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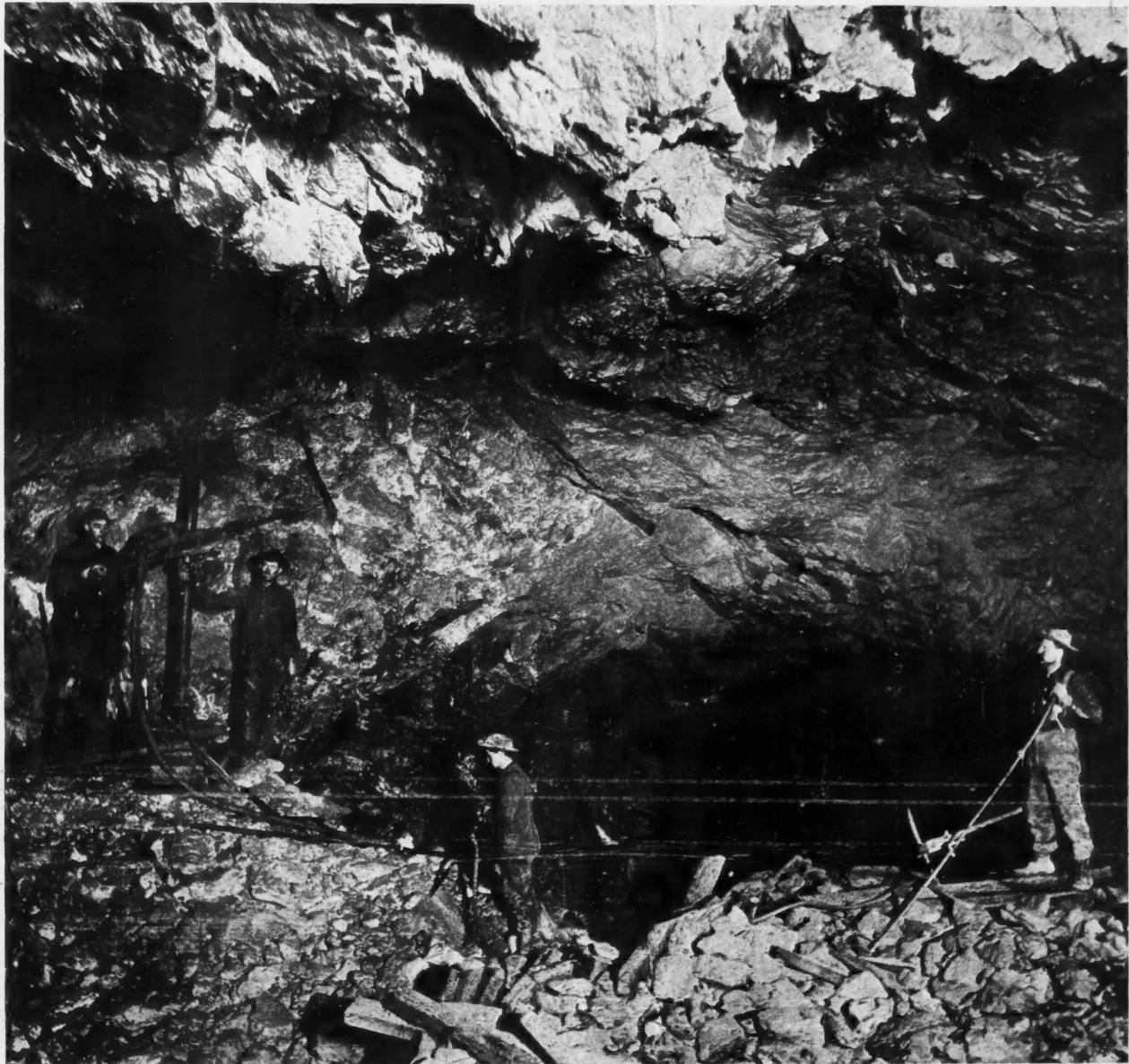
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ENGINEERING AND MINING JOURNAL

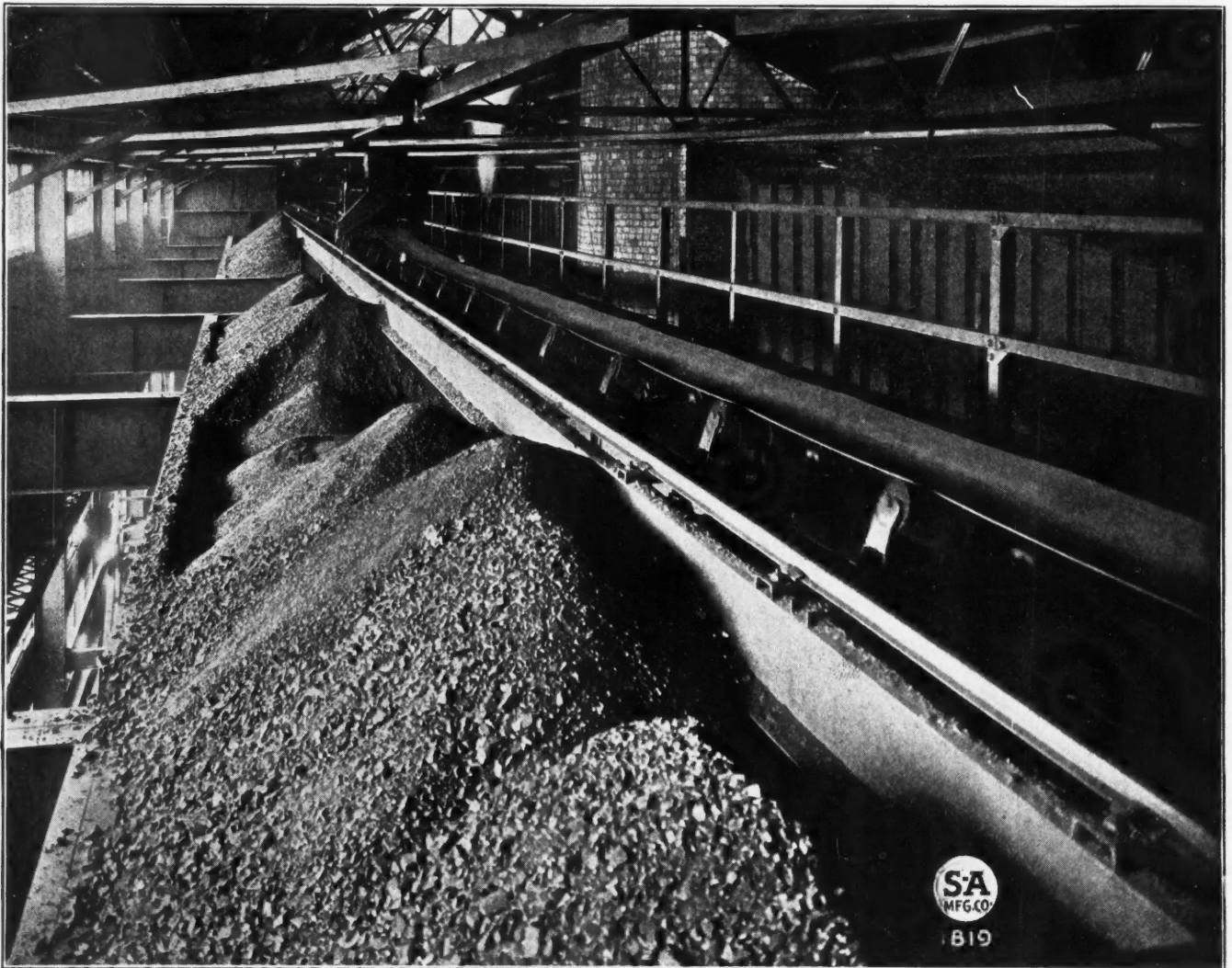
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June 11, 1921

Tariff on Minerals, by *Marc Pawl*—Smelter of the Calaveras Copper Company, by *E. H. Robie*—Air Receiver Calculations, by *Walter S. Weeks*



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A Weekly Journal of the Mining and Mineral Industries
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The Case for a Department of Mines

THE ARGUMENTS why the mining industry should now move as a body in support of a Department of Mines have been ably editorially summarized by *Coal Age* in the issue of May 26, apropos of the Frelinghuysen Bill, which is designed to establish what are vital statistical facts regarding the coal industry. The original draft of the bill placed the carrying out of its provisions in the hands of the Director of the Geological Survey, but as it now stands it is intrusted to the Secretary of Commerce and the Director of the Bureau of Mines. The bill is obscure as to how the work shall be divided; but the prevailing theory is that the statistical work and the reporting thereon shall be taken over by the Commerce Department and the technical investigations shall be conducted by the Bureau of Mines.

Technical investigations on coal have always been one of the chief features of the Bureau of Mines, so that this new commission will hardly disturb it from its routine; but the proposed duties of the Department of Commerce will mean lifting the coal statistical work from the Geological Survey and transferring it to the Commerce Department. For this we see no logical warrant whatever; it is not, we believe, in the line of constructive reorganization, but more in the way of light-hearted and wanton monkeying. Mining is not commerce, and no casuistry can make it so. The Geological Survey has developed the investigations and statistics of coal production for many years with great success and accuracy; and during the war their data furnished satisfactorily the facts for the Fuel Administration.

On the other hand, the mineral statistics of the last census (the census is the chief statistical organization of the Commerce Department) were notably bad; so that when the present census began there were conferences between the Census Bureau, the Geological Survey, and the Bureau of Mines, with a view toward getting more reliable statistics than in the past. *It was granted that these could only be intelligently collected and properly interpreted for presentation by men familiar with the mineral industry*; and, therefore, the Interior Department bureaus, at the request of the Census Bureau, selected Mr. Frank J. Katz, of the Geological Survey, to take charge of mineral statistics for the census and to arrange for a fusion of the endeavors of the Census Bureau and those of the Interior Department in such manner as to avoid duplication. Therefore, the only way that the Department of Commerce will be able to gather and present mineral statistics reliably in the future, if it relieves the Geological Survey and the Bureau of Mines of their mineral statistics, will be to hire a new corps of men familiar with the industry; and in the long run it is more likely that the work will slip back into the hands of routine statisticians.

The trouble is that we have no single Government branch to which Congress can look as representing mining. Instead, we have two bureaus in the same department, jealous of each other's extension of activities, and, therefore, not disposed to fight back to back, under a Secretary of the Interior who usually is apologetic and half-hearted when a powerful cruiser in the uncharted seas of Washington's executive departments bears down with the intention of relieving the department from some of the mining duties.

The industrial side of mining is only fragmentarily represented at best. Most has been done by the Geological Survey, where it was least in place. The metallurgists and experiment-station experimenters who are doing most valuable work in their line for the Bureau of Mines have little idea what the business of mining may be, or why the Bureau of Mines should be interested in it. We need reorganization right there. Transfer the Bureau of Mines and the Geological Survey bodily into the Commerce Department, if you will: they do not belong there, but they would probably be more actively reorganized under Hoover than any one else. But Hoover is only a transitory phase in Washington; new Secretaries of Commerce will come, and certainly they will not be mining men, and not even engineers; they will be merchants or manufacturers, as in the past. The Government machine, on the other hand, will, we expect, go on forever; so that the all-important thing is to have any change a change for the better per se.

If we take the Geological Survey and divest it of its economic work which it has undertaken, to its great credit and to the great good of the country; if we take the Bureau of Mines and rechristen it for what it really is, a Bureau of Mineral Technology; if we create a new Bureau of Mineral Economics; and put all under a Secretary of Mines—then we shall have an adequate organization without much more expense and personnel than we have at present.

The mining industry, which embraces metals, non-metals, coal and oil, is an enormous one; it is not commerce, but a producer of the raw materials for manufacturing and commerce. It is as fundamental as agriculture, and not to be casually grouped with the boot-and-shoe industry or the ladies' millinery business. It is one of the principal industries of the greatest mining country in the world, which mines the framework of commerce and industry for many countries besides our own; and yet when Congress wants something done with regard to the industry, it does not know where to turn.

During the war, the Interior Department bureaus were passed by and the economics of the metal mining industries were intrusted to the War Industries Board; of coal and oil, to the Fuel Administration. And now

the colossal Frelinghuysen Bill, designed to throw light on the coal industry, puts hesitatingly one foot each on two ships sailing in different directions.

The Engineer and the Business of Mining

"IS ENGINEERING A PROFESSION or a business?" It is a question which has been consistently discussed of late, in connection with the fight in New York State over the engineer's licensing law. For the mining engineer, however, his chief interest is not in engineering, but in mining. We think that we shall receive general agreement to this preliminary definition. And, therefore, the question which we would like to propound to him is whether mining is a profession or a business? And we think we shall receive the great majority of votes to the effect that mining is a business. It is an industry.

The engineering of mines is not to be compared closely to the law, medicine, or the clerical occupations. The doctor, the lawyer, or the clergyman prescribes for the body, for civil strife, and for the soul, from his knowledge of the laws of physiology, or codified law, or of the moral and divine law respectively. They are compensated therefor by fees, flat charges, or salaries. But they do not sell any material commodity; and in this we see the wide difference between the practice of these professions and the engineering of mining.

The engineering of mining is the business guiding of one of the greatest extractive industries; and the engineer of mines, in the true sense that it has come to be generally accepted, studies, comprehends, and guides the whole transaction. It is not a simple operation, but a series of problems in steps: A. Find the ore, develop it, expose it and measure it. B. Remove it from the ground. C. Reduce the metal out of the ore. D. Market your metal. These operations have developed specialists: for A, the geological engineer; for B, the mechanical-electrical engineer; for C, the metallurgical engineer; for D, the managing and financial engineer. Who, then, is the engineer of mining? Any one of the above, or any combination of more than one.

A generation ago, the engineer of mining was all of the above combined: a *multum in parvo*, an *e pluribus unum*; and there were some able specimens thus developed. Nowadays knowledge has gone too far: the jack of all trades in mining is master of none: there is no profit in attempting the stretch.

But the whole thing is a business. The primary object of the operation is to produce and sell material commodities *at a profit*. The four kinds of engineering which control the business all are carried on with the main object of a profit.

These things are open to no dispute. Nobody will disagree with us. But we believe that the engineers of mining would do well to follow out the logical deductions and courses. Much has been written and said within the last two years about the duty of the engineer as a citizen; that the engineer was best fitted to handle the public business; that the engineer of mines should devote his abilities to guiding the economic affairs of the country. But there is a hiatus here. The progress of organization in the mining industry has been such that the fact is that the mining engineer does not, as a class, take any intelligent interest in his own business. The background of impression that he is a professional man—that he is a kind of scientist—hampers him.

There is an academic timidity about the high-class engineer, when it comes to discussing anything but technology—a shrinking away from contemplation or discussion of the fundamental economic conditions governing his industry—that almost reminds one of the recent European professional caste feeling of superiority to "trade." Your engineer can locate and estimate the ore; can remove it skilfully from the ground; extract the metal with marvelous skill. This is engineering, he will tell you. But, what about the tariff on minerals, on tungsten, chrome, and bauxite? "A forbidden subject, my dear sir," says the high-class engineer, in effect: "do not mention it in my presence again." Yet this may determine whether you will mine or not.

How about the McFadden Bill, to subsidize the gold miner? "Mercy, how coarsely the man talks—we shall be ranked next with the promoter class!" What about the Pittman Act, without which your mines would be now closed? Is it sound or not—what do you think about it? "The subject, my persistent sir, is not in place in an assemblage of professional men." What about the mineral policy of England and of France? "Hadn't we better leave that to the State Department?" What do you think of the way the Bureau of Mines and the Geological Survey are being run? "Isn't that the business of the Directors? They might not like it if we expressed an opinion." What about the Minerals Separation grip on flotation? "That is a subject that I could easily get myself in trouble with—if I don't think about it, I shall retain my professional detachment." What do you think about these apex controversies: are they silly or are they constructive? "Oh, say now; I have a friend who is a geologist." What do you think about licensing mining engineers? "Are they licensing mining engineers—oh, yes; I remember. Engineering Council has attended to that. I haven't the slightest idea what it is all about, but it has all been arranged for us."

The engineers of mining should realize that they are engaged in a business transaction, if they are engaged at all. They should cease to be afraid of the great controlling factors in their own business. Until then, we are forced to admit, we should not hold ourselves superiorly fitted for handling other kinds of business, including public business.

Farmers' and Miners' Combinations

THE ANNOUNCEMENT of the formation of the Farmers' Finance Corporation, a "co-operative financial institution" with a capital stock of \$100,000,000, is of intense interest, not only to farmers and food consumers but to the mining industry. Like the agricultural industry, mining is a great basic industry, engaged in the production of raw materials for general use; and the problems of these two great fields of endeavor are in many ways similar. There has been a notable hiatus between the farmer and the consumer, a wide split between the prices the grower gets for his produce, which often does not permit him to go on producing, and the price the housewife pays for the family's food, which often bears little relation, in its altitude, to the cost or volume of production. The reason is, in general, poor marketing systems, waste, ruinous competition in distributive methods, and petty or larger combinations of middlemen at various stages to keep prices at a certain profitable level.

The answer to this problem has been found in certain sections by combinations of producers into a marketing organization—like the California Citrus Growers' Association, in which growers hold stock and which is a purely co-operative body, marketing the citrus fruits scientifically and economically. No one has protested against these regional organizations. They have been good things. They have eliminated waste. They have closed up the price gap between producer and consumer to the advantage of both—or at least to that of the producer. They have reduced to a minimum the rake-off of the non-productive middlemen. There ought to be more of them for our country's health as an agricultural nation; and agriculture is the backbone of a country, economically and as a guarantee of stability and democratic institutions. These associations are also, however, combinations in restraint of trade. They involve private price-fixing agreements. There is no getting away from it.

And now a national association or combination of farmers on this basis is proposed. The new organization is a subsidiary of the United States Grain Growers, Inc., recently organized at Chicago, which will organize the marketing of grain and "stabilize and perhaps reduce the price of flour." Besides grain, it is planned to embrace, along similar lines, livestock, fruit, vegetables, poultry, eggs, tobacco, and other products. The immediate steps will be the establishment of terminal sales agencies, warehousing facilities at terminal markets, an export corporation, and a marketing news service.

