the men that the proposed cut of 75c. a day should be effective from April 1. The managers agreed to this and the representatives of the men agreed to bring it before the men at a mass meeting about to be held.

Iron Ore Taxation Muddle Worse Each Week

Constitutes Principal Issue Before Minnesota Public

The question of taxing iron ore properties in Minnesota becomes a little more muddled each week. At the outset of the present legislative session the tonnage tax was a paramount issue, but the validity of this was a question and after seeking and devising many ways to tax the iron properties, the advice of the attorney general was sought, with the result that instead of a tonnage tax which is nothing more or less than an additional or super property tax it was advised that an occupational tax was constitutional. With this constitutional weapon two bills were prepared imposing a 6 per cent tax on the occupation of mining, but one bill provides that 50 per cent of the revenue go into permanent trust funds. These two bills passed the House of Representatives and are now in the hands of a Senate committee. The fight has simply narrowed down to a sectional fight between the northern and southern portions of the state. The supporters of the occupational tax forget, it is claimed, that at the present time mineral lands are assessed under the present ad valorem system at the rate of 50 per cent of the true value, which is a 25 per cent higher rate than is imposed on urban real estate and a 50 per cent higher rate than is imposed on rural real estate. If more additional revenue is required the same is procurable through the ad valorem system as the valuation

of such property is easily figured and the rate of assessment can be raised to meet any requirements or demand instead of resorting to the system of occupational taxes which, it is said, tends to retard progressive tax legislation as other occupational bills were immediately introduced which created considerable confusion.

Again it is pointed out that the supporters of the bill do not desire to raise the assessment under the ad valorem system as the rate would be so out of proportion to other property that the public would not permit the abuse, so they use other methods with new names and rely on the theory that what is not prohibited by the constitution of the State of Minnesota is permitted, instead of accepting the matter as a principle. The theory of the occupational tax is based on the principle that the tax will reach by indirection a class of people, property or business which under any ad valorem system cannot be made to pay what is considered a tax equivalent to that imposed on other people, properties or business capable of being actually appraised and valued. As stated above, all mineral lands on the iron ranges can be accurately valued by estimates and for that reason should not be considered under the system of an occupational tax. To single out any one industry for abnormal taxation, it is held by some, is a feature that should be avoided in any state or country and the present time is not ripe for higher taxes on any commodity needed for construction in all parts of the world. It is stated by an authority that no extra tax or tonnage tax could be made so low as not to force the low-grade ore interests out of business. It has

been proven that various low-grade deposits can be profitably mined and sold by resorting to a process of milling and concentration before shipping. This requires large outlay of money and time and also necessitates the handling of a large tonnage for a profitable business.

Situation on Lake Superior Ranges Doubtful

Navigation Expected To Open April 15, With Ore Moving Slowly at Start

The iron ore situation in the Lake Superior district is still doubtful as far as estimating the tonnage that will be moved during this coming shipping season. Since the demand by the furnace companies will determine the amount of ore shipped the outlook is not very bright but optimism prevails in most places. Many of the furnace companies have sufficient ore in their yards and a considerable tonnage has accumulated at the lower docks, but to offset such a condition it is a fact that many mines have closed temporarily, with a very small tonnage of ore ready to be shipped. Should a demand be created by improvement in general trade conditions during the next couple of weeks many properties will again reopen and a busy season can be anticipated.

Many factors enter into the iron and steel situation at present, but the most prominent one is that of the railroad situation. A just and fair settlement of this controversy would place the railroads in a position where they would feel justified in ordering large quantities of sorely needed rails and equipment.

All indications point to the opening of navigation about April 15, as such ice as remains is rapidly disappearing. Every indication points to a very slow movement of ore at first and only very favorable unforeseen conditions can change this situation, but there is every reason to believe that by July 1 the movement will be greatly increased.

Minnesota Steel and Oliver Companies Seek Reparation

Duluth — Reparation for overcharges amounting to \$180,000 during Federal control is asked in complaints filed with the Interstate Commerce Commission by the Minnesota Steel Co. and the Oliver Iron Mining Co. against the Director General of Railroads and the Duluth, Missabe & Northern R.R. The Minnesota Steel Co. asks \$82,356.39, covering excess charges on shipments of coal and limestone to its Steelton, Minn., plant from June 25 to Nov. 15, 1918. During this period it was forced to pay \$15 per car from Duluth as against \$7.50 per car prior to this period. The claim of the Oliver Iron Mining Co., amounting to \$95,394.26, is for alleged excess charges on shipments of iron ore from the Arcturus mine to the concentrator at Bovey. The freight rate on these shipments was raised from \$5 per car to \$18.50 per car it is claimed.

Utah Companies Cut Wages 25c. Per Day

A general reduction of 25c. a day in wages paid underground workers in Utah went into effect on April 1. High costs and low metal prices have forced this step.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Tariff Program Decided Upon by Leaders

Farm Products, Anti-Dumping and Ad Valorem Duties To Be Considered First—Permanent Measure Being Drafted

Tariff plans now have been agreed upon by leaders in the House and the Senate. The emergency tariff bill, covering farm products only, in exactly the same form in which it was vetoed by President Wilson, will be re-passed. Immediately thereafter, attention is to be turned to an anti-dumping bill. Next on the program is legislation providing that ad valorem duties are to be based on American prices instead of on foreign invoice values. Following this, the permanent tariff bill is to be passed, with the revision of the internal revenue laws to await disposition of the tariff.

As the Committee on Ways and Means has completed its tariff hearings, work on the permanent tariff is going ahead rapidly, with the promise that a bill will be reported out within six weeks. The metal schedule is being handled by a subcommittee consisting of Representatives Tilson, of Connecticut; Mott, of New York, and Timberlake, of Colorado. This subcommittee is meeting twice a day, and it is believed that its portion of the bill will be considered before those covering some of the more controverted schedules.

The anti-dumping legislation is expected to give immediate relief in those cases where particular advantages are afforded foreigners to market their goods at a sacrifice, possibly, but for cash, and where they have the advantage of depreciated exchange. It is probable that the anti-dumping measure

will provide that each imported article shall pay a tax equal to the difference between the American costs of production and those in foreign countries.

War Mineral Awards

Awards were recommended by the War Minerals Relief Commission during the week ended March 19, as follows (the name of the claimant, the mineral, the amount recommended, and its percentage relationship to the amount claimed is shown): Manganese Metal Co., manganese, \$19,003.55, 35 per cent; A. L. Wakeham, chrome, \$784.84, 49 per cent; Sawyer Tanning Co., chrome, \$2,793.04, 39 per cent; Sawyer Tanning Co., chrome, \$18,487.23, 67 per cent; Sawyer Tanning Co., chrome, \$1,877.21; 19 per cent. The total of the recommendations for the week was \$38,125.87.

International Mine Rescue Meet at St. Louis

Arrangements have been made by the Bureau of Mines to hold this year's International Mine Rescue and First Aid meet at St. Louis Sept. 1, 2, and 3. Delegations representing Canada, England, France, and Belgium will attend. A conference will be held during the meet on standardization of mine rescue methods. There will also be displayed commercial exhibits of mine rescue apparatus.

In conjunction with the meet, the Joseph A. Holmes Memorial Association will hold its annual meeting and awards will be made of its heroism medals.

Mine Products Lead in Railroad Tonnage

In its latest statistical statement showing total freight tonnages for several commodities on Class 1 railroads, the products of mines continued to maintain a long lead over the products of agriculture, forest products, manufactures, and animal products. The figures are for the third quarter of 1920. The total tonnage of products of mines during that period was 346,040,830. This is a decided increase over the tonnage for the second quarter, which was 272,179,656 tons. There was an increase in each separate item making up the total. The number of carloads into which the tonnage from

the mines during the third quarter was divided was 7,205,790. The subdivisions of the total are as follows, the figures being given in tons:

Anthracite coal, 31,335,703; bituminous coal, 185,729,568; coke, 11,516,072; iron ore, 54,238,232; other ores and concentrates, 9,296,618; base bullion and matte, 860,091; clay, gravel, sand, and stone, 41,446,060; crude petroleum, 3,313,532; asphalt, 1,329,720; salt, 2,637,821; other products of mines, 4,337,413.

The division of tonnage as between the principal transportation districts is as follows: Eastern district, 208,068,452 tons; Pocahontas district, 19,133,463; southern district, 30,224,414; and western district, 88,614,501.

NEWS BY MINING DISTRICTS

Special London Letter

Tin Price Improves—Mexico Mines of El Oro Report Satisfactory—Strike in Rhodesia Serious — Burma Corporation Again Actively Developing

BY W. A. DOMAN

London, March 15.—A new development has taken place in the tin market. It will be remembered that the Federated Malay States pegged the price, and subsequently withdrew it, announcing at the same time that it would not throw the concentrates on the market. Now the Netherlands Indies Government, in conjunction with the Billiton Company, has concluded a contract with the Federated Malay States not to sell tin for at least three months. The announcement has been followed by a recovery in the price of the metal to about £160 per ton, a rise of £10 in two working days.

Following upon the unfortunate position shown by the Geovor (in Cornwall) report, comes a loss made by the East Pool and Agar last year of £19,421, which, with about £9,000 for depreciation, gives a deficit of approximately £28,000. No one expected such a result from this company, which seems to own the richest property in the Duchy. The loss is due to the fall in the prices of tin, wolfram, and arsenic, and to the advance in working costs. The report of the managers shows that physically the property is in a very sound condition. There is a large quantity of high-grade tin ore in sight, but, at the moment, it does not pay to work it. Dolcoath proposes to issue £17,500 in 1/— preference shares to maintain the plant and for other purposes until matters improve.

Mexico Mines of El Oro issues quite a satisfactory report for the twelve months ended June 30 last. Not only has the company paid 18/— per £1 share in dividends, the same as for the

preceding year, but it declares an interim amount for 1921-22 of 4/—. Financially this is good. Little in the nature of development work was done, however, the only disclosures of note being on the new west vein on the eleventh level of Oro Nolan. Ore extracted amounted to 136,265 tons and was not altogether replaced, for the reserves are estimated at 350,100 tons, as compared with 379,100 tons. The value is also rather lower in respect of gold at 10.92s. and silver at 8.82 oz. is .62 oz. higher. The company was fortunate in being able to reduce working expenses slightly, and the percentage of extraction made an improvement from 86.50 to 89.64.

STRIKE IN RHODESIA ASSUMES SERIOUS PROPORTIONS

The miners' strike in Rhodesia has assumed a very serious aspect. The men refused to concede to the owners the right to engage and dismiss anyone they liked, that is, non-unionists, and the consequence is a lock-out. A member of the Legislative Council intervened and put forward fresh proposals to the owners, but these were rejected, and the repatriation of the natives has already begun. The only mines at work are the Falcon, Cam and Motor, and Rhodesia Broken Hill. At Wankie Collieries and Shamva the men are on strike. At the Falcon, development work has ceased owing to the low price of copper.

The Burma Corporation is again becoming active in development and is putting up raises from the No. 6 level at the southern end of the proved orebody. Two of these workings, the 1,679-ft. and the 1,135-ft., are in capital ore, the assays being respectively 36 oz. silver, 39 per cent lead, and 20 per cent zinc for the last 15 ft. in the former, and 34 oz. silver, 35 per cent lead, and 21 per cent zinc for 35 ft. in the latter. The weight of metal, it will be seen, is distinctly high.

CANADA

Ontario

Northern Customs Concentrators in Liquidation—British America Nickel Not To Resume

Cobalt—The report of the La Rose Mines, Ltd., for the year 1920, exclusive of the operations of the University, shows a production of 410,455 oz., having a net value of \$313,995, as compared with a production of 289,311 oz., valued at \$356,124 in 1919. Costs were reduced from \$1.05 in 1919 to 73c. in 1920. The profit was \$13,279.

At the annual meeting of the McKinley-Darragh held in Toronto recently little hope of resumption of operations was held out until there had been a very appreciable increase in the price of silver.

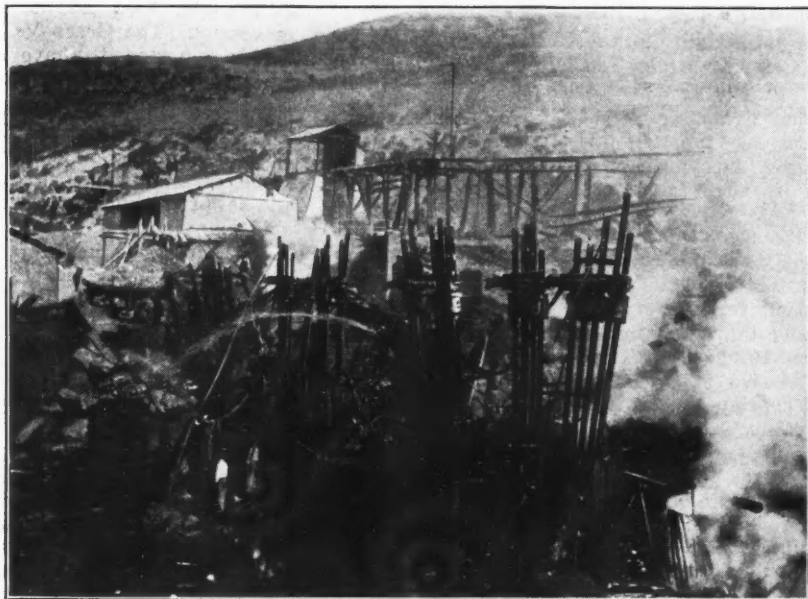
Northern Customs Concentrators, Ltd., has gone into the hands of liquidators. This enforced liquidation was brought about as the result of two actions against the company. Practically the only assets of the company consist of share holdings in the Bailey Silver Mines, Ltd.

The recent rumor regarding the resumption of underground operations at the British America Nickel Co.'s mines in the Sudbury district has been officially denied.

British Columbia

Trail—Shipments to the Consolidated smelter during the week ended March 21 totaled 7,968 tons coming from the company's mines.

Sheep Creek—With reorganization of Queen-Ore Hill Mines Co. to take over and operate the famous Queen mine in conjunction with the Ore Hill group an active summer around the Queen mine is expected. The Queen stamp mill will be put in condition for operation this season, there being a considerable quantity of material ready in the mine for milling.



REMAINS OF SAN RAFAEL MILL DESTROYED BY FIRE AT PACHUCA, HIDALGO, MEX., ON MARCH 6

MEXICO

Zacatecas

Conditions Good Owing to Activities of Mexican Corporation and Bote Mining Co.

Zacatecas—The district as a whole has not been so seriously affected by the drop in the value of silver as might have been expected, owing to the fact that two of the large Anglo-Mexican mining concerns operating in the El Oro district have recently become interested in several of the old properties here, and have been preparing to unwater and generally investigate them. The two companies, namely, the Fresnillo unit of the Mexican Corporation (silver) and the Bote Mining Co. (silver and gold), although having suspended milling operations in December last, have both continued construction work upon their new plants. As a result, the district has, if anything, become more active, and employment conditions are actually better than when silver was at top prices. The new plant of the Fresnillo unit is expected to be ready about the middle of the year. Mr. Cook continues as manager of this important unit, which, when completed, will be one of the largest silver mills in existence.

As in the case of the Fresnillo unit, the drop in the price of silver forced the suspension of the Bote company's milling operations last December. Since then, remodeling of the mill and plant has been under way and new machinery is being added to increase the capacity. Improvements will include tube mills, classifiers, concentrators and thickeners. A change of management is projected, with a view to more energetic operation of the company's properties. Gordon Wilson is closely identified with the general reconstruction and improvement policies.

The La Fé company (silver-gold), which was actively investigating the possibilities of the Guanajuatillo dis-

trict, southeast of Zacatecas, curtailed these operations considerably during the latter part of 1920. This work has again been resumed on a modified scale. The mill, which was finished by the company and only tried out in 1914, when revolutionary conditions rendered further operations impossible, continues inactive, with no indications of immediate resumption of work.