The parent corporation, the United States Grain Growers, Inc., is reported to comprise in its membership most of the grain growers of the country; and the new subsidiary will doubtless have as its stockholders eventually most of the other big farmers, as individuals or groups. A campaign will be launched to distribute its stock among farmers at \$100 a share. The general counsel for the organization is Clifford Thorne, of Chicago; and it is announced that Bernard M. Baruch will serve in an advisory capacity for the corporation.

We must approve of the principle of these co-operative organizations. At the same time, we feel rather aghast at the results to which logic and business common sense have led. Here is a farmers' combination, prospectively more powerful than any business or industrial combination the world has ever seen. Standard Oil and the United States Steel Corporation will be relegated to inferior rank. Those who have hitherto freely indicted labor organization as the greatest trade-restraining combination in the country, and criticised the anti-trust law for not being applied to them, will find food for thought in this new type of combination, most inclusive and powerful of all. It has been found difficult to attack the trade-restraining activities of the labor unions, because they have not been incorporated; but these new farmers' combinations are incorporated and fearless. Mr. Thorne, the counsel, stated, "We are asking no favors of the Government. Nor are we asking for anything that we are not willing to accord to every other line of industry. We are going to operate on a business basis."

This last setting forth of position makes plain the permissible application of the plan to the mining industry. We are forced to approve of it, on logical grounds, for the farming industry, although, as we stated above, we cannot quite foresee the further results of this most profoundly significant development and experiment in socialistic organization. Who, for example, is going to

represent the consumers' interests, and will not this necessity eventually compel government supervision of prices? But we have much the same evils or defects of organization in the mining industry that the farmers have to suffer under: the same faulty marketing and distributing methods, the same unreasonable split between thirteen-cent copper to the producer, large or small, and dollar copper to the home builder, with the difference mainly absorbed by an army of middlemen. On this problem we know our copper producers have been working. Will they perhaps intrepidly follow the course of the farmer and organize the Miners' Finance Corporation, to "stabilize" the price of metals, as the United States Grain Growers, Inc., purposes doing in the case of flour; to study the problems of marketing and the elimination of middlemen's profits, and provide the consumer with his sheet and wire copper at a less price, while the miner gets a better price?

There is a difference, to be sure, between the agricultural and the mining industries, in that large groups control more in the latter. But these large groups have not combined, and, therefore, have been inactive in supporting their industry: great size has made them timid and sensitive against possible attack. The farmers have had no such timidity, any more than the labor unions had; and their numbers make them formidable and effective. And there are a host of miners outside of the largest companies who would have no more hesitation in any plan that would promise better support and organization to their industry than the farmers have had.

Reform in the Patent Office

A GENIUS FOR INVENTION is something which not all of us possess, but it is nevertheless a fairly common attribute of the American engineering mind, and the efficient co-operation of the U. S. Patent Office in recording and protecting our ideas is necessary. The year 1920 was by far the busiest year in the history of that Government bureau; the lull in business seems to have given inventors an opportunity to develop their thoughts and to dream of new things. As a result, over 40,000 applications for patents are now awaiting examination and response on the part of the Patent Office. This means that the average new application is not reached for seven months after it is received. True, the inventor sometimes wishes to delay the granting of a patent as long as possible, in order to have protection extend over a longer time; but in many cases the applicant is anxious to have the status of his invention determined at the earliest possible date, so that he may make plans accordingly. To him a delay of seven months before anyone even looks at his application is most undesirable, and the condition is not a healthy one.

The American Engineering Council has joined with several other associations in a broad movement to bring about sweeping reforms in the Patent Office. In addition to the condition just outlined, the Nolan bill awaits action by Congress, and the passage of this act is to be pushed by the Council. It provides for the promotion of the international rights of inventors, which are often of more importance than domestic rights. We trust that all of those interested will give their maximum support toward a betterment of conditions. Some inventors, of course, are freaks, but most of them are not, and to them we owe a large share of our industrial progress.

WHAT OTHERS THINK

Further Comments on the Naica Case

The observations of "Lay Student" in *Engineering and Mining Journal* of May 14 regarding the Naica case will, I am afraid, leave a wrong impression in the minds of your readers regarding the essential features of the recent decision of the Supreme Court of Mexico in this litigation. I must leave to others the discussion of the subtleties of civil law, but having gone into the case pretty thoroughly in behalf of one of the principal stockholders, I may venture to give your readers—whether they may be students of law or plain business men—a brief statement of the central features of the case.

The decision of the Supreme Court of Mexico in January, 1921, ordered the return of the principal mine of the Naica company to the heirs of Stoppelli on the following grounds (the parts of the summary given below in parentheses constituting my comments):

1. That Stoppelli, one of the original organizers of the company, had contributed the mine to the corporation at the time of its organization in 1897 (although he had to contribute merely the right to denounce the mine, which right, moreover, he sold to the company).

2. That the Naica company had not been legally organized, because of certain omissions in its original articles of incorporation (although these omissions had later been legally repaired).

3. That the company, by reason of these omissions, was non-existent, and, therefore, the property held by it belonged to its associate members, and on dissolution each associate was to receive back what he had originally brought to the company at its organization.

4. That, though the right to petition the court for the dissolution of the company under the law is confined to associates in the company, namely stockholders, and although Stoppelli had forfeited his shares for failure to meet the last five of a series of fourteen assessments against them for an increase in capital, this forfeiture was illegal, and thus the plaintiffs were absolved from their legal responsibility to prove their status as associates as a condition to the prosecution of their case.

5. That if it were true that Stoppelli had forfeited certain shares for failure to pay assessments against them, these were not all of the shares he possessed, because he must have received other and non-assessable shares (the court argued) in return for the alleged contribution of the mine to the company (although no record of these shares had at any time been made by the company, and their existence was unknown to any person; nor had any claim at any time been made regarding them in behalf of any person. Moreover, all of the existing shares of the company were plainly described as assessable in the original articles of incorporation).

6. That a settlement between the company and the heirs of Stoppelli made in 1905, on the termination of the previous litigation between them, was inconsequential because it had not been ratified by the Stoppelli heirs (although the money paid by the company in the settlement was retained by the estate, and its return or

tender under Mexican law being a necessary precedent requirement to any action attempting to set it aside).

7. That the right of action of Stoppelli was not outlawed by the statute of limitations, although more than twenty years had elapsed from the date of the organization of the company at the time the action was brought, because under the Civil Code no illegal organization is made legal by the passage of time. (This position was taken by the court, although the Civil Code in no way applied to the Naica case, it having to do with a mercantile transaction and thus falling within the scope of the Commercial Code, as indeed the court itself held with respect to every other point in the case).

8. That there was to be no legal effect given to the amendment by the original parties of the original defective charter of the company which they thought they accomplished when they adopted their by-laws in the year following the organization of the company, and included therein all the necessary legal observances omitted from the original papers (this being held, although nothing in the law prohibits such amendment of articles of incorporation).

There are a number of other interesting and pertinent points in the decision of the court, but the foregoing are the most material. Indeed, none of them is of relative consequence compared with the single one in which the court ingeniously contrived to give legal status to the plaintiffs through the creation of the fictitious *non-assessable* shares which it assumed that Stoppelli had at one time possessed (unconsciously, it must have been), and in some mysterious way had transmitted to his heirs.

The entire structure of the decision, with all the legal argumentation, would crumble if the fiction of "non-assessable shares" were removed. This fantastic conception has nothing to do with law, whether civil or Anglo-Saxon, but is the illegitimate offspring of outraged Fact by Wanton Judicial Casuistry.

Nothing in the facts of the case afforded an escape from the embarrassment under which the court suffered in attempting to give countenance to the plaintiff's demands. Other difficulties could be overcome by argumentation, or at least obscured; but no amount of verbiage could conceal the plaintiff's lack of right to be in court at all. Consequently, the missing fact had to be contrived.

"Lay Student" suggests that to Americans the Naica case is difficult because they are accustomed to Anglo-Saxon jurisprudence, whereas the Naica case was governed by civil law. This, however, in my view, does not explain the difficulty which right-minded Americans find in accepting this extraordinary decision of the chief court of Mexico. The Naica decision was not arrived at as a result of the vagaries of the civil law. The civil law, which applies in Mexico, applies also in French jurisprudence. Indeed, French authors are the main sources of interpretative authority in Mexican jurisprudence. But a decision such as the Naica decision could not conceivably be rendered by the courts of France, because there logic and legal learning are used by the courts to discover and clarify justice; whereas in the Naica case they were used to obscure it.

The civil law is different from English law, but its aims are identical with it, in making justice acknowledge fact.

HENRY BRUERE.

New York.

The Tariff on Minerals

A Novel View in Opposition to the Policy of Tariff Protection For Minerals, Based on the Present Status of Our Mineral Industries and the Effect of a Tariff on Their Development

BY MARC PAWL

Written for *Engineering and Mining Journal* and *Chemical and Metallurgical Engineering* jointly

THE Ways and Means Committee of the House of Representatives has an exceedingly difficult job in trying to fix just rates in the new tariff bill that is to be introduced during the present session of Congress, for no man can know the conditions surrounding all the multifarious industries of this country, and no man can visualize the ramifying effects of a tariff. The difficulties are increased by the testimony and the briefs brought before the committee, for they are almost invariably highly colored by the desires of financially interested pleaders. In some of the briefs not a single fact is given without distortion, though a very few give fair and even scholarly presentations of their cases from the pleaders' standpoints.

In most pleas, especially by monopolistic concerns, costs, which ought to be the very foundation on which a tariff is erected, are carefully concealed, or excessively high costs covering the less defensible part of the industry are given, and the public is asked to grant a tariff to bolster prices, the justice of which is not shown.

In going over the reports of hearings before the Ways and Means Committee of the House, the unanimity of the emphasis placed on certain points is striking. Nearly all bills declare that they are "to provide revenue for the Government and for other purposes." One is to provide for the national security and defense, but I have seen one only that frankly states that it is merely to fix a duty on a mineral. One fears the Greeks who come bearing gifts.

Many of the pleas are for a tariff of 100 per cent or more of the price of the mineral or metal before the war, though some are less, and many have not yet reached the form of bills. Most of them ask for duties that will hold prices at or near the level reached during the Great War, but all show that the industry will not be overly enriched, and that the ultimate consumer will never know that his pocketbook has been touched.

Congress, in order that it might have less biased information than that introduced by special pleaders, provided for a Tariff Commission to investigate conditions governing the various industries, one of the most forward steps taken in tariff legislation in this country. This commission has done serious, hard work, but being composed of mortals, even as you and I, will require years to cover the huge and ever changing industrial world before it.

EFFECTS OF A MINERAL TARIFF

Perhaps no industry offers simpler conditions for weighing the application of a tariff than the mineral industry, and no industry except farming is more vital to our well-being.

General Hancock was, of course, wrong when he said that the tariff was a local issue. None but the immediate beneficiary has a local habitation. The payor is every purchaser from Cape Prince of Wales to Key

West, and the effect of a mineral tariff may be much more serious than the immediate effect it has in increasing the industry or raising prices.

Ore deposits are diminishing assets. They are like cisterns—they hold a fixed quantity, but unlike cisterns they cannot be filled again. The first production—that from the outcrop—is the cheapest, and as the deposits are worked to greater depth, or the richer ores are worked out, the costs become greater. The first deposits worked are usually the richest and nearest to transportation routes, and there is only one crop of ore.

On these truths, so axiomatic that they are almost trite, is built the mining industry, yet every appeal for a tariff is based on the assumption that these factors do not apply to the particular item under consideration. The plea is almost invariably made that if proper "protection" and "encouragement" are given, the industry will prosper, though the lack of prosperity may be due to lean deposits, inefficient operation and poor location, for ore deposits are where you find them and may be in very inconvenient places.

Never before has there been so good an opportunity for a proper estimation of the country's mineral resources as the present. During the Great War, the prices for minerals and metals reached heights unheard of. Prospecting took on new life, and men went over the country with a fine-toothed comb. Every possible outcrop was carefully examined and known deposits were worked to the limit. At the same time, governmental agencies gathered together all possible data thus made available.

OUR MINERAL RESOURCES AND PROPOSED TARIFFS

Although the United States is the richest mining country in the world, there are certain metals and minerals in which it is very poor, of which the principal are nitrates, the platinum metals, tin, nickel, soluble potash salts and diamonds. We have some of all of them, but by no possibility can we get enough for our needs from known deposits. If we think of our mineral resources as represented by a pyramid, these mineral products may be taken as forming the apex, thus approaching zero. If we imagine the lower part of the pyramid as curving so that at the bottom the sides become nearly horizontal, the base may be taken to represent our illimitable supplies of such minerals as salt.

Using such an idea, the minerals and metals on which duties are now being asked have been grouped in the accompanying table. The list is divided into two main groups: I. Minerals of limited quantity; II. Minerals in large quantity. Under the first group three divisions may be made: A. Minerals insufficient for domestic needs; B. Minerals insufficient for domestic needs except at artificial prices; C. Minerals sufficient for the immediate future. It is probable that few if any of the

producers will agree with the grouping, but the divisions are as indicated by the statistics of the United States Geological Survey.

MINERALS ON WHICH DUTIES ARE ASKED

	Proposed Tariff	Price in 1913
I. Minerals of limited known quantity:		
A. Minerals insufficient for domestic needs:		
1. Antimony ores.....	10c. per lb. contained Sb in ores, matte and antimonial lead.....	Best grade, 8.53c. per lb.
2. Cobalt oxide.....	75c. per lb.....	50c. or more per lb.
3. Tin ore.....	10c. per lb. Sn and 4c. on Sn in ore.	44.2c. per lb. Sn.
4. Graphite (lump and amorphous).....	Lump 3-6c., amorphous 2c. per lb..	Ceylon lump 6.5-11c. per lb.; amorphous 1-1½c. per lb.
5. Diamonds.....	10% (incl. borts).....	.....
6. Iodine (resublimed)...	33¼% ad val.....	.....
7. Nickel.....	10c. per lb.....	38c. per lb.
B. Minerals insufficient for domestic needs, except at artificial prices:		
1. Aluminum (bauxite)...	Al 7c. per lb., bauxite, not determined.....	.....
2. Chromite.....	60c. per unit.....	50% Cr ₂ O ₃ , \$10.12 per long ton.
3. Manganese ores.....	40c. per unit.....	\$7-\$12 per ton.
4. Monazite.....	15c. per lb.....	None produced.
5. Tungsten ores.....	\$10 per unit (20 lb.) WO ₃	\$7.50 per unit WO ₃ .
6. Pyrites.....	10c. per unit S.....	8.4c. per unit S (Virginia).
7. Mercury.....	50c. per lb.....	52.7c. per lb.
8. Graphite (flake).....	6c. per lb.....	6-8c. per lb.
9. Mica.....	Unrefd, 25c. per lb. and 20% ad val.....	37c. per lb.
10. Potash.....	50c. per unit K ₂ O.....	66c. per unit.
11. Vanadium.....	\$1 per lb. (in ore?).....	.....
12. Magnesite.....	Crude \$15 per short ton. Calcined \$25 per short ton.....	Crude \$7. Austrian calcined \$16.20 per short ton.
C. Minerals sufficient for the immediate future:		
1. Arsenic (white).....	5c. per lb.....	4.4c. per lb.
2. Barytes.....	\$15 per short ton.....	\$1.71 per short ton.
3. Bromine.....	7c. per lb. plus 30% ad val.....	20.1c. per lb.
4. Fluorspar.....	\$5 per long ton.....	\$6.37 per ton.
5. Fuller's earth.....	75c. and \$1.50 per short ton.....	\$9.58 per short ton.
6. Lead ores.....	¾c. per lb. Pb cont.....	4.4c. per lb. Pb.
7. Molybdenum ores....	50c. per lb. on MoS ₂ and concentrates.	80% conc. 42¼c. per lb. MoS ₂ cont.
8. Zinc ores.....	2c. per lb. Zn in ore.	5.6c. per lb. Zn.
9. Feldspar.....	Not determined.....	\$3.31 per ton.
10. Sulphur.....	0.75c. per lb.....	0.8c. per lb.
II. Minerals in large quantity:		
1. Lime.....	\$1 per bbl.....	75.3c. per bbl.
2. Building and monumental stone.....	\$1 per cu.ft.....	.....
3. China clay.....	\$6 per ton.....	\$6.76 per ton.
4. Gypsum.....	50c. per ton.....	\$1.51 per ton.
5. Magnesium chloride..	\$15 per ton.....	Fused, \$8 per ton.
6. Magnesium.....	10c. per lb. plus 15% ad val.....	\$1.65 per lb.
7. Flint (quartzite is used as a substitute).....	Not determined.....	.....
8. Pumice.....	\$20 per ton.....	\$2.26 per ton.
9. Talc.....	\$10 per ton.....	\$11.90 per ton.
10. Salt.....	\$5 per ton and duty on container.....	\$2.72 per ton.
11. Coal.....	75c. per ton.....	\$1.33 per ton at mine.
12. Phosphorus.....	17c. per lb.....	.....

A. MINERALS INSUFFICIENT FOR DOMESTIC NEEDS

All of the minerals of the first group are necessary in our commercial economy and will be imported no matter what tariff is placed on them. Tin ore, diamonds, and graphite in lump form are three mineral products that the United States lacks almost entirely.

We do have some amorphous graphite, to which reference will be made again. Flake graphite is put in the second group.

ANTIMONY ORES

Our experience during the war showed that sufficient antimony to supply the needs of the United States cannot be produced from our known deposits at five times the price of 1913, the last normal year, or seven times the present price of 5.5c. per lb. Even at a price of 14 to 16c. which the proposed tariff would probably put on the metal, it is likely that not over 500 of the 7,500 tons normally used in this country could be produced. Ten cents per lb. above the normal market price for 7,500 tons would be \$1,500,000, that someone would

have to pay as a tax, although the revenue that the Government would receive would be \$100,000 less. Besides the deposits in our own country, Americans own considerable antimony deposits in Mexico.