The Los Campos property (silver-gold) ranks as one of the most interesting *antiguas* of the district. It was abandoned thirty or forty years ago, owing to the inability of the native owners to cope with the water problem with the crude animal-power methods they employed. The mine has been consequently under water since then. The El Oro company has taken an option on the property (held by local people) and has been installing hoists. Unwatering has already been started. It is the first attempt in many years to open up one of the famous abandoned Zacatecas properties—and their name is legion. Mr. Meisner is in charge. The Veta Grande property (silver-lead-gold) is a famous old group of mines lying a few miles north of the state capital. For several years, and particularly during the period of peak prices for silver, practically all the large Anglo-American-Mexican mining corporations at one time or another en-

deavored to come to terms with the native owners on this group, but without success until recently, when the Dos Estrellas Co., of El Oro, reached an agreement which will permit a thorough inspection of the holdings, covered by option.

Work upon these properties has been carried on spasmodically for several years under primitive conditions. Small lots of silver-lead and siliceous silver ores have been shipped to local buyers, and only from the upper workings, which have been free of water.

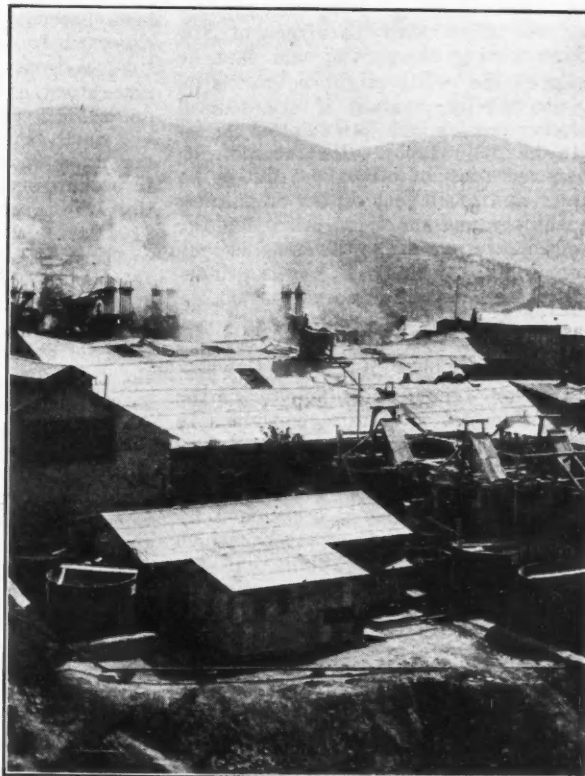
The Magistral property (copper) has remained inactive since the death of Mr. Gilbert, and is still involved in litigation.

Work on the Parroquia copper property is practically suspended, owing to the low price commanded by the metal. The closing down of the Aguascalientes smelter, of the A. S. & R. Co., will tend to further curtail chances of shipping ore.

The two ore-buying agencies, representing the American Smelting & Refining Co. and Cia. Metales y Metales, have practically been forced to close their doors for the present, as the numerous small "shipping" properties which generally sell their ores locally are unable to operate at profit under present prices. The result is that there is practically no exportation or production of silver, gold, copper, or lead in the district at present.

Hidalgo

Pachuca—The San Rafael company, whose mill burned on March 6, employed over 1,000 men.



ANOTHER VIEW OF THE DESTROYED SAN RAFAEL MILL, AT PACHUCA, WHICH MAY BE SEEN IN BACKGROUND

Durango**Shut Down of Asarco Smelter Serious Blow to Producers**

Durango, March 16 — The Asarco smelter of the A. S. & R. Co. at Asarco, Dgo., has been forced to close down this week owing to the lack of shipments of ore and the low prices of metals. This was to be expected ever since the principal mines of the company at Velardeña closed at the end of February. The company's announcement says that the suspension will be for an indefinite period. The effect will be serious for the few high-grade mines that are hanging on; when these close there will be neither mine nor smelter working in the State of Durango. The shutdown is all the more serious as it came without warning. It is reported that the smelter at Torreón, Coahuila, which opened less than a month ago, will also close, leaving the miners without any market whatever for their ore, many cars of which are in transit, but tied up on account of the railroad strike.

"It's an ill wind that blows nobody good," and there are those who have been watching and waiting, and have chosen the present as a most opportune occasion for investment in mines. The present situation (says our correspondent) has favored the investor with an important advantage which will probably not again return to him for some time.

Guanajuato**Removal of Duties Recommended To Aid Mining**

Guanajuato—Engineer Antonio Madrazo, governor of the State of Guanajuato, in expressing his opinion regarding the threatened paralysis of the silver mining companies, said that he believed the crisis might be partially, if not wholly, averted if the federal government should immediately legislate in their favor. He recommends the exemption of all export duties on silver and of import duties on mining machinery and supplies. Also that the freight rates on ore be the same as they were in 1910, which was less than one-half the amount charged at present.

Coahuila**Torreón Smelter May Shut Down**

Torreón—The Torreón smelter of the Cia. Minerales y Metales continues to operate one copper and two lead furnaces, but a shutdown is threatened unless the fuel supply can be replenished soon. The shortage is occasioned by the strike of railroad employees, which is about ended. This plant has ten furnaces, three copper and seven lead.

WASHINGTON**Chewelah Mining Co. Levies Assessment for Development**

Chewelah—Stockholders of Chewelah Mining Co., operating near here, have authorized a 1 mill assessment quarterly in addition to a 3 mill per annum assessment, to provide funds for additional development.

CALIFORNIA**Iron Mountain Mine Closed—Power Company Seeks To Collect Surcharge After April 10**

San Francisco—The King tax bill increasing the tax rate upon public utilities has passed the Legislature, and its effect upon mining operations is just beginning to appear. The Pacific Gas & Electric Co., supplying power to a number of mining companies, has asked the State Railroad Commission for authority to continue collecting the surcharge beyond the date, April 10, fixed by the commission. If permission is given mining companies will continue to pay the high rates now prevailing. Other utility companies supplying power may be expected to follow the same procedure.

The Natomas Co. of California dredged 20,459,001 cu.yd. during 1920. The gross gold recovery was \$1,680,675; costs, including taxes and insurance, were \$1,361,849; net was \$318,825. An interesting comparison of cost is given in the following table:

| | Gross, cents per cu.yd. | Cost, cents per cu.yd. | Net, cents per cu.yd. |
|---------|----------------------------------|---------------------------------|--------------------------------|
| 1914-17 | 9.16 | 4.57 | 4.59 |
| 1918 | 8.31 | 5.46 | 2.85 |
| 1919 | 8.66 | 6.41 | 2.25 |
| 1920 | 8.21 | 6.65 | 1.86 |

On gold-bearing ground not owned by the company 2,510,199 cu.yd. was dredged, realizing a profit of \$12,000 to the company. The remaining proven lands of the company total 142,000,000 cu.yd. and in addition 40,000,000 cu.yd. will be dredgable if pre-war costs again prevail. The peak of high costs has been passed, and net returns may be expected to increase. This conservative, well-managed company received a net return of \$902,646 from all of its operations, which include farm lands and rock crushing plants. After paying fixed and sundry charges and before charging depreciation and exhaustion the profit for the year totaled \$104,242.

At the Parr Terminal, Oakland, a shipload of 6,554 tons of sulphur from Freeport, Tex., is being unloaded. This is one of a number of similar shipments received by the San Francisco Sulphur Co. The sulphur supplies the coast market, chiefly satisfying agricultural demands and the Hercules Powder Co. and General Chemical Co. Sherwin Williams and other companies import sulphur from Texas and Louisiana. Ocean freights on sulphur range between \$7 and \$8 per ton.

Marigold—On Feb. 18 a 24-ft. section of the bucket line of No. 5 dredge of the Marysville Dredging Co. was removed in two days, thirteen hours. The dredge was digging to a depth of 87 ft. The bucket line contained ninety-eight 15-cu.ft. buckets, each weighing 4,400 lb.

Grass Valley—Idaho-Maryland has uncovered the 1,500 level in the Canyon shaft. Assistance of old miners familiar with the former work in the

Idaho-Maryland has been had to locate old ore-shoots. The Grass Valley Consolidated is reported to have secured working options on ground south of the Allison Ranch mine.