COBALT OXIDE

Cobalt oxide is produced in only one mine, that at Fredericktown, Mo. Queerly, it is controlled by Canadian capital, and Americans produce much more cobalt ore in Canada.

TIN

We produce not more than 200 tons of tin concentrate per year, say 135 tons of tin, and we cannot enlarge this notably. The war put a price of 75c. to \$1 a pound on tin for a considerable period, but production did not increase. Great Britain, through her assiduous and long-continued collection of unprotected territories, has acquired about 50 per cent of the world's tin deposits, not including Siam's, which she also virtually controls, but the United States, a non-producer, uses about 80,000 short tons (1918 figures) out of a world's production of 131,000 tons, or more than 60 per cent, and it seems possible to control commercially only a part of the ore necessary. The largest independent miner of tin ore is Bolivia, which produces 28,000 tons of tin in ore that is shipped to other countries for smelting, equivalent to more than one-third of our requirements, and it is possible that more ore may be mined under the initiative of outside capital.

Years ago the spectacle of American tankers carrying kerosene to Asia and coming back empty moved some American capitalists to build a tin smelter at Bayonne, N. J., with the idea of smelting tin concentrate to be brought back by the tankers from the Malay Peninsula, but a British company had a smelter at Singapore and the government promptly placed a 33½ per cent export tax on the ores and the smelter at Singapore continued a strict monopoly. The Bayonne smelter was put out of business, but five others have grown up, and all the Bolivian ore can now be handled here, though much of it goes to Europe and Singapore. Excellent electrolytic tin, apparently fit for all purposes, is now made here. A tariff on ores will give revenue, but cannot build a tin mining industry.

It must be remembered, however, that the United States cannot buy ore sufficient for her needs, for she uses 60 per cent of the world's output, and, including Siam's output, Great Britain controls nearly 60 per cent.

A duty of 10c. per lb. on tin would make an extra cost of \$3 a ton on tin plate, and unless a rebate were allowed on export material, this might readily kill the export trade. Americans, however, would have to pay the increased cost.

Americans have several million dollars invested in tin mines in Bolivia and other millions invested in tin mines in the Federated Malay States and China.

GRAPHITE

This country has no deposits of lump graphite, from which the best crucibles are made, but imports its supplies from Ceylon, the one great producer, and Americans are interested financially in Singalese deposits. Our American deposits of amorphous graphite are not to be compared with the deposits in Sonora owned and operated by Americans. These deposits formerly fur-

nished and probably yet furnish the graphite for the best lead pencils of both domestic and foreign make. The heavy duty proposed, about 100 per cent on flake graphite, is probably aimed at the Madagascar flake, which really competes with the American product, but the tariff on amorphous graphite is from 167 to 200 per cent of the 1913 prices.

DIAMONDS

The problem of the diamond is only a phase of the "woman question." The diamond millionaires of Great Britain, forming one of the most rapacious and complete monopolies known, were created and are kept growing by the American bride-to-be. Her solitaire is usually far more expensive than the young man can properly afford, and the price is maintained and kept up to all the traffic will bear. The mass of diamonds are indefensible luxuries for which prices beyond all reason are charged and paid to satisfy mere whims, so that no objection can be made to a tariff of any sum. A smaller part of the diamonds imported are for serious use. (It is not, however, intended to suggest that being a bride-to-be is not a serious matter!) They are the bort or imperfect stones and the carbons or amorphous diamonds, and are used in diamond drilling, glass cutting, etc., and a duty on them is a tax on necessities and especially on mining. The prices for these stones reflect the prices on gem stones and are out of all reason, even without a duty.

IODINE

Iodine has so far been produced only experimentally in this country. It comes from Chile, where it is obtained as a byproduct from the nitrate deposits in which American firms have millions of dollars invested, and can be produced in quantities far beyond the world's needs.

NICKEL

The suggestion that a tariff be placed on nickel is probably not to be taken very seriously. The richest nickel deposits in the world, those of Sudbury, Canada, are largely held by the International Nickel Co., an American company, and this company also supplies the larger part of the world's manufactured nickel. The investments of the company in Canada are valued at many millions. Under no imaginable circumstances could the United States supply its needs of the metal.

On none of the minerals of the first group, except diamonds for gems, does a tariff seem justifiable.

B. MINERALS INSUFFICIENT FOR DOMESTIC NEEDS EXCEPT AT ARTIFICIAL PRICES

In the group of minerals insufficient for domestic needs except at artificial prices are several minerals of which it is conceivable that if the price were high enough the entire needs of the United States might for a short time be supplied from domestic mines. During ordinary times, however, it has been found expedient to import a considerable part of our supplies, the proportion varying from almost the total quantity of potash to a comparatively small part of our flake graphite and mercury.

With the exception of monazite, this group of minerals was of enormous use in carrying on the Great War. Except for aluminum, graphite, mica and pyrites, these minerals were almost or quite irreplaceable by substi-

tutes. We have not yet joined the League of Nations and there is as yet no insurance against war. Few thought the Great War possible; another may be nearer than we think.

Using for our nation the same sort of thoughtful care that we do for our families, what must be our attitude toward these deposits, the depletion of which, comparative or total, is apparently only a handful of years away?

BAUXITE

An important item that must be stressed when considering the cost of minerals is the matter of purity. Thus American bauxite ordinarily carries from 8 to 9 per cent SiO_2 , against 2 to 3 per cent SiO_2 in good foreign material, and only 55 per cent Al_2O_3 , against 62 per cent Al_2O_3 in the foreign ore. These differences are equivalent to an added cost of several cents a pound to the manufacturer if he must use the lower grade mineral. The same reasoning applies to chromite and manganese ores, to monazite and pyrite. The mass of domestic ores are of lower grade than the imported ores, and if the American metallurgist is compelled to use them either he must bear the added expense of reduction, or he must pass the cost along with the duty to the ultimate consumer—to you and to me, and to William Jones and John Brown, who are so lost in the crowd that, like the grains of sand on the beach, we blend in blurred obscurity unless someone stoops to look at us.

CHROMITE

Under the desperate needs of the Great War we produced 82,350 long tons of chromite averaging 50 per cent or less Cr_2O_3 at \$48 per ton, but at the same time we imported more than 100,000 long tons averaging 50 per cent or more Cr_2O_3 at \$28.88 per ton. That is, we produced four-ninths of our needs at a cost one-third higher than that of the five-ninths imported. Not only were the actual costs higher during the war, but an indirect cost was added of which little account was taken. That was the excess of cost in working lean concentrates, of which I have just spoken. At a time when every pound of coal and every bit of electrical energy was so greatly needed, we had to waste a great deal of it in slagging off useless rock. This was a tax as burdensome as the higher prices, but invisible to any but the metallurgist.

MANGANESE ORES

Almost the same conditions applied to manganese ores. Our own deposits were mostly small and mostly poor. Some high-grade deposits were developed and some are now known, but they are very much smaller than our needs, and must have high prices to work successfully. The manganese deposits associated with the copper ores at Butte (rhodochrosite) and Phillipsburg, Mont., are large, and water power is conveniently developed, but mining is expensive and the ore is not the cheapest to reduce. But even under war conditions, we cannot produce the ores we need, and under peace-time conditions higher grade ores at much lower prices can be readily obtained from India, Brazil and Russia.

Americans own large manganese deposits in Brazil, and other deposits are owned in Mexico and India, involving investments of probably \$5,000,000.

MONAZITE

The proposed tariff on monazite is another case of a proposal to compel the use of American material of

lower grade and higher price. The marketable monazite from the Carolinas carries only 4.5 to 5.5 per cent ThO_2 , against about 6.5 per cent in the Brazilian monazite, and 8 to 9 per cent in that from Travancore. If the bill passes, either the waste of chemicals and the extra freight and labor costs required to use the American material or trebled cost for foreign "sand" must be faced. It is worth mentioning that John Gordon, an American, is the principal Brazilian monazite producer.

TUNGSTEN ORES

Tungsten ore is another particularly bad subject for a tariff. In 1917, under prices at least three times the normal and which had existed for two years, we were able to produce a little more than one-half of our needs. In 1918, under similar prices, we produced one-third of our needs. Under a price of \$17 per unit, two and one-half times the normal price before the war and the price which it is hoped will be reached under the proposed tariff of \$10 per unit, it does not seem probable that the United States can produce more than 3,000 tons per year for three years from the deposits now known. Indeed this seems a rather optimistic estimate. Remembering the intensive prospecting of the war period, we have no reason to expect the discovery of deposits that will greatly alter the situation.

Americans own tungsten deposits in Bolivia, Mexico, Portugal, Argentina, Korea and Siam, worth probably a million dollars. The imposition of a tariff will, of course, prevent their shipping their ores to this country.

PYRITES

Before the Great War most of our sulphuric acid plants were fitted to use pyrites only, and great cargoes were brought from Rio Tinto, Spain, to supplement domestic supplies. Huge quantities of acid are made from waste gases from smelters, and sulphur is now being burned in large quantities for acid making. The usefulness of sulphuric acid depends largely on its cheapness, and a high degree of civilization demands cheap sulphuric acid, but tariffs on pyrites and sulphur mean dearer acid. In their need for pyrites, Americans were forced to buy pyrites mines in Canada and have considerable money invested in them. Their output will be affected by the tariff like any foreigner's product.

MERCURY

Of mercury the United States mines about half of the world's supply, but according to testimony before the Ways and Means Committee our ores carry only about 8 lb. to the ton and our cost is 93c. to \$1 a lb. According to the same testimony, Spanish quicksilver is produced at a cost of 50c. per lb. During the Great War, the price of mercury reached \$125.89 per flask of 75 lb. If the figures for costs of production are accurate, American mercury cannot compete with foreign mercury even under the proposed tariff, for it certainly cannot be put on the market at less than 20 per cent gross profit. This added to the cost of \$70 to \$75 per flask will make a price of \$84 to \$90 per flask. The Spanish producers, if their costs are given correctly, should at the same rate of profit be able to lay their mercury down in this country at slightly less. Either the figures are wrong or the tariff proposed by the

miners will be futile. For years American mercury has been sold for export at \$5 per flask under the domestic price.

FLAKE GRAPHITE AND MICA

Of flake graphite the deposits of the United States are comparatively large, and Americans are known to be interested in flake graphite deposits in Canada. The Madagascar flake is better than the American, and will probably be imported in spite of a tariff, the duty merely adding to the user's troubles.

Mica is mined from pegmatite dikes and like all pegmatitic minerals is proverbially in uncertain quantity. The mining of mica in this country has always been so precarious that large users have invested in Canadian deposits in order that they might be sure of their supply. No one can foresee or foretell what the future supply will be. It is peculiarly an industry adapted to countries like India, where labor is cheap. Prices for mica have always been very high, and with the advent of the great electrical industry they have become higher. It is at present a small industry employing very few persons.

POTASH

So far very few deposits of soluble potash salts have been found in the United States. They are confined to the small brine lakes of northwestern Nebraska, the salt fields in Great Salt Lake Desert, and Borax Lake in the Mohave Desert, California. There is no likelihood of our being able to supply our needs from these sources. More laboriously, potash is being obtained from kelp along the Pacific Coast, from the dusts of cement mills, from wood ashes, from alunite and from green sand marls of the Coastal Plain. Experiments without number have been made on the production of potash from the feldspars and other silicates, but to date these have not met with commercial success, though the use of glauconite is promising. We are still, and probably will be for a good while, dependent on the German and French deposits for a large part of our potash. The proposed tariff will add 75 per cent to the cost of potash, and may encourage continued experiments on the extraction of potash from the silicates. Potash is used mostly in fertilizers that are used in farming, the most poorly paid of the basic industries, and by the farmer must the cost of the experiments be paid. The passing along of the tax is in his case a grim pleasantry, for he does not and cannot fix the price of his products.

VANADIUM

The proposed vanadium tariff is probably not to be taken too seriously. More than half of the world's vanadium comes from the unique deposits at Minasragra, Peru. The deposits are American owned and operated, and recently changed hands at a price of \$3,000,000.

Our own vanadium deposits are mostly in southwestern Colorado and southeastern Utah. A large part of the output is made as a byproduct from radium ores.

It is likely that at recent prices we can supply most of our needs for five years or more from the known deposits.

MAGNESITE

Under normal open market conditions, magnesite has been a comparatively cheap mineral, but it is heavy and bulky. The American mines are located in California

and Washington, but the principal users, the steel mills, are located from Chicago eastward to Buffalo. The California deposits are comparatively small, and for many years were worked with the tacit acknowledgment that without an unreasonable tariff they could not well compete with the Austrian magnesite on account of the much greater size of the Austrian deposits and the high freight rates from California to the Eastern steel mills. Before the Great War it was not always easy to get supplies of magnesite as they were needed, and one of the large American magnesite brick manufacturers bought an Austrian deposit and invested altogether \$1,000,000 in the project. Other Americans bought and operated magnesite deposits in Venezuela, Lower California and Canada.

In 1915, the year following the outbreak of the war, when all imports were cut off, Austrian calcined magnesite was selling for from \$25 to \$26 a ton in New York, and brought as high as \$60. The deposits near Chewelah, Wash., were rediscovered, and the high prices and shortage of magnesite offered an excellent opportunity for their exploitation. One company made an investment of nearly a million dollars and another company made an investment of half a million. At the prevailing prices and shortage of the material even the California deposits were enabled to ship to the East, and large developments were made. But the war came to a close and left the large Washington investments unamortized. With the cessation of hostilities in Europe, the usual sources of magnesite again became more or less available, and railroad freight rates had meanwhile increased largely, so that neither the Washington nor the California operators would have been able to ship magnesite in competition with the European producers, even had the demand not collapsed with the steel business. It is now proposed that a duty of \$25 per short ton of calcined magnesite, equivalent to more than 150 per cent ad valorem, be levied, making the price to the Eastern consumer at least \$41 per short ton of calcined magnesite, and probably nearly as high to the Western buyer.

On the crude magnesite a duty of \$15, or more than 200 per cent, is proposed, making the cost at least \$22 per ton. Should the consumption be equal to that of 1913, it would be equivalent to 172,591 tons of calcined and 161,967 tons of crude, on which would be levied a total tax of \$6,740,000. It is explained that the cost is distributed over so many tons of steel that it will be unnoticeable. It will, however, put out of business the Americans who have invested in mines in foreign countries.

The proposed tariffs are so high that, if put into effect, they may defeat their objects, for at these prices it seems possible to make profitably an artificial magnesite and thus leave the Western mines without their market.

BAUXITE AND ALUMINUM INDUSTRY

It is impracticable to consider the tariff in relation to all the minerals as such and without regard to the manufactures from them; thus bauxite must be considered with aluminum. In the United States the aluminum industry is centered in a single company. It owns most of the American bauxite deposits and controls most of those in the Guianas—the best and largest known. This company, the Aluminum Company of

America, has a monopoly of aluminum production both in the United States and Canada, and in 1919 its capacity in the United States was 90,000 short tons of the world's plant capacity (exclusive of Canada) of 270,000 tons, and including its Canadian plant, possibly 210,000 tons, or about 70 per cent of a total of 310,000 tons. It has kept free from competition probably as closely as any other American company.

It has net assets of more than \$110,000,000, apparently mostly derived from earnings.¹ Inquiry along this line at the tariff hearings was not allowed to proceed. The representative of the company admitted that it had had, through its Canadian branch, a selling agreement in Canada and Europe which on account of the law did not apply to the United States. The cost of manufacture is supposed to be from 12c. to 13c. a lb. The selling price is from 28c. to 30c. a lb. In the committee hearings no data were brought out or asked for on this point. In its brief the company speaks of using only Arkansas bauxite of low grade, although in British Guiana the company owns the finest known bauxite deposits, and has brought in large quantities of the ore.

A tariff on bauxite means a burden on any company that might have the temerity to try to compete with the Aluminum Company of America, and further profit to the present monopoly. Aside from raising revenue, it can do no good. The company manufactures aluminum products and a tariff on the metal means more profit to the company, added cost to competitors in the manufacture of aluminum articles, and added cost to the consumer.

IMPORTANCE OF SOME ORES IN MODERN WARFARE

Manganese, chromite, mercury and tungsten are indispensable in modern warfare. Without manganese the making of steel is immensely more difficult; without chromite armor plate is useless and tool steels sink to a level little higher than carbon steels; mercury makes our best percussion caps, and without tungsten high-speed steels we would have been unable to equip enough factories to turn out our munitions in the Great War.

It is possible that very high artificial prices may cut part of the metals off from some of their most useful though as yet unproved applications. This may be shown by chromium. Stainless steel, an alloy of 13 to 17 per cent chromium with iron, is remarkably resistant to rust and seems to offer great possibilities of usefulness. As an example, concrete sea walls now destroyed by the rusting of the steel reinforcement would probably stand indefinitely were stainless steel bars used for reinforcement. The extra cost for such material would be much less than the cost of replacing the walls.

In many oil wells the pipes are destroyed by corrosion long before the well is exhausted. In certain favored wells it seems possible that a stainless steel casing could be used. The present cost of the chromium in a ton of such steel would be from \$40 to \$50 per ton, and must be near if not above the limit of cost. The heavy duties asked may well be the deciding factor for such possible uses.

In proposing heavy duties on these minerals, the plea has been that there is great need of home development

¹Hearings on general tariff revision before the Committee on Ways and Means, House of Representatives, Pt. 2, pp. 894-921.

so that the Government might have the necessary quantity of the minerals in case of another war, and that the mines should be kept in a state of development so that the ores could be quickly obtained and that if the mines were allowed to close they would be flooded and ruined.

This is merely plausible sophistry, for no man will develop orebodies to let them stand for the Government's convenience. Development means depletion, and a tariff on the ores means a premium on early depletion. Flooded and caved mines are bad, but exhausted mines are useless. If the Government held in stock supplies of these ores large enough to carry us through a considerable period of another great war, such a situation could be faced with more equanimity.