Redding—The Iron Mountain mine of the Mountain Copper Co. has been closed indefinitely, and the company's Hornet mine is producing pyrites for sulphuric-acid manufacture. The Utah-California Gold Mining Co. has recently purchased mining property near Calahan, Siskiyou County, and is preparing for active work. A heavy snow-storm late in February interfered with the operations of the Valdor dredge through breakage of power lines and ditches.

NEVADA**Work on United Comstock Mines Adit Progressing**

Virginia City—The United Comstock Mines Co., at Gold Hill, is driving its adit from seven headings. A Hoar shoveling machine is at work in the portal heading which has reached a point 1,100 ft. from the portal. The haulage adit is 8 ft. high, 9 ft. wide at the bottom and 7 ft. at the back. Three shifts of five men each, one machine man, two muckers and two hammers, are being used at the portal action. The round consists of three 6-ft. back holes, three 6-ft. breast holes, three 8 to 9-ft. cut holes, two 4-ft. easers and three 6½ to 7-ft. lifters. Forty per cent gelatine dynamite, 1½ in. diameter, is used, 126 sticks per round being required. Bear brand fuse and electric delay exploders are used. Sixty 1,800-lb. cars are usually filled per round. Twelve-pound rails are used, double track being laid to within 300 ft. of the face. The haulage adit will be 9,000 ft. long. In the near future 40-lb. rails will be laid, and then a storage-battery locomotive and five-ton self-dumping cars of the Granby type will be installed. Ten or twelve months will be required for the completion of the adit.

Mina—Mineral County, Nevada, has bonded itself for sufficient money to purchase the hydro-electric power line that is already constructed from the power plant at Lundy, Cal., to Hawthorne, Nev., and to construct the line from Hawthorne, through Luning, Mina, and to the Simon district. Work on this will be started at once. It is said that this assures adequate electric power for the operation of the new Simon Silver Lead mill and the mines in the Simon district and elsewhere throughout the county.

MONTANA**Further Curtailment in Production in Butte District**

Butte—The North Butte Mining Co. suspended copper production on March 28, laying off 400 men. About sixty will be retained on upkeep work. Anaconda closed its mines April 1. The smelters will run for a week longer and the Great Falls refinery about a month. More than 5,000 men will thus be rendered idle.

IDAHO

Coeur d'Alene District

Hercules and Tamarack & Custer Mines Closed; Northport Smelter Expected To Follow Suit

Wallace—The Western Union Mining Co. has let a contract to crosscut 200 ft. north from the vein from which shipments are now being made, believing that the main vein will be reached within that distance. Since last November lessees have shipped thirteen cars of lead-silver ore that produced a net smelter return of \$33,000. The company receives a royalty of 25 per cent.

The Brady Development Co., after a suspension of about a month, has resumed work. The company has a bond on the Olympia group and the Rose claim, situated between the Green Hill-Cleveland and the Tamarack & Custer. The company is driving a crosscut from the Headlight workings which will cut the vein at a depth of 1,200 ft. The crosscut has now been run 1,450 ft., and is expected to reach the vein soon. Patrick Brady, of Wallace, is manager of the company, which is being financed by Pennsylvania capitalists. J. C. Parsons, of Pittsburgh, is president. The vein on surface is 30 ft. wide and a shaft 100 ft. deep shows considerable lead carbonate ore.

The Idaho Group Mining Co. is the name of a new corporation which has taken a bond and lease on the Idaho group of claims, situated on Pine Creek. The property is owned by Charles McKinniss. The Idaho group at one time was under bond to the Nabob Mining Co., which started a crosscut tunnel from the main Nabob tunnel to cut the vein at a depth of 1,400 ft. This was abandoned when within about 500 ft. of the vein and the bond forfeited. One of the conditions of the bond was that if it was given up the owners of the Idaho group should have a perpetual right to the use of the Nabob tunnel in the development and operation of their property. In the upper tunnel on the Idaho there is a splendid showing of lead-silver and zinc ore, and it is expected to make shipments of the former to the Bunker Hill smelter, which is only about fifteen miles away by wagon road. If the work in the upper tunnel proves satisfactory, the crosscut from the Nabob will be completed, and ultimately if an orebody is developed it is regarded probable that the use of the Nabob mill may be secured.

W. C. Siderfin, of Butte, manager of the mining interests of Senator W. A. Clark, recently inspected the Sunset mine, near Wallace, owned by Senator Clark. The West Sunset Mining Co., which is controlled by the Days, is extending a drift from the 1,000 level of the Sunset into the West Sunset and in doing so has opened quite an important body of lead-silver ore, all of which is reported within the Sunset ground, the face of the drift being near the common end line of the two properties. The ore-shoot is reported to be 3 ft. wide

and of practically clean lead-silver ore, a showing which it is believed will induce Senator Clark to develop the Sunset further.

The Hercules and the Tamarack & Custer mines closed down on March 20, and the Northport smelter, at Northport, Wash., and the Pennsylvania refinery, at Carnegie, Pa., will soon follow. The low price of lead and the absence of a market, together with the excessive freight rates on bullion to the East, are given as the reason. Seven hundred men are out of work as a result. A considerable number will be retained on development work.

COLORADO

Chipeta Company at Ouray Cuts Milling Ore on H. A. C. Property—Camp Bird Remains Shut Down

Ouray—Camp Bird remains entirely shut down, though rumors persist that development will be resumed before many months. Good ore has been developed at the main tunnel level in the west drift under the largest of the old orebodies.

The Atlas and Mountain Top properties continue active operation, running mills at or near capacity. Unusually high freight and treatment rates on high-grade products work severe hardship on the Mountain Top, which survives only because of a very fine body of high-grade silver and lead ore; development continues to increase ore reserves and justifies the management's intention of enlarging the milling facilities soon. These two are the only mines making any production steadily.

The Lundberg-Wilfley Lease on the Barstow has developed a large body of very good gold-silver ore. The force has been increased and stoping is going forward actively. The bins and stopes are being filled with ore which will be milled during the summer.

The Eurades Mining Co. has by active development since last summer opened up several promising veins. Recently the Blanchard vein was reached from the main crosscut and showed where cut a 3-ft. streak of heavy bismuth-iron ore carrying good copper and high silver values. This is likely to develop into a good orebody. R. S. Harding is now superintendent.

The Paymaster-Whitecloud company has suspended operations since the violent death of Superintendent Fred Jacob. Ore has been discovered and was in process of development; work will be resumed this spring.

Work on the old Guadalupe will soon be resumed under James A. Lannon, who completed a power line to the property last fall and installed an air compressor.

The long-continued exploratory work of the Chipeta M. & M. Co. on the H. A. C. property has been rewarded by the discovery of a wide vein of milling ore where the crosscut reached the Oak Street vein. The ore is a simple gold-silver ore carrying no other mineral but pyrite, in a quartz gangue. A

power line is now being constructed and an air compressor and drills will be put in; development will then be pushed with the expectation of erecting a milling plant later. This is a promising property, hitherto undeveloped.

Development by hand on the Hidden Treasure, the Thomas F. Walsh property near the Camp Bird, continues steadily. An air compressor and other necessary equipment were delivered at the mine last fall but installation was deferred until the severe winter snows should abate. It is the intention of this company to put the air compressor in commission early this year and develop actively, with a milling plant in the near future a very likely possibility.

Telluride—The Smuggler-Union Mining Co. will resume more active development work in the Humboldt property, and may be in the market for about fifty additional miners.

Sawpit—John L. Stivers, of Montrose, has been appointed receiver of the Colorado Vanadium Corporation, which failed last fall, owing about \$400,000 to creditors in San Miguel County, including many laborers and merchants in Telluride.

Silverton—The Red Mt. Silver Mines Co. is considering the installation of a reduction and refining plant, having a capacity of 500 tons per day. It is planned to erect the plant during the coming spring as soon as the condition of the roads and weather permit. J. J. Cusick is general manager and C. L. Tripp metallurgist.

Central City—Development of the East Notaway mine will be resumed under the direction of Thomas Martin. The east heading on the 600 level will be advanced.

Crested Butte — The Allied Mines Corporation is planning to erect a 50-ton flotation plant at the Augusta mine. It is reported that substantial reserves of broken and unbroken ore are available in the mine, and that much of the material on the dump can be treated to advantage.

Silver Plume—Development work has been resumed on the Dives-Pelican property, under the direction of G. L. Cole.

Lawson—The Little Giant Mining Co. has leased its Tabor property to John Smith, who is driving a crosscut to cut the St. James vein.

UTAH

Utah Apex Stops Development Owing to Market Conditions

Mammoth—The old Mammoth mine has practically ceased work upon an order from the smelters reducing monthly shipments of siliceous silver ores to 100 tons, as they have been receiving a disproportionate amount of ores of this character. The Mammoth has a good tonnage of low-grade copper ore, at present unmarketable. Some work may be continued on the tunnel level and higher up where hoisting is not necessary.

Park City—Shipments for the week ended March 18 were 1,864 tons as compared with 1,836 tons the week preceding. Shippers were: Judge allied companies, 832 tons of ore and concentrates and 15 tons of zinc; Silver King Coalition, 476 tons; Ontario, 431; Naildriver, 110. The Daly West, it is reported, will pass its coming quarterly dividend, owing to the low price of metals. A large amount of development work is planned, as more labor is now available. Funds at present on hand amount approximately to \$145,000.

Eureka—Tintic shipments for the week ended March 18 amounted to 155 cars; Tintic Standard, 55; Chief Consolidated, 29; Dragon, 18; Iron King, 16; Eagle & Blue Bell, 10; Iron Blossom, 6; Victoria, 5; Grand Central, 3; Gold Chain, 3; Bullion Beek, 3; Colorado, 2; Ridge & Valley, 1; Gemini, 1; Alaska, 1; Swansea, 1; Sunbeam, 1.

Bingham—The Utah Apex has suspended development work and shaft sinking as well as ore shipments, owing to the unfavorable state of the lead market.

ARIZONA

Magma Copper Down March 31—Development Progressing at Hill Top

Hill Top—The lowest of the three tunnels of the Hill Top Metal mining company has been driven 3,600 ft. into the mountain and will cut the main vein carrying silver-lead in about 700 ft. This will give about 1,500 ft. of back. Plans for a lead smelter and rail connections are still under advisement. The Hill-Colvin group of four claims that adjoins the Hill Top ground on the east is under examination by prospective purchasers.

Superior—The Magma Copper Co. shut down March 31 because it has a substantial supply of unsold copper on hand and cannot dispose of its production. The company will continue to operate the mine pumps and a limited amount of development work will be done. The labor force will be reduced from about 210 men to about sixty men. Old employees will be given first choice whenever the company is ready to resume operations. W. C. Brownig is general manager.

Chloride—The long-drawn-out legal difficulties involving the Tennessee and Schuylkill mines have finally been adjusted out of court. The latest litigation was that of Frank A. Garbutt vs. the Schuylkill Mining Co. In this action judgment was entered in favor of Mr. Garbutt for the full amount of various mortgages held by him against the properties. These, with incidental costs, amounted to over \$340,000.

Mr. Richard H. Cole has entered into contract with the Schuylkill Mining Co., to finance and operate its properties. The preliminary step in this has consisted in the purchase by Mr. Cole of the mortgages and judgment held by Mr. Garbutt. Mr. Cole is now in charge of the mines. He and his associate, C. A. Burke, recently made a thorough in-

spection of the workings of the Schuylkill and Tennessee. Mr. Cole is now in the East completing financial arrangements while Mr. Burke remains at the properties. Former Superintendent Keile, of the Tennessee, has been brought to Chloride, and plans are being worked out for the prompt resumption of operations.

Winkelman—The Continental Commission Co. has not sold the old 79 mine, as has been recently stated. The company is installing some new mining equipment, as the market conditions are unfavorable for shipping ore. The Little Treasure Mining Co., east of Winkelman, is preparing to bring in its mining equipment. Isaac Rogers, formerly superintendent at the Dripping Springs Copper Co. property, has taken a lease and bond on the Cow Boy mine, owned by C. W. Megraw, from which much gold has been taken. The small milling plant will have additions to improve capacity. The Riggins gold property on the other side of the Gila River is also under lease and bond to Rogers. The Adjust Mining Co., operating the Shepherd-Whiteman lease on Deer Creek east of town, will increase its operations in charge of Blanford C. Burgess.

NEW MEXICO

St. Joe Lead Co. Preparing To Develop Warnock Property—Burro Mountain Down April 1

Magdalena—Unusual interest is being manifested in mining in this section. Dr. Samuel C. Appleby, of Baltimore, Md., was here recently in the interest of capitalists of that city and principally to investigate the Rosedale Gold property. In former years this was a good producer but was closed down indefinitely after the second mill was destroyed by fire. Dr. Appleby was accompanied on his return by Messrs. Exter and Crawford, who are to close the sale of the property. It is understood that immediately after the sale the mine will be reopened and a new mill built.

The Copper Belt Silver & Copper Mining Co., which has been doing development work for two years, is preparing to do core-drilling on its property, which is three miles from town. A great deal of prospecting and assessment work on the new location is in progress.

A few months ago a deposit of vanadium ore was discovered on the Redemer & Dugger claims and much development work done. A number of recent offers for this property have been rejected as the owners are undertaking to block out the ore.

Lordsburg—The Co-operative is hauling what is its third car of silver-lead ore for this month for shipment to the El Paso smelter. Returns on the last car showed 75 oz. silver per ton, the total return being about \$2,400. Lessees in this district are active in seeking to supply the demand for siliceous ores required at the smelters at Douglas, Ariz.

Tyrone—Final payment on the Cora Miller mine has been made by the Montclair Mining Co., of New York. This property was purchased from the Mangas Mining Co. in February, 1920. A 35-ton cyanide mill has been erected. Development work consists of a tunnel, shafts and winzes. High-grade silver ore is reported on the 275 level.

The Burro Mountain Branch of the Phelps Dodge Corp. shut down tight on April 1. Arrangements are being made for a considerable period of in-operation. The general store will close and the electric lights will be shut off April 15. A gas engine will be installed to pump water for fire protection. Mexican labor will be sent at company expense to any point on the border desired. The move is regretfully made, as an excellent force had been built up and living conditions were most satisfactory. It was a model camp and conducted by the management upon liberal lines that made it one of the most desirable places for mine workers to be found in the whole Southwest.

Alamogordo—The St. Joseph Lead Co. of Missouri, which purchased the George W. Warnock lead property in January, is building roads and laying a water pipe line. Core drilling will be started soon, as \$20,000 has been allotted for development. Should conditions justify, a mill will be installed and concentrates shipped to Herculaneum, Mo., for final treatment.

MINNESOTA

Mesabi Range

Bennett Mine at Keewatin and Utica at Hibbing Closed

Duluth—The Minnesota Steel Corporation has announced the erection of a new wire mill at its plant. C. F. Blackmer, assistant superintendent of the American Steel & Wire Co.'s plant at Waukegan, Ill., will have charge of the new addition.

Keewatin—The Bennett mine of the Pickands Mather Co. has temporarily closed owing to the slack market. Some repair and development work will continue to be done, but over 100 men were thrown out of employment.

Hibbing—The Utica mine of the Pickands Mather Co. has closed down indefinitely. At first the mine was placed on a four-day-a-week basis, but this week received notice to cease all operations.

Cuyuna Range

Strikers Return at Croft Mine at Reduced Wages

Crosby—A number of mining crews have been put back at work at the Croft mine, John A. Savage & Co., following a shutdown resulting from strike of the miners upon reduction of wages. Those returning to work have accepted the company's new wage schedules, which are in line with the reductions that have been made all over the district. Production is being carried forward from raises and slices above the new 333 level and a substantial daily hoist obtained.