MINERALS SUFFICIENT FOR THE IMMEDIATE FUTURE

In the group of minerals the deposits of which seem to be sufficiently large to furnish our needs for an indefinite time are two of the principal industrial metals—lead and zinc; two elements usually recovered only as byproducts—white arsenic and bromine; molybdenum, a metal apparently just finding its use; and a number of non-metallic minerals, particularly sulphur. Of lead and zinc the United States is the largest producer. The only difference between the minerals of Group C and Group B is that our supply is larger, but the end is just as definite and as certain to be reached.

If I understand the pleas for a tariff on zinc aright, however, it is not that we cannot produce in competition with the world, but that many of our poorer mines cannot compete. So far as I know, no figures of costs are given for the Franklin Furnace mines nor for the best of the northeastern Oklahoma mines. For many poor mines undoubtedly the costs are higher than the market price, but that would be true if the price were a dollar a pound. The principle advocated seems to be that when once a camp is started the tariff should follow rising costs in order that the operators may continue to make money until the zinc ore is all mined. If for poor zinc mines, why not for every non-paying industry?

Much the same arguments apply to lead. It is, however, a remarkable and disconcerting fact that if we except the continuance of the Joplin field into Oklahoma, the Bawdwin deposit in Burma is the only really large new deposit of lead that is known to have been found anywhere in the world in the past ten years. This shows how much nearer the end of the mines may be than we have thought.

Bromine is saved as a byproduct from salt wells and will be saved only if the price and demand justify. Arsenic is caught in the fumes at the great copper and precious metal smelters and practically must be saved to prevent its being a nuisance. Though some is now being made from arsenopyrite, no direct production is needed if the fumes are saved. Before the great increase in freight rates it could be marketed very cheaply. The duty asked, 5c., is probably more than a 100 per cent tariff on cost f.o.b. New York.

Our supplies of sulphur are comparatively large and cheaply produced from the domes of Louisiana and Texas. It is difficult to see how anyone can compete with them more than temporarily. If prices on both pyrites and sulphur are revised upward by high tariffs, the price of sulphuric acid, fertilizers and other mate-

rials must rise accordingly, or be kept from approaching pre-war levels.

MINERALS IN LARGE QUANTITY

The minerals in large quantity are mostly those generally referred to as non-metallic, by which we mean that the compounds are more useful than the contained metals are after isolation. They are mostly bulky materials and the supply approaches infinity so far as human industry is concerned. Thus the ocean is a huge salt bed in solution and an inexhaustible supply of magnesium ore.

In these bulky products, position, freight and labor, rather than foreign competition, may cut the largest figures, and unless carefully drawn laws are made one locality may be placed at the mercy of a particular company.

This may be illustrated by a story told some years ago by a gentleman connected with a cement company. The company owned cement plants near the boundary in both this country and Canada. When a former tariff law was being framed in this country, he went before the Ways and Means Committee and asked for a specific duty of \$1 a bbl. on cement to keep out the "pauper-made" cement of Canada and other countries, explaining that an earlier tariff of 20 per cent was equal to about \$1 a bbl. He did not explain that, at the earlier date, the price of cement was \$5 a bbl., but that at the time of his plea cement was being made profitably as low as 70c. a bbl. Then he went to Canada and petitioned for a tariff of 20 per cent against the American cement, as he wished to put up a mill in western Canada, where an extensive region was being supplied by a recently erected American plant. After both tariffs were granted, a new plant was built to supply the field in western Canada, and both an American and a Canadian community were compelled to pay tribute to the company.

Before the war anhydrous magnesium chloride used as a source of magnesium and as a component of oxychloride cements came from Germany, where it was made as a byproduct of potash refining. Probably it has not been very successfully made anywhere in this country, though the hydrous chloride is easily made.

Phosphorus is made in the electric furnace from lime phosphates. The other items are so familiar that little explanation is needed except as to coal.

M. R. Campbell estimates that at the present rate of use we have coal enough for 4,000 years, but the best steaming coal is being used rapidly and may not last more than fifty years, so that this might well be separated and put under Class C. Of the lignites and other poor coals the supply is huge, but on the other hand our uses are increasing at a rapid rate. As the United States is the largest exporter of coal, a tariff could have the effect only of raising the already high price in some poorly supplied locality like the Pacific Coast.

The fixing of a tariff on this group of minerals may well follow the same considerations as are applied to the fixing of tariffs on manufactured articles or farm products.

GENERAL CONSIDERATIONS

Some repetition in an effort to emphasize some of the points raised in this paper may be pardonable.

Of certain necessary minerals and metals we have

practically none. Of certain other minerals, the bulky and common class, our supplies are very large, and of a few like salt, magnesium and lime, the supplies are, so far as human industry is concerned, unlimited. Between these two groups of minerals are two other groups. Of one we have a known quantity sufficient for our needs for a short time only and at highly artificial prices. Of the other we have a supply that is sufficient for our needs for some time to come. To all of the deposits of these two groups there is a definite end. Using them is precisely like drawing the water from a cistern, except that an ore deposit is filled only once, and when once mined, it is gone. There is no second crop. They are wasting assets.

Of the first group, that which we lack entirely, diamonds for gems are luxuries sold at absurdly extravagant prices, and no valid objection can be made to a duty of an amount comparable to the price. On the other substances, except boron and carbons, tariffs may be levied according to the theories of the party in power without directly affecting the mining industry of this country. To the last group tariffs may be applied much as to manufactures.

The minerals of the two middle groups, except bromine and arsenic, deserve entirely different consideration. Bromine and arsenic may also fairly be treated as manufactured products, for bromine will be saved from brines only if it pays, and arsenic can be supplied to fill all our needs as a byproduct from the smelters. We have the others in limited quantity. To place a tariff on them is to place a premium on depletion and to hasten the day when they too will be among the minerals of which we cannot supply our own needs. To bring that day more quickly than necessary is economic crime.

The civilization that we enjoy and that we are attempting to intensify is making more and more use of mineral products. To our grandfathers nickel was a curiosity; to our fathers aluminum was an unseen metal; tungsten, vanadium and chromium were heard of only among the abstruse things of chemistry. To us they are all necessities, and perhaps the Great War was won so soon because Germany lacked tungsten.

The mineral products are becoming more and more indispensable to us and depletion of deposits more and more of a menace. A hundred years ago iron furnaces were operated on chunks of iron ore picked up between Washington and Baltimore; now a single blast furnace will turn out as much pig iron in a day as one of those furnaces would in months, and it must have a large and assured ore supply to guarantee operation. When our great Lake Superior iron deposits were discovered they were heralded as inexhaustible—but our iron and steel industry has grown so that already we have had to commence beneficiation of the lean Lake Superior ores, and American firms are exploiting iron deposits in Cuba and Chile. It is probable that in 100 years the owners of the Brazilian iron fields will control the world's steel trade.

We have been the world's greatest copper producers, but our energetic mining firms have found it expedient to take over the great copper deposits of South America.

Besides these great investments by the most powerful of our mining interests, many smaller investments have been made in foreign mines—made at a time when our every endeavor has seemed to be to obtain foreign trade.

These men have retained their American citizenship, and their ties with the United States are very real. Uncle Sam never forgets them when their income tax is due and they pay precisely the same rates as those of us who live at home where we have some advantage from the tax. These men have been, and are, the advance guard of American exports. They buy American machinery, foods and clothing; and in very many places they import American timbers for their mines and American lumber with which to build their mills. They are probably our best field agents for American exports. Do we believe in American exports, or is it mere cant?

Some of the American owned foreign mines are so close that the minerals are brought into the United States by aerial tramways; others are in the snowy heights of the Andes and in torrid India.

Probably the total American investment in foreign mines amounts to between \$600,000,000 and \$1,000,000,000, and if our metallurgical industry grows with our population it will mean greater and greater foreign investments. Are these then to be forgotten when we are passing tariff legislation?

Not only our own Americans but other miners in foreign countries are willing to sell us their cheap and rich ores. If we insist on making our own ores expensive by placing a protective tariff on foreign ores, then we place in the hands of our competitors the cheap ores of the world, and our manufactures must be increased in cost. The proposition that ores intended for incorporation in goods to be exported will be relieved of duty only half answers the question. Our own machinery and the manufactures of our own country must yet be made of the expensive ore, and the cost is passed on to the consumer, with the argument for each duty that it affects him little. Straws broke the camel's back.

But above all, the tariff puts a premium on the early depletion of our deposits. It will leave posterity only the caved mines that might have been an asset to them. Posterity will have to buy from the foreigner his deep mined ores and the United States will always work on expensive metallic products. The cynical question, "What has posterity done for us?" so glibly asked in reply to such an objection, may be answered by another and more honest question:

"Shall we rob our children?"

Removal of Chlorine From Zinc Electrolyte

A method of preserving electrodes used in the deposition of zinc, by the removal of chlorine from the zinc-bearing solutions prior to electrolysis, has been formulated by Messrs. D. Avery, of Melbourne, and R. H. Stevens, of Hobart, who have patented the process and assigned the patent to the Electrolytic Zinc Co., says *Chemical Engineering and Mining Review*.

The removal of chlorine is effected by the diversion of a portion of the solution from the circuit from time to time, and treatment with Ag_2SO_4 after acidification. The precipitated AgCl is settled and filtered, and the chlorine-free solution returned to the circuit. Silver sulphate is recovered by agitating the chloride with H_2SO_4 and zinc dust to precipitate metallic Ag, which is reconverted into Ag_2SO_4 after filtering and washing, by heating to 250-300 deg. C. in a converting pan. The granulated mass thus obtained is ground prior to reuse.

The Smelter of the Calaveras Copper Co.

Small Plants Often Require Variations From Common Practice in Both Design and Operation—Here Sintering of Flotation Concentrates in Dwight & Lloyd Machine and Intermittent Running of Blast Furnace Are Features

BY EDWARD H. ROBIE

Metallurgical Editor, *Engineering and Mining Journal*

IN LOOKING ABOUT for the most advanced practice in copper smelting, one usually goes to the large plants, such as those at Anaconda, Douglas, and Garfield. Operations there are conducted on a big scale, with ample financial backing and with well-trained operating and metallurgical staffs. For these very reasons, however, these large establishments do not have the problems which frequently must be solved in smaller and more remote plants, so, in the quest of

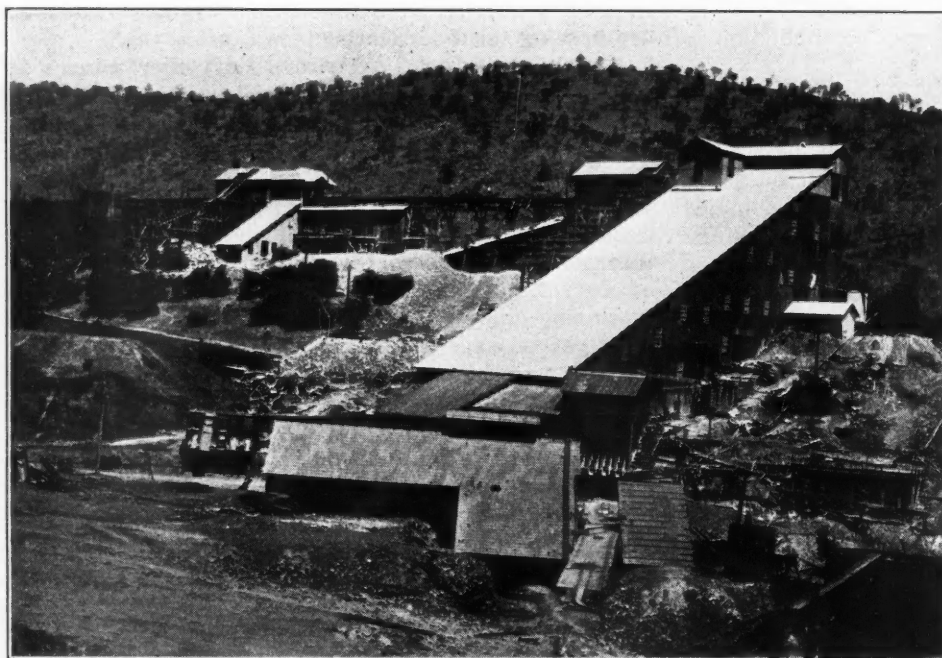
this part of the smelter equipment had to go on part time. Most smeltermen hesitate to bank a furnace for more than a few hours. An instance is recorded of one superintendent, who, with the gracious idea of giving the employees Christmas day off, decided to bank his furnaces for the holiday, only to be rewarded by finding them frozen up solid when the blast was again turned on. At the Calaveras plant, however, there is no particular difficulty in running the furnace for five hours

and then banking it for nineteen hours; in fact, it is sometimes down for forty-two hours. This smelter has other features of interest, so that a description may not be amiss. The plant has been closed down since October, 1920, but this is no disgrace in these days, and when the copper market improves, operations are likely to be resumed on a greater scale than before.

The ore consists of chalcopryrite, fairly massive, in a gangue of close-grained slate, the analyses running from 1.6 to 2.5 per cent copper. The mine can produce from 500 to 600 tons per day. The ore is carried about one-half mile by electric tram to the coarse-crushing department, where it is discharged into a 250-ton bin. From this bin it passes to a No. 7½-K Gates gyratory crusher, followed by a revolving

screen to remove plus 1½-in. material. This oversize is again crushed in a No. 3 Austin gyratory, and the product, united with the screen undersize, is conveyed to the top of the mill building, a distance of about 300 ft., and is discharged into a 1,300-ton bin, from which the ore is removed by Challenge feeders and sent direct to the ball mills of the fine-grinding department.

Three ball mills are provided, an 8 ft. x 30-in. Hardinge, an 8 ft. x 36-in. Hardinge, and an 8 x 6-ft. Allis-Chalmers mill with ¼-in. grate discharge. The average screen test of the ball mill feed and discharge is as follows:



THE CALAVERAS COPPER CO.'S CONCENTRATOR

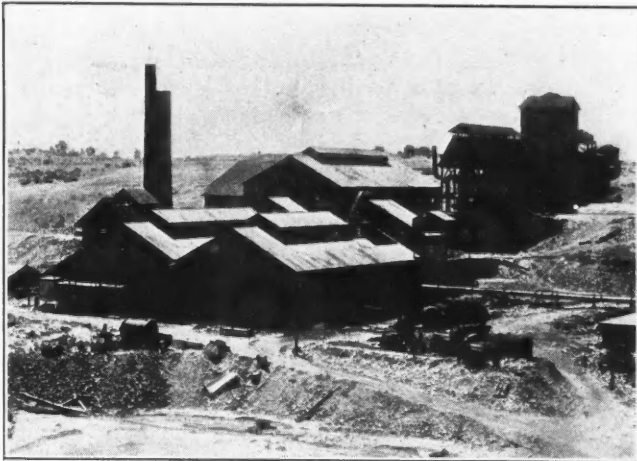
new ways of doing things, the small smelter should not be entirely disregarded.

One of the principal difficulties which the small plant is likely to meet is that of insufficient ore or matte to supply a smelting unit. Before the smelter of the Canada Copper Corporation, at Greenwood, B. C., closed down two or three years ago, this condition was met in an interesting way at that plant. One 20-ft. blast furnace was in operation, but as the ore averaged only approximately 0.95 per cent of copper, and the matte was about 48 per cent, it can readily be imagined that the settler did not fill up rapidly. One small acid-lined converter was more than sufficient to handle what matte the furnace produced. The converter crew would start a blow about 9 a.m. By noon the copper was in the molds, after which time the business of converting was over for the day, and the furnace settler was given a chance to recuperate until the next morning.

At the smelter of the Calaveras Copper Co. at Copperopolis, Cal., which is to be described briefly in this article, there was not sufficient ore for the blast furnace, so

SCREEN TEST OF FEED AND DISCHARGE

Size	Feed		Discharge	
	Per Cent	Cumulative per Cent	Per Cent	Cumulative per Cent
Plus 1 inch.....	31	31	..	..
Plus ¾ inch.....	25	56	..	..
Plus 10 mesh.....	20	76	4	4
Plus 20 mesh.....	..	..	9	13
Plus 40 mesh.....	13	89	16	29
Minus 40 mesh.....	11	100	..	..
Plus 60 mesh.....	..	..	21	50
Plus 80 mesh.....	..	..	13	63
Minus 80 mesh.....	..	..	37	100



THE CALAVERAS SMELTER AT COPPEROPOLIS, CAL.

The total capacity of the three mills is 550 tons per day, operating in closed circuit with Dorr duplex classifiers and with 90 per cent of the classifier overflow passing 80 mesh. The mills are customarily run at 18 r.p.m. and with 33 per cent of water in the discharge. Equal quantities of 3- and 4-in. forged steel balls are added as needed. White-iron liners made at a local foundry are used with satisfactory results, but no tests have been made to compare these with more expensive alloy steel liners. With the conditions which exist at this plant there is a preference for the conical type of mill over the grate-discharge mill installed. Less trouble is occasioned by uneven feed, and a higher percentage of time in efficient operation is secured.

After grinding, the pulp goes direct to the flotation department. No. 400 Pensacola Tar & Turpentine Co. oil is added to the ball mills for frothing purposes. The classifier overflow is treated in three units of Cal-low pneumatic cells, there being four rougher, four finishing, and two cleaner cells in each unit. The concentrates from the roughers and finishing cells pass to two cleaners, and the tailings from these two cleaners are treated in two more cleaners. Typical analyses of feed, finished concentrates, and tailings are given in the table, but these analyses are not absolutely correlative.

AVERAGE ANALYSES

	Cu	Fe	SiO ₂	Al ₂ O ₃	S
Feed.....	2.0	18.7	34.6	24.7	-5.0
Concentrates.....	15.0	25.1	16.0	10.5	21.2
Tailings.....	0.19	15.8	39.8	27.2	2.0

The ratio of concentration is 8:1. The tailings go to a settling pond, from which clean water is returned to the mill. The concentrates are thickened in three Dorr thickeners to about 50 per cent water.

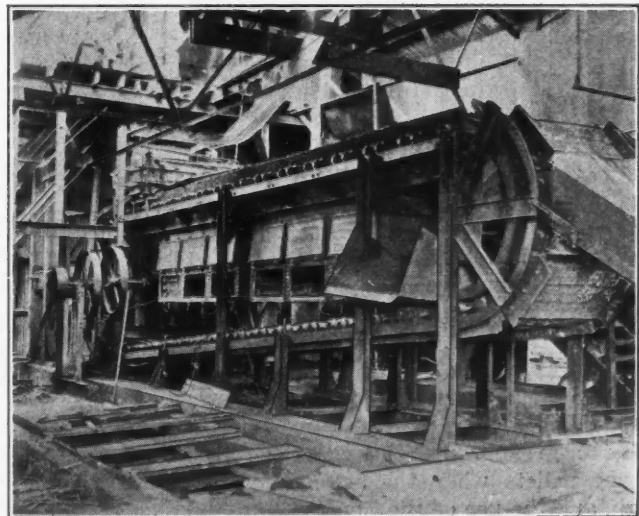
An unusual feature is the entire absence of tables in this mill. With an easily floatable mineral such as chalcopyrite, careful attention to the flotation machines makes tabling unnecessary. The recovery of copper averages above 90 per cent, which is considered satisfactory.

The thickened concentrates are dewatered in an 8-ft Oliver filter, with a 6-ft. filter held in reserve. As the ore is not slimy, there are no filtration troubles; the mechanical agitators provide the only agitation necessary. The filter cake is discharged on to a conveyor belt, which passes over a 75-ton bin. This small bin is used to store concentrates when the sintering plant is shut down for any cause.

Flotation concentrates, at most of the large American copper plants, are roasted or dried in McDougall, Wedge, or Herreshoff multiple-hearth furnaces, and subsequently smelted in reverberatory furnaces. The problem of so preparing fine concentrates that they may be smelted in blast furnaces is a real one at some plants, however. Three methods of doing this have received attention: briquetting, nodulizing, and sintering. Of course, the concentrates can be dumped wet in a blast furnace, as was done at the Morenci, Ariz., smelter of the Phelps Dodge Corporation until it closed down a year or two ago. There a 33-ft. furnace was used, and little coarse ore was charged. A large amount of flue dust was made, but most of it was recovered, and it was remarkable how well the furnace ran. Blast furnaces are not adapted to fine ore smelting, but in a pinch, at a sacrifice of capacity, and with low blast, such work can be done.

Briquetting is not popular—never was, and probably never will be. It is troublesome, somewhat costly, does not remove sulphur, and the briquets have the bad characteristic of breaking up when dumped into a furnace. Nodulizing is a better solution, and has received its principal application at the Braden smelter in Chile. Sintering in Dwight & Lloyd machines gives promise of being an even more satisfactory means of agglomerating the fine particles, especially where there is an abundance of sulphur. It has been used for some years at the Coniston, Ont., smelter of the Mond Nickel Co., where fine ore from the mines, flue dust, and concentrates are mixed and sintered, and the product is charged to blast furnaces. This plant is still running. I do not recall the percentage of sulphur in the sinter, but it is so low that open-heap roasting of the coarse ore is no longer practiced, the sinter and green coarse ore making a charge of sufficiently low sulphur content for economical blast-furnace smelting.

Sintering was also practiced at the Copperopolis plant prior to closing down, with highly satisfactory results. The flotation concentrates from the Oliver filter are conveyed to a hopper-bottom bin above the sintering machine. Into this bin also are discharged a small proportion of fine sinter and all the flue dust which the plant produces. An 8-in. screw in the bottom of the bin feeds into a pug mill, which thoroughly mixes the



THE DWIGHT & LLOYD SINTERING FURNACE

materials and discharges into the feed hopper of the sintering machine. The bottom of the front of this hopper is raised somewhat, so that the ore piles up about two inches higher than the sides of the pallets, thereby increasing the capacity of the machine and tending to make a better sinter with a feed of flotation concentrates.



PAN CONVEYOR FOR CARRYING SINTER TO BINS

The sintering machine is the standard 42-in. Dwight & Lloyd, and has a capacity of about 100 tons of sinter per twenty-four hours, roasted from about 15 per cent of sulphur down to 5 to 8 per cent. The upper limit of sulphur in the feed is about 18 per cent; more than this results in too great melting of the bed and injury to the grates. The important factors in the successful sintering of the wet plastic flotation concentrates are the proper proportioning of the charge to get the right amount of sulphur and sufficient porosity, and thorough mixing in the bin and pug mill.

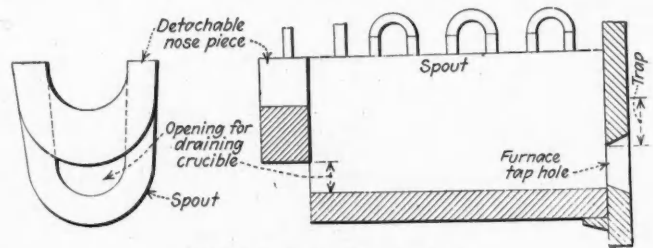
The sintering makes a particularly solid cake, and sometimes the sinter from two pallets will stick together as they discharge. From the grates the sinter falls on to a grizzly with 3/4-in. openings. The undersize is carried by a pan conveyor to the feed bin, this undersize being ideal material to dilute the sulphur in the charge to the sintering machine, and to make the bed sufficiently porous for the penetration of the air.

The sinter fines are usually ample for the purpose, but, if they are not, a small amount of crushed quartz is added and a corresponding amount taken off from the blast-furnace charge. Fine limestone in small quantities is a great help in keeping the sinter from sticking to the pallets when the sulphur in the charge is too high, and the use of the lime rock or fowl slag is an aid in the subsequent smelting of the sinter. The coarse sinter is carried by a pan conveyor to a fire-proofed bin,

from which it is drawn to the charge floor of the blast furnace.

The 40 x 120-in. Power & Mining Machinery Co. (now Worthington Power & Mining Works) blast furnace has twenty 5-in tuyères and is 10 ft. high from the tuyères to the top of the jackets. Because of the high percentage of alumina in the concentrates, this furnace was not expected to smelt more than 100 tons per day, but it can handle more than double that amount, particularly if the sinter is charged hot. So, rather than limp along on low coke and blast, it was found advisable to operate the furnace but one shift a day. The average running time is about five hours, and sometimes it is necessary to skip a day entirely. Of course, with continuous running the coke consumption would be a little less and the labor charge slightly lower.

Before banking the furnace the ore column is lowered, extra coke is added, and the whole covered with a layer of flue dust. Experienced metallurgists will wonder what happens to the settler. To operate but one shift a day, the settler was reduced in size so that it would be full of matte at the end of the run. It was evident that if the furnace were tapped in back, the hole in the breast jacket would not always be drained and would cause trouble in starting. A specially cast water-cooled spout was therefore designed, as shown in the sketch below. The front end of this spout is made almost as deep as the back end, so that there is no trap to the spout itself. A heavy water-cooled nose piece was made to fit the end of the spout, so that the top of this nose piece would provide the desired trap, the bottom being 3-in. above the bottom of the inside of the spout. This leaves an opening about 3-in. square, which is low enough to drain the furnace to the bottom of the hole in the breast jacket. This hole is plugged each morning with a small piece of asbestos rope and clay, and it is easy to punch this out at the end of the run, so that the furnace is always thoroughly drained directly into the settler. Each day, at the end of the run, the matte is tapped out of the settler, which is completely drained. The settler lining lasts indefinitely, but with the intermittent running it is necessary to dig out the accumulation of solidified matte and slag about once in three weeks. When the plant is reopened it is planned to have portable settlers, so that one can be kept



BLAST FURNACE SPOUT

in reserve and placed in position while the accumulations in the other are being removed. Not all of the flotation concentrate is sintered, for this would make too high grade a matte. A typical furnace charge is about as follows:

BLAST FURNACE CHARGE, IN POUNDS	
Sinter.....	2,200
Wet flotation concentrates.....	900
Coarse sulphide ore.....	200
Lime rock.....	150
Quartz.....	150
Total.....	3,600
Coke, 11.8 per cent.....	425

Analyses of the sinter, matte and slag are approximately as follows:

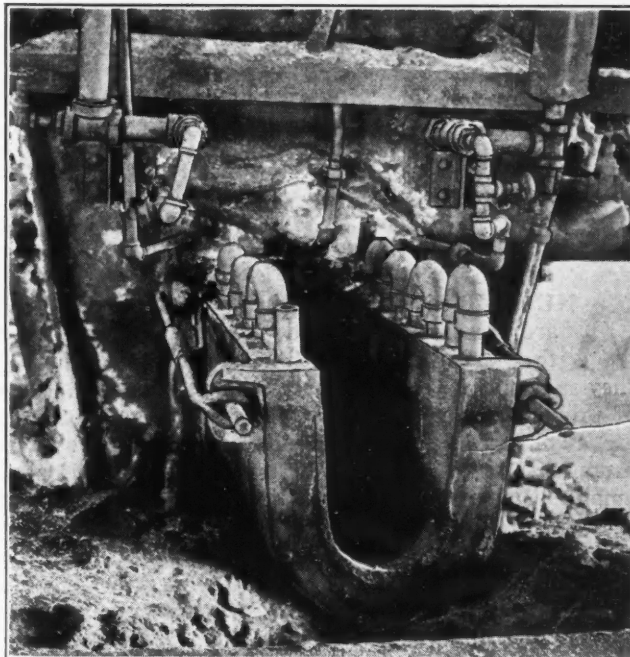
ANALYSES OF CHARGE AND PRODUCTS, IN PER CENT

	Cu	FeO	SiO ₂	Al ₂ O ₃	CaO	MgO	S
Sinter.....	16	36	18	11	..	5	7
Matte.....	50	..	..	..	..	..	..
Slag.....	0.5 to 0.6	36	34	13	6	7	..

The total coke consumption is almost 12 per cent of the charge, but as 92 per cent of the charge is ore, the cost of coke per ton of ore is not excessive. Nearly 30 per cent of the ore charged is flotation concentrates taken direct from the filter and containing about 20 per cent of water. This is dumped in, on top of the coke, and covered with the remainder of the charge, so only a little of it blows out, and the dust loss is small. The slag is almost an exact bisilicate, considering the alumina as an acid. The furnace smelts ten tons of charge per hour, or 7.2 tons per square foot of hearth area per twenty-four hours, with an average blast pressure of twenty-two ounces. This is fast smelting, and is made possible by the excellent character of the sinter produced by the Dwight & Lloyd machine, the furnace running especially fast when hot sinter is fed.

Sometimes the matte runs as high as 55 per cent without causing trouble. The usual practice is to tap about four tons of matte after the furnace has been running two hours, and ten tons more at the end of the run. The matte is tapped into 1½-ton pots, cooled with water sprays, crushed to —1 in. in a small Dodge crusher, and carried on an inclined conveyor belt to a bin, from which it is sacked, loaded on motor trucks, and hauled fifteen miles to the railroad station, where it is shipped to Tacoma.

As the precious metals amount to only about one ounce of silver per ton of matte, electrolytic refining is not economical, and plans are being made to refine



THE BLAST-FURNACE SPOUT. NOTE METHOD OF ATTACHING

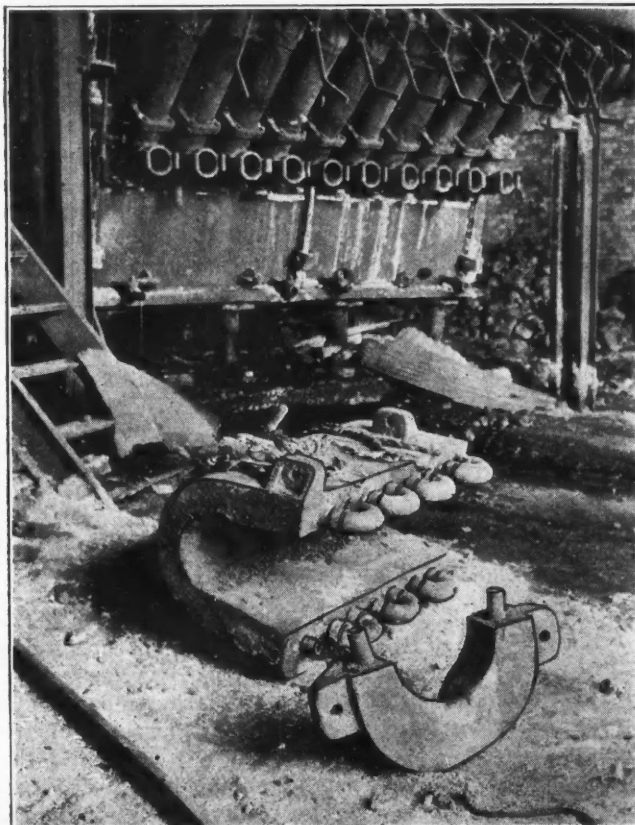
locally when smelting is resumed. Experiments have already been conducted with a small reverberatory in which the matte has been blown to finished copper by blowing air into the bath of matte, with an ordinary pipe. It is planned, however, to convert the matte to blister in a small bessemer converter and use the reverberatory only for the final simple refining process.

The whole scheme of smelting as outlined is more economical than would be the roasting and reverberatory smelting of such a small quantity of ore. It is also probably more economical to operate a large furnace one shift than a smaller furnace twenty-four hours a day. There are opportunities for a plant of this kind in many districts where smelting facilities are not available or satisfactory.

My thanks are due to Mr. S. M. Levy, general manager of the Calaveras Copper Co. at Copperopolis, for his kindness in explaining the novel features of his plant and granting permission for the publication of the data given.

Electric Smelting of Tin Ore

Tin ores become conductors of electricity at moderate temperatures, according to an article in *Metall u. Erz*, Vol. 18, pp. 77-78, abstracted in the *Journal of the Society of Chemical Industry*, so that by using large pieces of ore as a resistance, sufficient heat can be developed to melt it and reduce it to metal on the addition of coal. It is not generally necessary to add any slagging material, nor is it necessary to protect the tin oxide from going into the slag. It is preferable to carry out the process in a trough furnace with a low charging shaft and two or more electrodes dipping into the bath. Ore and coal are charged and the metal is tapped from the bottom until the hearth is nearly full of slag, which should be rich in tin. This is cleaned by adding a charge of coal only to separate its tin contents as metal. Pure metal may be so obtained and the tin content of the slag reduced to 0.3 per cent, and the losses by volatilization are much less than by other processes.



BLAST FURNACE, SPOUT AND NOSE PIECE

Air Receiver Calculations

Solutions of Simple Compressed-Air Problems Frequently Confronting the Master Mechanic, Applicable to Drills, Air Haulage, Storage and Compressed-Air Machinery

BY WALTER S. WEEKS

Written for *Engineering and Mining Journal*

A NUMBER of calculations involving the air receiver are presented here, and although known perhaps to those working with compressed-air haulage, they may not be so familiar to others. The first type of problem is the determination of the amount of free air available in a receiver while the air pressure is dropping from one given pressure to another. For example: An air receiver has a capacity of 500 cu.ft. The pressure in the receiver is 100 lb. per sq.in. gage. How long is it possible to operate a drill from the receiver alone if the drill requires 100 cu.ft. of free air per minute and the lower limit of operating pressure is 70 lb. per sq.in. gage?

Let us first develop the formula and then solve the problem. It will be remembered that the formula connecting pressure, volume, temperature, and weight of air is

$$PV = wRT$$

where P = pressure in lb. per sq.ft. absolute;

V = volume in cu.ft.;

w = weight of air in lb.;

R = constant = 53.4;

T = absolute temperature (Fahrenheit + 460).

At the start of the operation of the drill let the weight of the air in the receiver be w_1 , V the volume of the receiver, and T the absolute temperature which remains constant. Let P_1 be the pressure in lb. per sq.ft.

Then at the start,

$$P_1V = w_1RT \quad (1)$$

Let w_2 be the weight of air in the receiver when the drill stops and the pressure has dropped to 70 lb. gage. Let P_2 be the pressure in lb. per sq.ft.

Then at the finish,

$$P_2V = w_2RT \quad (2)$$

$$\text{From (1) } w_1 = \frac{P_1V}{RT}$$

$$\text{From (2) } w_2 = \frac{P_2V}{RT}$$

The weight drawn from the receiver is $w_1 - w_2$.

How many cubic feet of air at atmospheric pressure has been drawn out?

Let P_3 = the atmospheric pressure in lb. per sq.ft.

Let V_{at} = the volume at atmospheric pressure.

Then:

$$P_3 V_{at} = (w_1 - w_2)RT = \frac{P_1V - P_2V}{RT} \times RT$$

$$\text{or } V_{at} = \frac{V(P_1 - P_2)}{P_3} \quad (3)$$

The pressures are in lb. per sq.ft., but as the unit of conversion to sq.in., 144, appears in both the numerator and denominator of the right-hand member, it may be cancelled, leaving the symbols representing lb. per sq.in. In the numerator, as we have the difference of two pres-

ures, either gage or absolute pressures may be used. P_3 is, then, always the absolute pressure of the atmosphere in lb. per sq.in. We shall assume it to be 15. To solve the numerical problem: $V = 500$, $P_1 = 100$, $P_2 = 70$, $P_3 = 15$.

$$V_{at} = \frac{500(100 - 70)}{15} = 1,000$$

The receiver will supply 1,000 cu.ft. of free air above 70 lb. The drill will operate $1,000 \div 100 = 10$ minutes.

The same formula is used to determine the time to raise the pressure in a receiver with a given compressor. Example:

A receiver has a capacity of 1,000 cu.ft. How long would it take a compressor supplying 500 cu.ft. of free air per minute to raise the pressure from 70 lb. per sq.in. gage to 100 lb. per sq.in. gage.

First, how many cubic feet of free air must be put in?

$$V_{at} = \frac{1000(100 - 70)}{15} = 2,000$$

$$\text{Then } \frac{2,000}{500} = 4 \text{ minutes.}$$

Sometimes it may be necessary to help out a compressor when an intermittent drain of the air exceeds the capacity of the compressor, such as the operation of an air hoist for hoisting or hauling. Example:

A small geared hoist pulling cars out of a tunnel requires 120 cu.ft. of compressed air per minute at 60 lb. per sq.in. gage. Whatever the pressure in the receiver, the air is wiredrawn through the throttle valve to 60 lb. The haul requires six minutes. The compressor supplies 300 cu.ft. of free air per minute. The receiver may be pumped up to 90 lb. per sq.in. gage at the start and the pressure must not drop lower than 60 lb. at the finish of the haul. What must be the size of the receiver?