THE MARKET REPORT

Daily Prices of Metals

| Month | Copper, N. Y. net refinery* | Tin | | Lead | | Zinc |
|-------|-----------------------------|-------------|---------|-----------|-----------|--------|
| | Electrolytic | 99 Per Cent | Straits | N. Y. | St. L. | St. L. |
| 24 | 12.00 | 28.75 | 30.25 | 4.20 | 3.95@4.10 | 4.70 |
| 25 | 12.00 | 28.75 | 30.25 | 4.20 | 3.95@4.10 | 4.65 |
| 26 | 12.00@12.25 | 28.75 | 30.25 | 4.20 | 4.00@4.10 | 4.65 |
| 28 | 12.00@12.25 | 28.50 | 30.00 | 4.20@4.30 | 4.10 | 4.65 |
| 29 | 12.25@12.50 | 28.00 | 29.00 | 4.20@4.30 | 4.10@4.15 | 4.65 |
| 30 | 12.50 | 27.75 | 29.25 | 4.20@4.30 | 4.10@4.15 | 4.65 |

*These prices correspond to the following quotations for copper, "delivered": 12.25, 12.25, 12.25@12.50, 12.25@12.50, 12.50@12.75, and 12.75c.

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.

Then, too, we must consider what has happened to zinc since production was cut down to 35 or 40 per cent of normal: the price has not yet begun to react. Therefore, we cannot expect any runaway copper market, and present prices are not likely to be materially altered for some time. The curtailed production will bring high prices much sooner than they would have come otherwise, however, and had production continued on the scale of the last few months we might have had 12c. copper for years.

Consumers remain uninterested, and inquiries in the last day or two have been largely because of curiosity. Export, and, to a less extent, domestic demand, has taken up the available stocks of the smaller producers, who have been cutting under the 13c. level of the large interests, and the price has naturally reacted toward the higher figure. The sentimental effect of the announced shutdowns aided the price recovery, but was not the principal cause. Demand from France and Germany has been good in the last week. A cable today states that the Copper Export Association is quoting 12.75c. delivered in Europe, which is equivalent to about 12.50c. f.a.s. New York.

London

| Month | Copper | | | Tin | | Lead | | Zinc | |
|-------|------------------|------------------|------------------|-------------------|-------------------|------------------|------------------|------------------|------------------|
| | Standard | | Electrolytic | Spot | 3 M | Spot | 3 M | Spot | 3 M |
| | Spot | 3 M | | | | | | | |
| 24 | 69 $\frac{3}{8}$ | 68 $\frac{1}{2}$ | 71 $\frac{1}{2}$ | 165 $\frac{1}{2}$ | 168 | 20 $\frac{1}{4}$ | 20 $\frac{3}{8}$ | 25 $\frac{1}{2}$ | 26 $\frac{3}{8}$ |
| 25 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 26 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 28 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 29 | 69 $\frac{3}{8}$ | 69 $\frac{3}{8}$ | 71 $\frac{1}{2}$ | 161 $\frac{1}{2}$ | 165 | 20 $\frac{1}{4}$ | 20 $\frac{3}{8}$ | 25 $\frac{1}{4}$ | 26 $\frac{1}{2}$ |
| 30 | 70 $\frac{3}{8}$ | 70 | 72 $\frac{1}{2}$ | 159 $\frac{1}{2}$ | 162 $\frac{3}{4}$ | 20 | 20 $\frac{3}{8}$ | 24 $\frac{1}{4}$ | 26 |

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

Lead

On Monday, March 28, the American Smelting & Refining Co. increased its official price of lead from 4c. to 4.10c., New York and St. Louis.

No supplies of lead appear to be pressing on the market at present, and in some quarters a shortage seems to exist. Sales have not been numerous, but the price has firmed somewhat, and second hands are getting even slightly better prices than we quote, for small lots. Chemical lead has not advanced in quite the same proportion as the ordinary grades, and is now quoted at 4.30@4.35c. St. Louis, or 20 points premium.

A novel incident of the week has been the appearance in the local market of representatives of the Penarroya interests, who have been trying to dispose of Spanish lead in this country at the equivalent of the London price. Although they have been more anxious to sell in large quantities—over 1,000 tons—it is said that they are also contemplating keeping a local stock to supply carload demands, and that a shipment of 2,000 tons is now on the way for this purpose. Lead from Spain can be delivered here at about the same price as that for which it can be shipped to London, but under present conditions the price cannot be cut under that at which domestic lead can be obtained. It would appear that this Spanish lead can now be laid down in New York for 4.25@4.35c. per lb.

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 |
| 24 | 391 | 99 $\frac{1}{2}$ | 57 $\frac{1}{4}$ | 33 $\frac{3}{4}$ | 28 | 391 | 99 $\frac{1}{2}$ | 57 $\frac{1}{4}$ | ... |
| 25 | 390 $\frac{3}{4}$ | 99 $\frac{1}{2}$ | 57 $\frac{1}{4}$ | ... | 29 | 391 | 99 $\frac{1}{2}$ | 57 $\frac{1}{4}$ | 33 $\frac{3}{4}$ |
| 26 | 390 $\frac{3}{4}$ | 99 $\frac{1}{2}$ | 57 $\frac{1}{4}$ | ... | 30 | 392 $\frac{1}{2}$ | 99 $\frac{1}{2}$ | 57 $\frac{1}{4}$ | 33 $\frac{3}{4}$ |

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 30, 1921.

The firmer tone which we mentioned last week has continued, and despite absence of demand the prices of copper and lead have advanced. Tin and zinc remained practically stationary. It is too early yet to say that the prices of these metals have reached their lows, but it is extremely doubtful if purchases can be made any more advantageously by waiting longer.

Copper

The most important news of the week is chronicled elsewhere. The closing down of Anaconda and the porphyries, together with the other companies recently mentioned, will result in a pro-

duction about 40,000,000 lb. per month less than has been the output up to now. Assuming the current production of the two Americas at 110,000,000 lb. per month, this will mean a cut of 36 per cent, even if no other companies decide to cease operations. This is large, but the figures must be compared with the copper stocks on hand, which amount to close to 1,000,000,000 lb., and to the current domestic and export sales, which have been estimated at about 60,000,000 lb. for February. A study of the situation will reveal that until business conditions revive, hope of any great improvement in the copper market is unwarranted. Even should all producers cease operations, the world could get along under present conditions for the best part of a year.

Zinc

The market is dull and quiet, and consumers are indifferent to the low prices. Quotations this week represent a loss of 5 points from the closing quotations of last week. No immediate improvement in the market is in sight, despite the low rate of current production, which is estimated by one large producer at about 20 per cent of capacity—and that at a loss. Scrap material is still available, and is an important element in satisfying market requirements. Steel prices have not settled down to a level that warrants any demand from galvanizers, the most important zinc consumers. High-grade zinc is quoted at 7c.

Tin

With the London holidays and the absence of demand in this country, tin has had a quiet week. Electrolytic is practically off the market, the producer quoting 30c. per lb.

Straits tin for future delivery: March 24th, 30.50@31c.; 25th, 30.50@31c.; 26th, 30.50@31c.; 28th, 30.25@30.75c.; 29th, 29.50@30c.; 30th, 29.75@30.25c.

Arrivals of tin, in long tons: March 22d, Straits, 30; 23d, Straits, 20.

Silver

Since our last report, the London market has been closed for three days for the Easter holidays, which have also been observed in the Far East. As a result, business has been on a small scale, although prices have been well maintained, both in London and New York. The buying inquiry which was in evidence a week ago has fallen off, and the market closes quiet.

Mexican Dollars—March 24th, 43½; 25th, 43½; 26th, 43½; 28th, 43½; 29th, 43½; 30th, 43½.

Gold

Gold in London: March 24th, 104s. 11d.; 29th, 104s. 11d.; 30th, 104s. 6d.

Foreign Exchange

The Easter holidays kept the foreign exchange market quiet. Sterling strengthened further and reached the highest point quoted since last summer. On Tuesday, March 29, francs were 6.975c.; lire, 4.135c.; and marks, 1.58c. New York funds in Montreal, 13 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@5½c.; market dull. W.C.C. brand, 5½@6c. per lb. Cookson's "C" grade, spot, 9½c. Chinese needle antimony, lump, nominal at 4½c. per lb. Standard powdered needle antimony (200 mesh), 6@6½c. 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 re-

fection 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. Very strong.

Quicksilver—Nominally, \$46@\$47 per 75-lb. flask. San Francisco wires \$45.50.

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—30@35c. 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 U₂O₅, and 5 per cent V₂O₅, sells for \$1.50 per lb. of U₂O₅, and 75c. per lb. of V₂O₅; ore containing 2 per cent U₂O₅, and 5 per cent V₂O₅, sells for \$2.25 and 75c. per lb., respectively;

higher U₂O₅ and V₂O₅ content commands proportionately higher prices.

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 26—Zinc blende, per ton, high, \$24.20; basis 60 per cent zinc, premium, \$22.50; Prime Western, \$21; fines and slimes, \$20@\$17.50; average settling price, all grades of blende, \$23.33.

Lead, high, \$43.45; basis 80 per cent lead, \$40; average settling price, all grades of lead, \$41.61 per ton.

Shipments for the week: Blende, 6,347; lead, 1,545 tons. Value, all ores the week, \$212,520. Shipments for three months: Blende, 69,611; lead, 12,476 tons. Value, all ores three months, \$2,453,160.

Blende shipments three months are 89,813 tons less than for the corresponding three months of 1920; calamine 2,567 less, and lead 9,702 less.

The market is lifeless and featureless, with 2,200 to 2,500 tons of zinc produced in excess of the purchase each week, which has averaged 5,375 tons per week. A firm demand for lead is again taking up the weekly production, and sellers are accepting the \$40 basis offered.

Platteville, Wis., March 26—No market for zinc or lead ore. Shipments for the week: Blende, 772; lead, 40 tons. Shipments for the year: Blende, 9,570; lead, 550 tons. Shipped during the week to separating plants, 371 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.

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

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. California grades, Floridon, \$43 per ton; Medina, \$39. Local grades, \$15@\$25, f.o.b. mines. Large oil companies use Floridon grade.

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—Per long ton, Florida ports: 77 per cent tricalcium phosphate, \$12.50; 75 per cent, \$11.50; 75@74 per cent, \$11; 70 per cent, \$7.35; 68 per cent, \$6.85; 68@66 per cent, \$6.60.

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. Imported, \$35@\$40; Canadian, \$20@\$40 per ton.

Mineral Products

Arsenic—White arsenic, 8½@9½c. per lb. in carload lots.

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.

Ferrocerium—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, 16@17c., f.o.b. works.

Ferromanganese—Domestic 76 to 80 per cent, \$90@\$95, f.o.b. furnace; re-sale, \$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, \$50@\$55; 50 per cent, \$85@\$90; 75 per cent, \$145@\$150.

Ferrotungsten—Domestic, 70 to 80 per cent W, 48@50c. 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@20¼c. 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, ½ 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 29, 1921.

Demand for steel products has continued to broaden, but by a barely perceptible amount. There is no forward buying, and scarcely any buying for construction purposes. The demand comes chiefly by way of releases on orders previously suspended.

The improvement is too slight to arrest the decline in steel production. Operations by the independent mills are practically stationary, at about 20 per cent of capacity, and the Steel Corporation's operations are decreasing slightly.

On carload lots with desirable specifications the market stands approximately as follows: Bars, 2c.; shapes and plates, 2.10c.; blue annealed sheets, 3c.; black sheets, 3.85c.; galvanized sheets, 5c.; wire nails, \$3; hoops, 2.80c. Standard steel pipe is now being shaded \$2 to \$4 a ton, by an extra discount of 2½ or 5 per cent.

Pig Iron—Control of prices of basic pig iron has passed to the steel works, which have accumulations they prefer to sell, as it is more economical for them to sell their cold iron and supply their own wants from time to time with fresh molten iron. A few sales have been made at about \$23, Valley, against \$25, the price the merchant furnaces have been maintaining. Bessemer is offered at \$25, or \$2 under the former quotation, while foundry is offered at \$25, Valley, a decline of 1 per cent.

Semi-finished Steel—The market is nominal, with asking prices \$38 for sheet bars and standard billets and \$40 for small billets.

Coke

Connellsville—Furnace, \$4.75@\$5.25; foundry, \$5.50@\$6.50.

¹Footnote Mineral Co., Philadelphia, Pa.

Erratic Behavior of Tin

Element of Speculation an Important Factor in the Market—The Failure of the Price-Control Policy of the Federated Malay States—Electrolytic Tin Being Tried Abroad, and Its Use Criticised

EDITORIAL MARKET STUDY

TIN LENDS ITSELF ADMIRABLY to speculation. It is a metal that is more valuable than most of the important non-ferrous metals such as copper, lead, and zinc, and as a consequence a smaller volume may be stored for an equivalent value. Unlike silver, another speculative metal, tin is actually consumed and in a large measure destroyed, so that its production and accumulation for a period of, say, thirty years or more is not of the importance in the general tin situation, as it is for silver. Furthermore, statistics covering the movements of tin from producing to consuming centers, and its disposal, are available to anyone who cares to make a study of the market.

Tin is one of the few metals produced in any volume the world over in which the United States produces from its own resources a negligible supply but consumes a greater quantity than any other country. Trading in tin is thus chiefly in the hands of the world's most important producing country—the British Empire—which produces about 60 per cent of the world's output of tin, and is safely lodged in the London metal exchange, where conditions are fully adequate to both speculative and commercial trading.

An Easily Misjudged Market

One has but to glance at the curve of London tin price fluctuations for, say, ten or fifteen years to realize what an important market factor speculation must be to account for the violent increases and decreases in price over short periods. The tin market in the United States, being largely dependent upon British supplies of the metal, conscientiously reflects the state of the London market, so that prices in New York correspond closely to those in London.

Tin is undeniably cheap when compared with prices current for the period of five years before the war, and has reached a price which but few interested market observers would have been willing to predict a short time ago. To show how companies directly concerned have misjudged the market it is only necessary to consult the recent report of a large American dredging company which has begun operations in the Federated Malay States, and whose probable future returns are estimated upon a basis of 40c. tin (the lowest basis given). However, not only tin producers but tin consumers have erred in predicting the market. Last year, when tin was 40c. per lb. and had declined from 63c. in January, consumers thought the metal an excellent purchase and usually did not hesitate in filling more than their immediate requirements. Consequently, when tin declined further they were subject to a loss that tended to make them wary of further purchases.

The total yearly production of tin in the world averages about 115,000 tons, which, weight for weight, would be equivalent to about one month's world copper production, showing how much easier it is to "corner" an important share of the world's tin than it would be to control its copper supply, and hence how much better tin is adapted to speculative purposes.

Regardless of the influence of speculation upon the tin market, the low prices at present are due to an unusual absence of demand for the metal by the tin plate, solder, and bearing-metal manufacturers, which are the most im-

portant consumers both in the United States and in Europe. An upward turn in prices is not expected until industrial conditions improve.

There are two principal methods for improving any market: the first to lessen production, thereby decreasing the available supply, and the second by stimulating and increasing consumption. The latter method is seldom used, but the former is a natural result of a poor market.

Price Control Ineffective in the Straits

The Federated Malay States government recently resorted to the first method, and has concluded an experiment endeavoring to decrease the available supply of tin, thus indirectly raising the price of the metal to a level commensurate with the cost of production. With this idea in view, early last December the F. M. S. government agreed to pay £235 per ton to the producers of tin for such metal as they were unable to market, but without inducing a market response, and so, about the middle of January, the purchase price was reduced to £205 per ton. In the meantime, however, exchange had risen so that, reduced to a dollar basis, the reduction in price was unimportant. No stimulation of the market was noticeable, and finally, late in February, the F. M. S. government abandoned the attempt to aid the local tin producer, thus acknowledging its ineffectiveness. Doubtless considerations of revenue as well as of the market prompted the government to release its indirect price control, for one of its chief sources of revenue is a tax on tin exports. The world's tin market is now again free to reflect the play of economic forces, but the trend has been notably downward.

Electrolytic Tin Being Used in Europe

Although the United States has no domestic tin resources, large amounts of imported tin concentrates are smelted by the Williams Harvey Corporation and the American Smelting & Refining Co. The latter company is the only one in the world producing large amounts of electrolytic tin, and in 1920 had an output of 18,511,160 lb. Several hundred tons of American electrolytic tin were recently exported to England, provoking interesting comment from British trade, which raised the question whether this variety of tin is suitable for tin-plate manufacture, although admitting its fitness for soldering purposes. Criticism was made that molten electrolytic tin is too mobile and runs too rapidly from the surface of the plate to be coated, leaving only a thin coating. The prejudice against its use is somewhat comparable to that met by electrolytic copper when it was first introduced. Electrolytic tin is sold on practically the same basis as Straits tin, but occasionally a concession is made in the price. It is of similar high purity. As tin consumers become more familiar with the characteristics of electrolytic tin, foreign objections to its use, if any, will assume more definite form. Judging from the reception accorded its introduction here, electrolytic tin is making splendid progress. It is interesting to observe that American-made tin is competing in a stronghold of tin production and smelting.