The free air used by the hoist each minute is $\frac{75}{15} \times 120 = 600$ cu.ft.

The air receiver must supply $600 - 300 = 300$ cu.ft. per minute, or a total of 1,800 cu.ft. of free air.

$$V_{at} = \frac{(P_1 - P_2)V}{15}$$

$$1,800 = \frac{30V}{15}$$

$V = 900$ cu.ft., which is the needed capacity of the receiver.

The calculation of the size of a large underground storage reservoir for compressed air is a problem of this type.

Another style of problem requiring a different formula is this: There are two receivers containing air at some pressure. If a valve is opened connecting the two, what will be the pressure in both?

See illustration. Let V_1 be the volume of A and let V_2 be the volume of B .

Before the valve is open let P_1 be the pressure in A in lb. per sq.ft., and w_1 the weight of air in A . Let P_2 and w_2 be the pressure and weight respectively in B .

After the valve is open, the total weight of air is $w_1 + w_2$ and the total volume is $V_1 + V_2$.

$$w_1 + w_2 = \frac{P_1V_1 + P_2V_2}{RT}$$

Let resultant pressure be P .

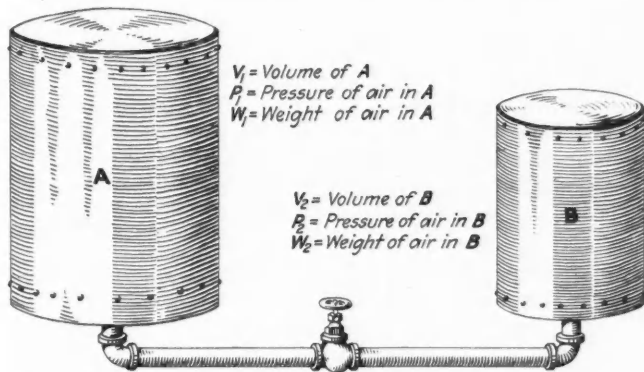
$$\text{Then } P(V_1 + V_2) = \left(\frac{P_1V_1 + P_2V_2}{RT} \right) \times RT \quad (4)$$

$$PV_1 + PV_2 = P_1V_1 + P_2V_2 \quad (5)$$

Let us study this formula for a moment. As a symbol for pressure occurs in every term, we may divide through by P , leaving the symbols representing lb. per sq.in. instead of lb. per sq.ft. The symbols represent absolute pressures. Let us denote the corresponding gage pressures by the subscript g , and rewrite the formula:

$$(P_g + 15)V_1 + (P_g + 15)V_2 = (P_{1g} + 15)V_1 + (P_{2g} + 15)V_2$$

The terms involving the atmospheric pressure cancel and leave gage pressures. So in this formula and in



TWO AIR RECEIVERS AT DIFFERENT PRESSURES CONNECTED BY A VALVE

those derived from it the pressure may be gage or absolute and the pressures in lb. per sq.in. or per sq.ft.

To continue from (5)

$$P = \frac{P_1V_1 + P_2V_2}{V_1 + V_2}$$

Example:

A has a capacity of 1,000 cu.ft. and the pressure is 90 lb. per sq.in. gage. B has a capacity of 500 cu.ft. and the pressure is 60 lb. per sq.in. gage. What will be the pressure if they are connected?

$$P = \frac{90 \times 1,000 + 60 \times 500}{1,500} = 80$$

The resultant pressure will be 80 lb. per sq.in. gage.

Another form of equation (5) is used in the calculation of compressed-air haulage systems to determine the size of the stationary storage so that when the tank on the locomotive is connected to it, this tank will be charged to a given pressure.

In the cut let A be the stationary storage and B be the tank on the locomotive. P_1 is the pressure in the

storage and is usually about 1,000 lb. per sq.in. gage. P_2 is the pressure in the locomotive tank when ready for charging and is usually about 250 lb. per sq.in. gage. Example:

The tank on the locomotive holds 48 cu.ft., and we wish to charge to 800 lb. per sq.in. gage. What should be the capacity of the stationary storage? Transposing equation (5)

$$PV_1 - P_1V_1 = P_2V_2 - PV_2$$

$$V_1 = \frac{V_2(P_2 - P)}{P - P_1} = \frac{V_2(P - P_2)}{P_1 - P}$$

$$V_1 = \frac{48(800 - 250)}{1,000 - 800} = 132 \text{ cu.ft.}$$

That is, if we have receiver capacity of 132 cu.ft. and pump it up to 1,000 lb. between chargings, we can charge instantly to 800 lb. To determine the capacity of the compressor, use equation (3) to determine the amount of free air to put in to bring the pressure back to 1,000. The air put in divided by the time in minutes between charging gives the free air per minute that must be supplied by the compressor.

Queensland's Mineral Output in 1920

The value of the mineral production of Queensland for 1920, according to official records just completed, was £3,462,701, which is nearly £1,000,000 more than for 1919. The output of gold continued to fall (the yield being only £489,700), and the drop in prices of rare metals that followed the release of surplus stocks held by Great Britain after the war caused the practical closing down of all the mines producing wolfram, molybdenite, and bismuth in Queensland; but the high prices ruling at the beginning of the year for tin, copper, lead, and silver resulted in an increased production of these metals, amounting in value, with that of coal, to over £1,000,000, and this in the face of high wages and cost of materials, some shortage of explosives, and a coastal shipping strike which for a time stopped supplies and interrupted the dispatch of ores overseas.

There was a substantial increase in coal production in 1920, which is showing unmistakable signs of expansion in all coal-mining districts, and in the output of gems (sapphires), which rose from £42,880 in 1919 to £65,800 in 1920. Of the total mineral production of more than £3,400,000, copper is responsible for over £1,500,000. Unfortunately, the activity which marked mining generally in the early part of the year underwent a severe check before its end, and present indications are that there will be a big falling off in 1921.

The silver-lead mines at Indooroopilly, near Brisbane, that have been opened up during the last two years, in 1920 yielded, from 173 tons of ore, silver to the value of £3,708 and lead worth £3,449, or a total of £7,157 and an average value of over £41 per ton. The holders of the two producing mines were marking time during a considerable part of the year, and results ought to be better for 1921. The absence of any large lode outcrops in this field militated against successful prospecting by ordinary methods; and experiments by some operators with the "electrical ore finders" that have been watched with some interest have proved quite unsuccessful, sinking having been taken considerably below the depth at which the "diviners" said ore would be found, but without the predicted result.

THE PETROLEUM INDUSTRY

Daily Average of April Petroleum Production Sets Record

THE outstanding fact of current petroleum statistics, according to the U. S. Geological Survey, is that stocks continue to pile up. Since May, 1920, pipe-line and tank-farm stocks of domestic petroleum, plus stocks of Mexican petroleum held in the United States by importers, have increased more than thirty-seven million barrels, an amount equal to almost a month's domestic production, and the quantity of crude oil now in storage is the greatest on record.

During April the production of petroleum continued to increase, the daily average for the month being the record figures of 1,334,633 bbl. Although imports during the month decreased somewhat, and consumption increased slightly, stocks at the end of April were more than six million barrels greater than at the beginning of the month.

Substantial increased daily average production during April is reported for Wyoming, Arkansas, Kansas, Oklahoma, California, and Kentucky, and smaller increases are reported for Montana, Colorado, New York, Indiana, and Tennessee.

Imports for April, amounting to 10,043,924 bbl., show a decrease in daily average as compared with March, of 62,078 bbl., although for the first four months of the year imports increased more than twenty-three million barrels as compared with production of the similar period of 1920.

The accompanying figures, compiled from company reports to the U. S. Geological Survey, show the quantity of petroleum removed from producing properties. Oil consumed on the leases is not included. This item and net changes in producers' stocks at the beginning and end of the year are obtained by annual canvass and are included in the final statistics of production:

Oil-Well Drilling Permitted Through Operating Mines

SPECIAL CORRESPONDENCE

An important decision that affects oil and gas operators is Illinois has just been rendered by the U. S. Circuit Court at Springfield, Ill., with reference to the right of an oil or gas company to drill through an operating mine.

The Superior Coal Co., of Gillespie, Ill., prevented the drilling of oil or gas wells through its mines in Macoupin County, Ill, by means of a blanket injunction secured on Aug. 14, 1915, in the Macoupin County Circuit Court, of Illinois, in the case of Superior Coal Co. vs. Ernest A. Ibbetson et al. One of the defendants in this suit, the Goag Oil & Gas Co., of New York, carried the case to the U. S. Circuit Court of the Southern District in Illinois, where the case was heard by Judge Fitzhenry.

The coal company offered the testimony of mining superintendents, mine inspectors, miners' union officials, and other parties interested in coal mining in Illinois. The Goag company presented the testimony of mining engineers and oil geologists and affidavits from large gas and oil producers who operate gas and oil wells in the Pennsylvania, West Virginia, and Ohio oil and gas fields that are situated in coal-mining districts where the two industries have been jointly carried on for many years with no trouble, interference, or danger. A final decree was recently entered in favor of the Goag Oil & Gas Co., which is given the right to drill through the large pillars of the Superior Coal Co. on filing a bond of \$5,000 to protect the coal company in case a well is not properly cased, cemented, or plugged.

Only gas has been found on the coal companies' land, and the number of wells permitted on forty acres has been restricted to three.

PETROLEUM PRODUCED IN THE UNITED STATES IN MARCH, 1921, APRIL, 1921, AND APRIL, 1920

(Barrels of 42 U. S. gallons)

State	March, 1921 (a)		April, 1921		April, 1920	
	Total	Daily Average	Total	Daily Average	Total	Daily Average
California (b)	10,482,000	338,129	10,170,000	339,000	8,265,000	275,500
Oklahoma	9,682,000	312,323	9,552,000	318,400	8,273,000	275,767
Central and Northern Texas	6,721,000	216,807	6,168,000	205,600	5,062,000	168,733
Coastal Texas	2,978,000	96,000	2,757,000	91,900	1,895,000	63,167
Kansas	3,086,000	99,548	3,289,000	109,633	3,239,000	107,967
Northern Louisiana	2,105,000	67,903	1,953,000	65,100	3,742,000	124,733
Coastal Louisiana	165,000	5,323	149,000	4,967	136,000	4,533
Salt Creek, Wyo.	915,000	29,516	1,174,000	39,133	781,000	26,034
Rock Creek, Wyo.	189,000	6,097	202,000	6,733	109,000	3,633
Grass Creek, Wyo.	158,000	5,097	176,000	5,867	124,000	4,133
Big Muddy, Wyo.	193,000	6,226	171,000	5,700	172,000	5,733
Elk Basin, Wyo.	71,000	2,290	74,000	2,467	54,000	1,800
Other Wyoming districts	88,000	2,839	116,000	3,867	63,000	2,100
Kentucky	768,700	24,797	777,700	25,923	715,500	23,850
Illinois	963,000	31,065	765,000	25,500	884,000	29,466
West Virginia	760,000	24,516	691,000	23,034	654,000	21,800
Pennsylvania	675,000	21,774	636,000	21,200	636,000	21,200
Central and Eastern Ohio	469,000	15,129	443,000	14,767	431,000	14,367
Northwestern Ohio	193,000	6,226	182,000	6,066	180,000	6,000
Arkansas	(c) 10,000	322	(d) 300,000	10,000		
Southwestern Indiana	77,000	2,484	76,000	2,533	51,000	1,700
Northeastern Indiana	24,000	774	26,000	867	23,000	767
Montana	97,000	3,129	96,000	3,200	8,000	267
New York	86,000	2,774	84,000	2,800	76,000	2,533
Colorado	10,000	322	10,000	333	8,000	267
Tennessee	1,300	42	1,300	43	1,500	50
Totals	40,965,000	1,321,452	40,039,000	1,334,633	35,583,000	1,186,100

(a) Revised. (b) Average of figures reported by Standard Oil Co. and Independent Oil Producers' Agency. (c) Includes only tank-car receipts by refineries. (d) Estimated in part.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Development of the Chloride Volatilization Process by the U. S. Bureau of Mines*

Experimental Work So Far Conducted at the Salt Lake Station
Indicates Value of This Method for Treating Oxidized, Semi-
Oxidized and Carbonate Ores of Copper, Lead and Silver

BY THOMAS VARLEY AND C. C. STEVENSON

THE art of treating ores by the chloride volatilization process is still in the experimental stage and has not been sufficiently developed to make it possible to state definitely what place it will occupy in the metallurgical industry. The theory upon which the process operates has received attention for the last twenty years, and much research and experimental work has been conducted. Much of the experimental work done has never been published, and it seems that the accumulation of such results, if made known, would be an important aid to the further development of the process. The object of this paper is, therefore, to bring salient features of the process to the attention of the metallurgical industry, both for the purpose of furnishing information, and receiving from interested parties any comments which the reading of this article may suggest. A bulletin covering the work done at the Intermountain Experiment Station of the U. S. Bureau of Mines, situated at Salt Lake City, Utah, is in course of preparation.

The chloridizing roast is usually accompanied by appreciable losses due to the volatilization of the metals as chlorides during the roast, these losses often running as high as 30 per cent, depending upon the temperature, the character of the ores, and the associated gangue material. It was not until 1891 that Croasdale, (*Engineering and Mining Journal*, Aug. 29, 1903,) by observing flue and stack deposits from the chloridizing roast, recognized the possibility of making volatilization a major instead of a minor feature of the roast. He then made tests on a large number of ores from different localities, the result of which showed the general application of the process. The main difficulty, as stated by Croasdale, was the lack of a suitable means for recovering the fume from the furnace gases.

In 1913, Cottrell (*Mining & Scientific Press*, March 29, 1913; also *Trans. A. I. M. E.*, September, 1918), announced his invention of the electrostatic precipitator, which solved the problem of separating the solids from the furnace gases.

*From U. S. Bureau of Mines Reports of Investigations, No. 2247.

About 1915 the U. S. Bureau of Mines, through Ralston (*Trans. A. I. M. E.*, Vol. LVII, 1917, p. 634), began an investigation at its Intermountain station, of the chloride volatilization process as a possible means of ore treatment. Since that time the Intermountain station of the Bureau, in co-operation with the department of metallurgical research, University of Utah, has gone extensively into the problem, both from a theoretical and semi-commercial standpoint. At present, volatilization is one of the major problems being investigated at the station. Other investigations have been instigated by G. H. Wigton (U. S. Patent No. 1,264,685; April 30, 1918), of Eureka, Utah; by S. I. Clawson (U. S. Patent No. 1,262,453; April 9, 1918), of Salt Lake City, and by others.

POSSIBILITIES OF THE PROCESS

The commercial utilization of the process will fill a long-felt want in the metallurgical industry. It is especially adapted to the treatment of oxidized and semi-oxidized and carbonate ores of copper, lead, and silver. Ores of this character are difficult to treat by gravity concentration or flotation. In the former method of treatment their tendency to slime upon crushing and their lower specific gravity, as compared with the sulphide minerals, create serious losses. In the latter method of treatment, much has been done in the way of sulphidizing oxide and carbonate ores, with subsequent recovery by flotation of the artificial sulphides. Difficulties in proper sulphidizing and low recoveries more than balanced the low cost of treatment in many plants, and in few instances has it proved successful.

In addition to the minerals named above, gold present in ores has been quite readily volatilized. Zinc does not volatilize if an oxidizing condition is maintained in the roasting operations. Some excellent results have been obtained on zinc concentrates containing silver and lead. Practically all the silver and lead, but very little zinc, has been volatilized. Experiments have shown that this is probably one of the best methods of making a clean-cut separation of lead and zinc.

No great amount of work has been done on sulphide ores, because of the

fact that the need of such a method for the oxidized and carbonate ores is more pressing. Some experiments, however, carried out on sulphides are encouraging. When the sulphur content is more than about 5 per cent, a preliminary roast is usually necessary before chloride roasting and volatilization.

METHODS OF EXPERIMENTATION: ANALYSIS OF ORE SAMPLES

The ores experimented with are always analyzed both for their chemical and mineralogical constituents; the latter by the microscope, to identify and determine the physical condition of the minerals. Both are extremely necessary. By the microscope examination it is possible to determine the size of crushing necessary to liberate from the gangue the greatest amount of mineral that can economically be recovered. The compactness or porosity of the ores in which the minerals occur is an important factor; usually the compact ores require finer crushing.

After the crushing size of the ore has been determined, it is then necessary to calculate, from analyses, the amount of chloridizing salts that must be added to insure the presence of sufficient chlorine to give complete chloridization and volatilization of the minerals.

MUFFLE TESTS

The assay muffle is usually used for the preliminary determination, and is heated to the temperature necessary to effect volatilization. This temperature varies with different ores, but when silver is present it is usually about 1,050 deg. C. Ordinarily, 100 grams of crushed ore is used, this being thoroughly mixed with salt or calcium chloride. These mixed charges, contained in 5 or 6-in. roasting dishes, are then placed in the heated furnace. Several series of tests are made, in which the varying factors are time of roast, temperature of furnace, fineness of crushing of ores, and varying amounts of salt and calcium chloride. The residues after roasting are weighed and assayed, and from these results the percentage of metals volatilized is calculated. In these experiments none of the fumes evolved can be caught.

ELECTRIC TUBE TESTS

Tests are also made by means of a horizontal electric furnace; a small boat containing the mixed charges is placed in a silica or porcelain tube, and then the tube is placed in the furnace. It is possible to pass air through the tube at any desired rate and also to collect the fumes and measure the gases. For this reason, and because of the control of temperatures, this apparatus is more desirable for preliminary experiments.

LABORATORY VOLATILIZATION PLANT

The present plant consists of a rotary kiln, dust chambers, a double-unit electrostatic precipitator, and a Stevenson chloride-injector, constituting a complete miniature chloride volatilization plant.

FLEXIBILITY OF THE PLANT

The kiln has three speeds, either one, two, or three revolutions per minute. The speed affects the capacity, ore transit, and dusting. The ore feeder is equipped with eight different speeds, which permit variation in the rate of feeding the ore from about 1½ to 12 lb. per hour. The rate of feed affects the capacity and length of time that the ore is in the furnace. The velocity of the gases is regulated by means of slide

ture up to 1,250 deg. C. can be maintained without difficulty.

PRELIMINARY SMALL-KILN TESTS

Tests are made in the small laboratory plant both for research investigations and as preliminaries to the large-kiln tests. From 10- to 25-lb. samples are desirable. The ore, with part of the chloridizing reagents, is fed into the upper end of the furnace by means of a mechanical ore feeder, and the remaining portion of the chloridizing reagents is injected directly onto the charge in the front or heated end of the furnace.

CONFIRMATORY LARGE-KILN TESTS

From 200 to 2,000 lb. of ore is usually taken in making final tests in the large kiln (Bulletin No. 11, Utah En-

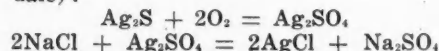
65-per cent was the best obtainable for silver. The usual method of making volatilization tests is to mix the ore and chloridizing reagent or reagents and to feed the mixture by a screw feeder or other means into the cool end of the furnace. The rotation of the kiln and the slope of the frame on which the furnace is mounted cause the charge to migrate downward toward the front and heated end. When the charge becomes heated, a chloridization of the metals is effected, with a subsequent evaporation of the metal haloid.

CHEMICAL REACTIONS

A decided difference of opinion exists as to the chemical reactions that take place. It is our opinion that different reactions are involved, depending on the chloridizing conditions brought about in the furnace.

The three following equations show the reactions that are most likely to take place, assuming silver as the metal to be chloridized and volatilized.

No. 1 (equation according to Croasdale):



If sulphates were present, this reaction would probably take place during some stage of the roast.

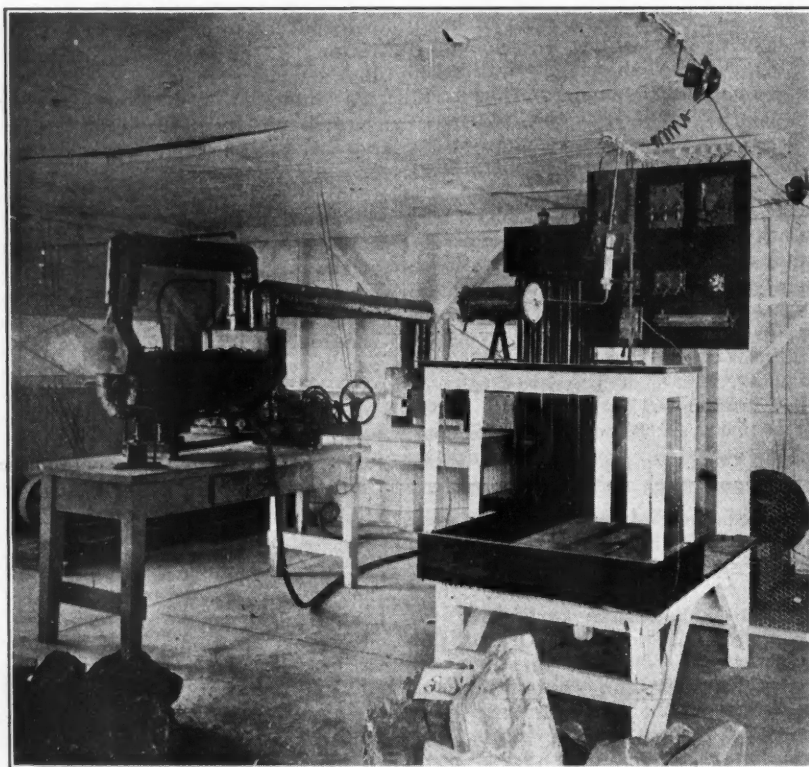
No. 2: $\text{RO} + 2\text{NaCl} = \text{Na}_2\text{O} + \text{RCl}_2$

Experiments have shown that silver, lead, and other metals can be chloridized and volatilized in the absence of sulphur. This reaction, represented by equation 2, would likely take place to some degree, providing the temperature were high enough and all the salt had not volatilized as sodium chloride before the charge could reach the temperature necessary to promote the reaction.

No. 3: $2\text{NaCl} + \text{SiO}_2 + \text{H}_2\text{O} + \text{heat} = \text{Na}_2\text{SiO}_3 + 2\text{HCl}$
 $4\text{HCl} + \text{O}_2 \rightleftharpoons 2\text{H}_2\text{O} + 2\text{Cl}_2$

It is doubtful whether this reaction would take place if the sodium oxide had nothing with which to combine. It is known that sodium oxide is difficult to form. However, if silicates in the gangue are available for combining, it is possible to get a reaction with part of the salt. This reaction is probably the most effective and represents the chloridizing of most of the metal present in an oxidized ore.

On the assumption that the equations given are correct—even to the complete chloridization of all the silver in the ore at some time during the thermal treatment—a condition remains that would be likely to prevent complete volatilization of the silver.



EXPERIMENTAL LABORATORY

Three-foot rotary furnace at the left; electric tube furnace on stand in center; and Cottrell treater at the back

dampers arranged in the channels that convey the gas. The gas velocity affects the dusting, grade of fume produced, and the concentration of the chloridizing atmosphere in the furnace. The chloride injector has forty-eight different speeds, which will feed from 2½ to about 20 oz. of chloridizing reagents per hour.

The treaters are constructed in two separate units of four and two pipes, respectively. These units may be used separately or collectively, which is equivalent to using either a two-, four-, or six-tube treater. The number of tubes used affects the velocity of the gas in the treaters and the clearance.

The furnace is fired with a blow torch, using artificial illuminating gas under low pressure, or oil and air about 20-lb. pressure. Any desired tempera-

ture Engineering Experiment Station, Department of Metallurgical Research, June, 1919, p. 24). In comparative tests the results obtained in the small plant have been almost duplicated in the large installation. The following results are typical for the two kilns:

Kind of Ore	Per Cent Crude Ore Content Volatilized, Small Kiln		Per Cent Crude Ore Content Volatilized, Large Kiln	
	Silver	Lead	Silver	Lead
Carbonate silver-lead ore.....	93	94	90	88
Oxidized silver-lead ore.....	85	94	90	92

IMPROVEMENT

The first tests that were made in the small furnace were conducted for the purpose of improving the extraction of silver from an ore containing 7.4 per cent lead and 6.80 oz. silver per ton. Previous work on this ore resulted in good extraction of the lead, but 60 to

Kind of Ore	Per Cent Crude Ore Content Volatilized, Small Kiln		Per Cent Crude Ore Content Volatilized, Large Kiln	
	Silver	Lead	Silver	Lead
Carbonate silver-lead ore.....	93	94	90	88
Oxidized silver-lead ore.....	85	94	90	92

Shall we assume that the metal is volatilized immediately upon being chloridized, or shall we accept a more logical theory, that time is required for the metal haloid to evaporate? The action of the chloridizing roast preparatory to leaching is sufficient evidence that the chlorides are formed at

relatively low temperatures and without being completely evaporated.

The following reaction could logically be expected to occur at increased temperature with at least part of the metal haloid:



As the charge passes through the furnace, the temperature continues to increase, and part of the salt rapidly volatilizes as sodium chloride, the remainder entering into the chloridizing reactions. The result is that the metallic chloride, which does not evaporate rapidly in the zones of lower temperature, is conveyed into the hotter regions, where the chloridizing atmosphere becomes lean. It would not require a strong imagination to conceive a decomposition or reversal of reaction, in which the metal would be left with the calcine as a non-volatile compound or element. Experiments have shown that the silver remaining in the calcine from a high temperature roast (1,000 deg. C.) is not present as chloride. It may be that some of the silver compounds occurring in complex oxidized ores are not chloridized at the relatively low temperature. If this were the case, it could logically be assumed that the chloridizing reagent or reagents might be volatilized or decomposed and dissipated before the silver would be in an available state to be chloridized.

By this reasoning, the most logical method of volatilizing metals from an ore would be to place the charge, consisting of ore and part of the chloridizing reagents, in the furnace, permit the charge to become heated to the proper temperature, and then supply the remaining portion of the haloid salt to the heated charge in the zone of high temperature. This method of supplying the chloridizing reagents would produce a highly chloridizing atmosphere directly where it is needed.

THE FIRST TEST

The following is the record of the first test made, wherein the chloridizing reagents were supplied to the charge in the front and heated end. This test was made for the purpose of chloridizing and volatilizing the lead and silver in an oxidized zinc ore, leaving high-grade zinc calcine.

The charge was fed into the feed end of the furnace by means of a screw conveyor. In addition, 4 per cent of hydrated calcium chloride was fed by hand at regular intervals to the charge in the fire box, instead of introducing it with the charge. The temperature was 1,010 deg. C. Steam was passed into the fire box. Good oxidizing conditions were provided.

Dense fumes were evolved, especially when the portions of chloridizing agent were supplied to the charge in the fire box. The following assays show the results:

Charge	Assay of Material			Per Cent Volatilized	
	Silver, Oz.	Lead, Per Cent	Zinc, Per Cent	Silver	Lead
Original ore (10 lb.)	6.8	7.4	32.6	...	...
Calcine with all CaCl ₂ · 2H ₂ O added in charge	1.32	1.58	...	74.3	73.0
Calcine with CaCl ₂ · 2H ₂ O added to fire box	0.68	0.63	44.86	90.3	92.0

These results are conclusive, and show definitely the advantage of adding part of the chloridizing reagent at the hottest point in the furnace, thereby giving a strong concentration of chlorine vapors at the critical temperature and at the time the chemical reactions take place.

Ore Transit—The ore transit should be as slow as possible, in order to reduce dust losses and prevent a high insoluble content in the fume. A linear travel of about 15 ft. per minute in a commercial kiln is usually sufficient to mix the charge and maintain the desired capacity.

SUMMARY OF RESULTS ON VARIOUS TESTS

Ore	Feed Assays					Amount of Per Cent Reagents Volatilized			
	Gold Oz.	Silver Oz.	Lead Per Cent	Zinc Per Cent	"Insoluble" Per Cent	Sulphur Per Cent	NaCl Per Cent	CaCl ₂ · 2H ₂ O Per Cent	Gold Silver Lead
Oxidized zinc concentrate	...	6.80	7.40	32.6	13.6	...	6	6	85 80
Oxidized silver-lead ore, Utah	0.07	9.39	15.7	1.25	62.0	4.47	10	10	80 89
Silver-lead ore, California	...	9.66	1.07	1.83	56.0	4.92	5	10	80
Oxidized silver-lead ore, Nevada	0.03	3.56	5.35	...	...	...	5	10	70 87 80
Oxidized silver-lead ore, South America	...	12.0	1.60	...	77.2	0.86	5	7	75 80

PHYSICAL CONDITIONS AFFECTING CHLORIDE VOLATILIZATION

Sintering — Sintering is promoted by the chloridizing reagents, common salt being especially active. The salt, upon decomposing, liberates its chlorine and combines possibly as a silicate or sulphate, both of which are fusible at the temperatures required to volatilize silver chloride. Most sulphide ores tend to sinter, which results in sealing the metal within the ore particles and protects it from the chloridizing gases, thus causing low extraction. This objectionable feature is usually overcome by the use of some inert non-fusible material, such as limestone. The addition of 5 to 15 per cent of lime rock will prevent sintering in some of the most troublesome ores. Use of calcium oxide would be still better, because no carbon dioxide would be given off to dilute the gases.

Baking—In making preliminary muffle or tube tests, baking and sintering should not be confused. Baking is the result of a crust-forming action in the charge, taking place in the regions of lower temperature in the furnace. Two causes are responsible for most baking—the evaporation of moisture, and the temporary fusing of salts that are later decomposed at the high temperatures. The evaporation of moisture from the ore causes precipitation of the soluble salts and deposition of suspended matter, both of which act as a binder and crust the particles of ore together. The low temperature fusion of sundry salts—either those contained in the ore, those supplied as chloridizing reagents, or salts formed from the reactions—serves as a binding medium and causes some trouble in the feed end. Baking forms rings of crusted ore in the feed end of the furnace, which continue to build up on the lining until the ore flows back into the dust chamber. Baking is not a serious difficulty. The crust is easily broken, and a heavy drag or rabble properly placed will prevent its formation.

Gas Velocity—The gas velocity should not exceed the speed necessary to carry away the combustion gases and fume. High velocity causes a high dust loss, low-grade fume, and a dilute chloridizing atmosphere over the charge in the furnace. A velocity of 10 to 20 ft. per second is usually sufficient in a properly designed kiln.

Temperature — The necessary temperature required for chloridizing and volatilizing the metals from an ore depends entirely on the metals to be volatilized. Copper and lead will volatilize at much lower temperatures than gold and silver. However, a temperature of 1,000 deg. C. should completely volatilize all the metals except zinc, provided the charge does not sinter.

Time—The time required to evaporate the metal haloids depends on the temperature and concentration of the chloridizing atmosphere. Forty to sixty minutes, under proper temperature and chloridizing conditions, should be sufficient.

U. S. Chamber of Commerce Has a Natural Resources Section

Several mining engineers are represented in the recently organized Department of Natural-Resources Production of the Chamber of Commerce of the United States of America, including Sidney J. Jennings, R. V. Norris, Van. H. Manning, and J. E. Spurr. The chairman of the committee is C. S. Keith, of Kansas City, Mo., and the vice-chairman, J. H. Ross, of Winter Haven, Fla. The other members of the committee are: P. B. Noyes, of Oneida, N. Y.; Christy Payne, of Pittsburgh, Pa.; E. T. Meredith, ex-Secretary of Agriculture, of Des Moines, Ia., and W. D. Davis, Bartlesville, Okla.

The Department of Natural-Resources Production is one of eight departments which have been organized in the Chamber of Commerce of the United States of America. The other departments are: Fabricated Production, Domestic Distribution, Foreign Commerce, Finance, Insurance, Transportation and Communication, and Civic Development.

MEN YOU SHOULD KNOW ABOUT

Arthur Thacher, of St. Louis, Mo., is visiting the zinc district of Wisconsin.

George R. Trask, mining engineer of Wallace, Idaho, was in New York City last week.

W. H. Rubey will do oil geologic work for the U. S. Geological Survey in the vicinity of El Dorado, Ark.

Howard R. Ward, consulting mining engineer, has moved his office to 45 West 18th St., New York City.

R. C. Moore, of the U. S. Geological Survey, is making geological studies in Garfield and Cane counties, Utah.

Forest Rutherford, consulting mining engineer, of New York City, has gone to Canada on mine examination work.

E. P. Mathewson returned to the United States on June 7 from an extended trip to England and the Continent.

Hjalmar E. Skougur, consulting engineer, of New York City, has returned from his three months' trip to European countries.

Edwin Ludlow, president of A. I. M. E., was in St. Louis, Mo., recently attending the meeting of American Engineering Council.

F. L. Ransome represented the University of California at the centennial celebration, on June 4, of the University of Virginia.

John Edwin, mining engineer, has just returned from Surinam, Dutch Guiana. He was in New York City for a few days this week.

A. W. Newberry, mining engineer, has returned to New York City from his recent trip to Washington, D. C., Chicago, Ill., and other cities.

Theodore Chapin, who has been doing private geologic work in the Tampico oil region, has resumed his duties with the U. S. Geological Survey.

J. Meyer, recently professor of chemistry at the University of Breslau, has succeeded Prof. W. Biltz as professor in the Bergakademie at Clausthal.

Philip N. Moore, mining engineer, has returned to his practice in St. Louis, Mo., after spending two years at Washington, D. C., on the War Minerals Relief Committee.

W. A. Lampport, president, and **C. A. McLean**, director of the Peterson Lake Mining Co., Cobalt, Ont., were in New York City recently in connection with the financing of the company.

Chester F. Lee, mining engineer, of Seattle, Wash., is in the East Kootenay district of British Columbia, investigating silver-lead properties for Seattle and Vancouver, B. C., investors.

John D. Northrop and wife, who have been in South America during the last year, sailed from Cristobal, Panama, by the "Quilpue" on May 25, and landed in New York City on June 4 last.

E. D. Frohmann, of Pittsburgh, Pa., has gone to Europe, where he will make a special study of the application of high-temperature cements for boiler and metallurgical furnace linings.

J. Dix Fraser, superintendent of the Atikokan Iron Co., was in Port Arthur, Ont., recently. Mr. Fraser's visit was relative to the sale of some of the holdings of the Atikokan Iron Company.

T. A. Rickard, editor of *Mining and Scientific Press*, delivered the principal address at the commencement exercises of the School of Mines of the University of Montana, Butte, Mont., on June 3.

W. J. Olcott, president of the Oliver Iron Mining Co., was in New York last week attending the meeting of the presidents of the various subsidiary companies of the U. S. Steel Corporation.

C. E. Siebenthal, geologist of the U. S. Geological Survey, was in St. Louis recently consulting with representatives of local zinc and lead interests. He has returned to Washington, D. C.

Joseph Mierzynski, of Chicago, president of the Palatine Mining & Development Co., accompanied by the board of directors of the company, recently inspected the company's holdings in northern Minnesota and Canada.

John J. Rutledge, superintendent of the U. S. Bureau of Mines station at St. Louis, Mo., has been transferred to a similar position at Urbana, Ill. **G. J. Salmon** has been designated as acting superintendent of the St. Louis station.

Heath Steele, mining engineer, with the mining department of the American Metal Co., Ltd., New York City, has been placed in charge of the Mexican enterprises of that organization. His address will be care of Cia. Minera de Peñoles, S. A., Monterrey, N. Leon, Mexico, D. F.

H. C. George, chief engineer for the Wisconsin Zinc Co., Platteville, Wis., has resigned to take a position as "Oil recovery engineer" in the U. S. Bureau of Mines, with headquarters in San Francisco. Mr. George was director of the Wisconsin State School of Mines at Platteville from 1908 to 1911.