COMPANY REPORTS

Bingham Mines Co. Earnings Better

Lead; Utah

A report of the operations for the Bingham Mines Co. for 1920 shows gross earnings of \$208,304.73 and net of \$153,330.11. The company received interest on loans amounting to \$12,216.87 and \$299,373.40 in dividends from the Eagle & Blue Bell Mining Co. (\$170,655.10 of which was paid from net earnings). Total net operating gain and income amounted to \$464,920.38, from which depletion and depreciation charges amounting to \$76,674.81 were deducted. Earned surplus balance on Dec. 31, 1919, was \$261,231.43, and on Dec. 31, 1920, is given as \$520,758.60. This considers the dividends from mining stocks paid from the net earnings (\$170,655.10) and not the dividends amounting to \$128,718.30 received as "return of capital."

Production from the Dalton and Lark mines amounted to 479,242 lb. copper, 311,289 lb. lead, 82,214.2 oz. silver, and 1,927.4 oz. gold, from 16,307 dry tons of ore. The Victoria mine produced 9,787 lb. copper, 1,540,022 lb. lead, 183,063 oz. silver, and 1,503.8 oz. gold, from 12,068 dry tons of ore. Yosemite mines produced 6,422 lb. copper, 93,762 lb. lead, 2,509 oz. silver, and 25.5 oz. gold. Operating statement follows:

| | | | |
|--|--------------|---------------------|--|
| Gross earnings | | | |
| Ore shipments, Dalton and Lark, gross value | \$178,432.58 | | |
| Less deduction for smelting, freight, etc. | 55,038.55 | \$123,394.03 | |
| Ore shipments, Victoria, gross value | \$293,002.99 | | |
| Less deductions for smelting, etc. | 134,259.70 | 158,743.29 | |
| Total | | \$282,137.32 | |
| Revenue | | | |
| Royalties | \$ 65,507.61 | | |
| Rents | 2,174.85 | 67,682.46 | |
| Gross earnings and revenues at properties | | \$349,819.78 | |
| Operating expenses | | | |
| Mining operations (Dalton and Lark) | \$ 48,317.42 | | |
| Mining operations (Victoria) | 44,894.18 | | |
| Management, legal exp., taxes, etc. | 31,711.20 | | |
| Insurance and misc. taxes, etc. | 16,592.25 | 141,515.05 | |
| Net earnings and revenues | | \$208,304.73 | |
| Mine development | | | |
| Prospecting and development of mines (Dalton and Lark) | \$ 27,825.72 | | |
| Prospecting and development of mines (Victoria) | 27,148.90 | 54,974.62 | |
| Net operating gain | | \$153,330.11 | |

No dividends were paid during 1920.

Chief Consolidated Mining Co.

Silver, lead; Utah

A report of the Chief Consolidated Mining Co. for the year 1920 states that 12,717,410 lb. of lead, 2,622,132 oz. of silver, 212,906 lb. of zinc, 4,461 oz. of gold and 3,814 lb. of copper were produced from 82,430 dry tons of ore. Net returns from the smelter amounted to \$2,242,708.58 and after deducting charges the return was \$357,380.45.

Surplus Dec. 31, 1919, amounted to \$1,638,022.65, and on Dec. 31, 1920, was \$1,641,710.30. Four dividends were paid during the year, totaling \$353,692.80 on the \$884,232 in capital stock outstanding.

Mass Consolidated Mining Co.

Copper; Michigan

A report of the operations of the Mass Consolidated Mining Co. for the year 1920 states that the work of closing the mine was completed early in the year. Income from real-estate sales and sundries amounted to \$27,338.92, and expenses totaled \$75,742.26. A balance sheet (for an unspecified date) states that copper amounting to 1,626,973 lb., valued at 13c. per lb., is on hand.

Mining Dividends for March, 1921

The following is a partial list of dividends paid by American mining and metallurgical companies during March, 1921:

| Companies in the United States | Situation | Per Share | Totals |
|---|---------------|-------------------|---------------------|
| American Smelting & Refining | U. S. | \$1.00Q | \$609,980 |
| American Smelting & Ref., pfd. | U. S. | 1.75Q | 875,000 |
| Calumet & Arizona, c. | Ariz. | .50Q | 321,260 |
| Federal Min. & Smelt., pfd., s.l. | Idaho | 1.00Q | 120,000 |
| Hecla Mining, s.l. | Idaho | .15Q | 150,000 |
| National Lead | U. S. | 1.50Q | 309,831 |
| National Lead, pfd. | U. S. | 1.75Q | 426,433 |
| North Star Mines, g. | Cal. | .20Q ^a | 50,000 ^a |
| Oroville Dredging, g. | Cal.-Colombia | 9d.A | \$25,745.18 |
| St. Joseph Lead, l. | Mo. | \$0.25Q | \$352,367 |
| United Verde Copper | Ariz. | 1.50Q | 450,000 |
| Utah Copper | Utah | 1.00Q | 1,624,490 |
| Companies in Canada, Mexico and South America | | | |
| Cerro de Pasco Copper | Peru | 0.50Q | 449,141.90 |
| Exploration Co., Ltd., s.l. | U. S.-Mex. | 1 s. | \$37,500 |
| Nechi Mines (Colombia), Ltd., pfd. g. | Colombia | 5 s. | £35,000 |

^a, Capital distribution; Q, quarterly; A, annual.

March dividend lists continue to reflect the depression in the mining and metallurgical industries; Federal Mining & Smelting, St. Joseph Lead, Utah Copper, and Cerro de Pasco Copper all show a reduction from previous dividend rates, and Chino Copper, Kennecott Copper, Nevada Consolidated Copper, Ray Consolidated Copper, and Mining Corporation of Canada all passed the dividends usually paid at this time.

Isle Royale Paid No Dividends in 1920

Copper; Michigan

A report giving the result of operations of the Isle Royale Copper Co. for the year 1920 states that 10,621,801 lb. of copper was produced, at a cost of 20.10c. per lb.; 10,026,284 lb. was delivered during the year, for which 18.61c. per lb. was received, and 8,690,848 lb. remained at hand Dec. 31, 1920. Earnings statement follows:

| | | |
|--|----------------|---------------------|
| Received for copper delivered | | \$1,865,445.56 |
| Cost of copper delivered: | | |
| Production cost at 18.24c. | \$1,829,022.04 | |
| Selling and delivery cost at 0.56c. | 55,958.20 | 1,884,980.24 |
| Loss on copper delivered, 0.19c. per lb. | | \$19,534.65 |
| Loss by reduction to market value (13c.) | | 617,145.22 |
| Miscellaneous receipts | | 69,010.54 |
| Net loss | | \$567,669.36 |
| Increase in capital investments: | | |
| Construction | \$88,932.56 | |
| Less obsolescence | 2,660.00 | |
| | \$86,272.56 | |
| Lake Milling, Smelting & Refining Co. | 26,443.58 | 112,716.14 |
| Increase in reserves for depreciation and depletion | | \$680,385.50 |
| | | 348,740.37 |
| Decrease in balance of current assets | | \$331,645.13 |
| Balance of current assets as in annual report for 1919 | \$1,863,270.18 | |
| Adjusted by Federal regulations: | | |
| Increase in value of copper | \$162,914.54 | |
| Less reserve for 1919 tax | 10,343.64 | 152,570.90 |
| Balance of current assets Dec. 31, 1920 | | \$1,684,195.95 |

No dividends were paid in 1920.

South Lake Mining Co.

Copper; Michigan

The annual report of the South Lake Mining Co. for the year 1920 states that no active mining operations were carried on at the property during the year. Assessments amounting to \$67,089 were collected, leaving uncollected assessments to the value of \$156,912.50.