D. B. Dowling, of the Canadian Geological Survey, and party are on the way to the Mackenzie River district, where they will make a general survey of the country from the mouth of the Peace River to the vicinity of the Arctic Circle. Their work will connect up detailed work to be done by three survey parties already in the field.

Mining engineers and geologists recently visiting New York City included the following: **T. M. Crampton**, now of Silverhorn, Pioche, Nev.; **Archibald Little**, of Detroit, Mich.; **B. F. Tillson**, of Franklin, N. J.; **Ozni P. Hood** and **E. A. Holbrook**, of the U. S. Bureau of Mines, Washington, D. C.; **Paul B. R. Cook**, formerly at Sofia, recently from Constantinople; **Chas. B. Murray**, of Cleveland, Ohio; **Mowry Bates**, of Tulsa, Okla.; **Charles Laurence Baker**,

of Cordova, Ill.; **Theodore H. Crook**, of Beaumont, Tex., and **George L. Klingaman**, of San Francisco, Cal.

OBITUARY

David Goodale, graduate in mining engineering of the University of California, native of San Francisco, Cal., and member of the firm of Atkins, Kroll & Co., of that city, died suddenly at his home in Berkeley, Cal., on May 24 last.

Roy F. Smith, mining engineer, for the last three years engaged on mine examinations and geological work with the Empire Zinc Co., of Colorado, died at Gilman, Col., on May 17 after a brief illness. Mr. Smith was a native of Denver, Col., where he received his preliminary schooling before entering the Colorado School of Mines, from which he received the degree of engineer of mines in 1911. Immediately after graduation he entered U. S. Government employ, but at the end of a year resigned to accept a position with the Empire Zinc Co. During the eight years he served that company he filled various positions from mine surveyor to mine superintendent. He had shown much ability in mine geology and examination work. Mr. Smith was buried at Denver by the Masonic fraternity, he having been a Thirty-second Degree Mason and a Shriner. He had just joined the A. I. M. E.

Dr. Tulio Ospina, long the director of the National School of Mines at Medellin, Colombia, died at Panama Hospital on Feb. 8, 1921, as the result of an operation. Dr. Ospina was born at Bogotá about 1856, the son of Mariano Ospina Rodriguez, a prominent South American statesman and president of Colombia during 1857-1861. Young Ospina spent his youth in Medellin and in Guatemala. When of age he went to the United States for study, and was graduated from the University of California about 1880. Returning to Colombia, he devoted himself to the geology, mining, and the metallurgical development of his country, ultimately becoming the leading Colombian authority in those fields. Dr. Ospina held the chairs in geology at the University of Antioquia, where he was rector for a time, and at the National School of Mines at Medellin, which he finally served as director.

At the time of the Second Pan-American Scientific Congress, at Washington, D. C., in 1915-16, Dr. Ospina was a special delegate from Colombia, and presided at the sessions of the Division of Mining, when also he presented a paper, "The General and Economic Geology of Columbia." Broad interests and varied activities brought Dr. Ospina into a number of historical and other societies, carried him as a deputy several times to the Antioquia Legislature, and for a term or two to the National Congress at Bogotá.

THE MINING NEWS

LEADING EVENTS

WEEKLY RÉSUMÉ

The Ingalls committee has completed its draft of a bill providing for a revision of the United States mining laws, the text of which is given in this issue. At Washington, Senator Nicholson has introduced a bill calling for the creation of a Federal Department of Mines with Cabinet representation. Secretary Fall is said to favor one-man administration of the War Minerals Relief Act, and has offered the post to Ira E. Robinson, a lawyer, of West Virginia.

In Colorado, the Arkansas River, swollen beyond its normal flow, has caused great damage in Pueblo, though the A. S. & R. smelter is said to have escaped serious injury. In Utah, the Utah Apex Mining Co. has filed exceptions to the accounting made by the Utah Consolidated Mining Co. In Nevada, at Tonopah, strike conditions are reported unchanged. Wages were cut at Virginia City and Gold Hill on June 1. In the Lake Superior district, the rate for transporting ore on the Great Lakes has been fixed. Independent operators in the district cut wages June 1. Three companies at Chisholm, on the Mesabi Range, have refused to pay the village tax levy.

Arkansas River Floods Pueblo, Colorado

Heavy Rains, Cloudburst and Failure of Two Dams Result in Devastation of City—A. S. & R. Smelter Reported Undamaged

Heavy rains in the Arkansas Valley above Pueblo, Col., caused floods that devastated the town on the night of June 3 and the following day. Barely had the population begun to recover from this disaster when a cloudburst, coupled with the failure of two dams on Beaver Creek thirty miles west of Pueblo, again flooded the city, doing serious damage.

The Pueblo smelter of the American Smelting & Refining Co. occupies a position on the bank of the Arkansas River directly in the path of the flood. Wires received at the company's New York offices indicated that the plant was shut down but in good condition, with no known loss of life among the employees. The plant of the Colorado Fuel & Iron Co. is said to be above harm's reach.

Later reports had it that the Platte River has risen sufficiently to flood sections of Denver. The mines at Cripple Creek were reported to be closing down on account of washouts on the Colorado Midland railroad and because of power shortage caused by injury to the Arkansas Valley power plant.

Revision of United States Mining Laws Proposed

Ingalls Committee Completes Draft of New Bill Providing for Amending and Codifying Statutes Relating to Location of Mining Claims on Public Domain—Secretary Fall and Director Bain Still To Pass on Recommendations

The full text of the bill drafted by the Ingalls committee providing for the revision of the mining laws of the United States is given as follows:

"A bill to revise, amend, and codify the laws of the United States regulating the location of mining claims on the public domain, and for other purposes.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled. That this act may be cited by the short title of 'United States Mining Act.' Wherever the word 'person' occurs in this act it shall be construed to import the plural or singular as the case demands, and shall include individuals, associations, partnerships, and corporations.

"Sec. 2. In all cases lands valuable for minerals shall be reserved from sale, except as otherwise expressly directed by law.

"Sec. 3. With the exceptions hereinafter noted, all valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and purchase, ownership and operation, and the lands in which they are found to occupation and purchase, by citizens of the United States and those who have declared their intention to become such, under regulations prescribed by law. Provided, that this act shall not affect deposits of potassium, coal, phosphate, sodium, oil, oil shale, or gas; nor shall it pertain to withdrawals of public land which may have been, or may hereafter be, made; nor shall it apply to lands acquired under the act of March first, nineteen hundred and eleven (Thirty-six Statutes, page nine hundred and sixty-one) known as the 'Weeks Law.'

"Sec. 4. Proof of citizenship, under this act, may consist, in the case of an individual, of his own affidavit thereof; in the case of an association of persons unincorporated, of the affidavit of their authorized agent, made on his own knowledge or upon information and belief; and in the case of a corporation organized under the laws of the United States, or of any state or territory thereof, by the filing of a certified copy of its charter or certificate of incorporation.

FORM AND SIZE OF CLAIM—REQUIREMENT AS TO DISCOVERY—EXPLORATION ON LAND CLASSIFIED AS NON-MINERAL

"Sec. 5 A. Every full mining claim upon unsurveyed lands shall be located in the form of a square containing forty acres laid out on cardinal lines, conforming to the system of public

land surveys, but claims may also be located in the form of a square containing ten acres laid out on cardinal lines, conforming to the system of public land surveys. Other fractional claims shall be located in the same manner as full claims, but their area and form may be governed by available areas. When mining claims are located upon surveyed lands they shall conform to the subdivisions of the public land surveys. A full mining claim on surveyed lands shall be a quarter-quarter section or lot, but legal subdivisions of forty acres may be subdivided into ten-acre tracts. Other fractional claims on surveyed lands shall be located in the same manner as full claims, but their area and form may be governed by available areas.

"B. Subject to limitations contained in this article, discovery of valuable mineral shall not hereafter be necessary in order to locate and hold a mining claim, but when a claim is recorded in the United States Land Office, the records shall include a sworn statement as to whether or not a discovery has been made. A claim located and recorded without discovery on land classified as mineral may be held for five years without discovery, after which it shall be open to relocation under the same conditions as though it were a claim upon which the required expenditure for development had not been made; provided, however, that upon failure to make discovery within the period of five years a locator shall have the right to hold the claim or claims for further annual terms, not exceeding five years, by payment into the United States Land Office annually in advance fifty dollars for each acre or fraction thereof, which annual payments shall be in lieu of any further requirements for assessment work.

"C. Should the owner of a claim located without discovery of valuable mineral make such a discovery during such five-year period, or during such five-year extension thereof, as stipulated in Article 3 of this section, he shall file a sworn statement as to that fact with the other papers in the United States Land Office, showing the nature of such discovery and of the mineral discovered. Upon the verification of such discovery by a United States deputy mineral surveyor, delegated by the officer in charge of said Land Office to make an examination, which examination shall be at the expense of the claimant, such discovery thus established shall entitle the owner of the claim to hold and possess it under the same conditions as though discovery had been made before the original record was filed in said Land Office. If discovery of a valuable mineral be

made by drilling more than one hundred feet in depth, affidavits by at least two persons thoroughly acquainted with the facts, setting forth the nature of the discovery and the place, depth and time at which it was made, shall be accepted by the United States Deputy Mineral Surveyor, delegated by the officer in charge of said Land Office to make examination, as prima facie evidence of discovery, provided that such affidavits be made within thirty days following the discovery.

"D. Where no proceedings have been initiated in the United States Land Office to acquire a non-mineral estate in public land classified as non-mineral, mining claims may be located thereon with or without discovery, but in the absence of a discovery a subsequent location on such land shall not be recognized if made by the original locator, or by any person in privity with him, within two years after the prior location had become invalid.

"E. One discovery shall be sufficient to support the holding and patenting of a maximum of four contiguous full-claims, aggregating 160 acres (if held in common ownership), or sixteen contiguous ten-acre claims, aggregating 160 acres, if held in common ownership.

"F. No person shall hereafter locate any mining claim or placer ground in Alaska as attorney for another unless he is duly authorized thereto by a power of attorney in writing, duly acknowledged and recorded in any recorder's office in the judicial division where the location is made. Any person so authorized may locate mining claims on placer ground for not more than two individuals or one association under such power of attorney, but no such agent or attorney shall be authorized or permitted to locate more than two mining claims on placer ground for any one principal or association during any calendar month. No person shall hereafter locate, cause or procure to be located, for himself, in Alaska, more than two such claims, not to exceed twenty acres each in the case of an individual, or forty acres if an association, in any calendar month; and no such claim in Alaska which is longer than three times its greatest width shall hereafter be patented. Any claim attempted to be located in violation of this article shall be null and void, and the whole area thereof may be located by any qualified locator as if no such prior attempt had been made.

"G. Final entry and payment shall be made for all mining claims located hereafter within seven years from the date of the original location, exclusive of the time consumed in adverse suits and contests; except that in the case of extensions obtained under the provisions of Article B of this section the time limit for final entry and payment shall be twelve years from the date of the original location.

"H. In all cases of an application for a patent to mineral land a discovery shall be a condition precedent.

MARKING, NOTICE, AND RECORDING OF LOCATIONS—ANNUAL DEVELOPMENT WORK

"Sec. 6. A. The location of a claim must be distinctly marked on the ground so that its boundaries can be readily traced, and such marking shall include the placing of a permanent monument extending not less than two feet above the ground at each corner

of the claim. At the time when the claim is monumented there shall also be posted in a conspicuous place on the claim a notice of location, which shall be according to a form prescribed by the United States Surveyor General and in conformity with the terms of this act. All notices of location of mining claims hereafter made shall contain the name or names of the locators, the date of the location, and such a description of the claim or claims located by reference to some natural object or permanent monument as will identify the claim, and such notice of location of all claims, whether located before or after the effective date of this act, shall be recorded in the United States Land Office for the district in which located; the claims located after the effective date of this act shall be recorded within ninety days after the date of location; all claims located prior to the effective date of this act shall be recorded within one year after said date.

"B. On each claim located after the effective date of this act, and until a patent has been issued therefor, not less than five dollars' worth of labor shall be performed or improvements made during each year for each acre or fraction thereof comprised in such claim; or in lieu of the performance of such labor a sum computed at the rate of five dollars for each acre or fraction thereof may be paid each year, including the year of location, into the United States Land Office for the district; on each claim located after the tenth day of May, eighteen hundred and seventy-two and before the effective date of this act, and until a patent has been issued therefor, not less than one hundred dollars' worth of labor shall be performed or improvements made during each year. On all claims located prior to the tenth day of May, eighteen hundred and seventy-two, ten dollars' worth of labor shall be performed or improvements made during each year for each one hundred feet in length along the vein until a patent has been issued therefor; but where such claims are contiguous, and are held in common, such expenditure may be made upon any one claim.

"C. Upon failure to comply with the conditions as to annual work or payments, as provided in Article B of this action, the claim or mine upon which failure occurred shall be open to relocation in the same manner as if no location of the same had ever been made, provided that the original locator, or locators, or any person, or persons, in privity with him or them, shall be disqualified for a period of one year from making such relocation and a resumption of work shall not save the original locator, or locators, their heirs, assigns, or legal representatives from the effects of such failure. Provided further, that a sale to an innocent purchaser for value after such failure and after such resumption shall cure such failure in the absence of a relocation prior to such sale.

"D. Upon the failure of any one of several co-owners to contribute his proportion of the expenditures required by the terms of Article B of this section, the co-owners who have performed the labor or made the improvements, or who have paid the equivalent thereof to the United States Land Office as is required by Article B of this section, may, at the expiration of the year, give such delinquent co-owners personal

notice in writing by publication in the newspaper published nearest the claim for at least once a week for thirteen consecutive weeks, and if at the expiration of ninety days after such notice in writing or by publication such delinquent should fail or refuse to contribute his proportion of the expenditure required by this section, his interest in the claim shall become the property of his co-owners who have made the required expenditures.

"E. The period during which the annual work is required to be done, as specified in this section, shall be the calendar year during which location of claim be made. Provided, that if it be impossible to finish the work begun during the calendar year of location, and if the work has been diligently and continuously prosecuted, completion of the work, by diligent and continuous prosecution thereof, in the ensuing calendar year shall hold the claim. Provided, however, that this permission may not be construed as a waiver of the performance of the obligatory assessment work during the second calendar year. Provided, further, that on claims located on placer ground in the Territory of Alaska said annual work shall be done during the calendar year in which they are located, and regardless of the time of year in which location may have been made.

EXTRALATERAL RIGHTS AND OWNERSHIP IN ALL MINERALS AND SURFACE EMBRACED WITHIN THE CLAIM

"Sec. 7. Subject to the existing extralateral rights of mining claimants or patentees, the holder or patentee of a mining claim located hereafter shall have the exclusive right of possession and enjoyment of the surface held by him and of the minerals covered by this act which lie beneath the claim and within vertical planes passing through the surface boundaries of said land, but shall not have the right to follow any mineral deposit beyond said planes. And the holders or patentees of claims heretofore located shall have similar exclusive possession of all the minerals covered by this act which lie beneath the claim and within vertical planes passing through the surface boundaries of said land that is not covered by any existing extralateral rights.

PROCEEDINGS OF PATENT

"Sec. 8. A. A patent for any land claimed and located for valuable deposits may be obtained in the following manner: Any person, association, or corporation authorized to locate a claim under this act, having claimed and located a piece of land for such purposes, and having complied with the terms of this act, may file in the proper district land office an application for a patent, under oath, showing such compliance, together with proof of a discovery of valuable mineral, together with a plat and field notes of the claim or claims in common, made by or under the direction of the United States Surveyor General, showing accurately the boundaries of the claim or claims, which shall be distinctly marked by monuments on the ground. The claimant shall post a copy of such plat, together with a notice of such application for a patent, in a conspicuous place on the land embraced in such application previous to the filing of the application for a patent, and shall file an affidavit of at least two persons that such notice

has been duly posted, and shall file a copy of the notice in such land office.

"B. Upon compliance with the terms of Article A of this section the claimant shall be entitled to a patent for the land, in the manner following: The register of the district land office, upon the filing of such application, plat, field notes, notices, and affidavits, shall, for the period of sixty days, publish a notice, that such application has been made, in a newspaper to be by him designated as published nearest to such claim; and he shall also post such notice in his office for the same period. The claimant at the time of filing this application, or at any time thereafter, within the sixty days of publication, shall file with the register a certificate of the United States Surveyor General that twenty dollars' worth of labor has been expended or improvements made upon the claim by himself or grantors for each acre of the claim; or that cash has been paid into the United States Land Office to an amount bringing the total expenditure up to twenty dollars for each acre of the claim; and that the plat is correct, together with such further description by such reference to natural objects or permanent monuments as shall identify the claim; and shall furnish an accurate description to be incorporated in the patent. At the expiration of the sixty days of publication the claimant shall file his affidavit, showing that the plat and notice have been posted in a conspicuous place on the claim during such period of publication. If no adverse claim shall have been filed with the register and the receiver of the proper land office, at the expiration of the sixty days of publication, it shall be assumed that the applicant is entitled to a patent, upon the payment to the proper officer of five dollars per acre, and that no adverse claim exists; and thereafter no objection from third parties to the issuance of a patent shall be heard, except if it be shown that the applicant has failed to comply with the terms of this act. Provided, however, that in the District of Alaska adverse claims authorized and provided for in this and the following section may be filed at any time during the sixty days' period of publication or within eight months thereafter, and the adverse suits authorized and provided for in the following section may be instituted at any time within sixty days after the filing of said claims in the local land office. Provided, further, that where the claimant for a patent is not a resident of or within the land district wherein the vein, lode, ledge, or deposit sought to be patented is located, the application for patent and the affidavits required to be made in this section by the claimant for such patent may be made by his, her, or its authorized agent, where said agent is conversant with the facts sought to be established by said affidavit.

ADVERSE CLAIMS AGAINST APPLICATIONS FOR PATENT

"Sec. 9. A. Where an adverse claim is filed during the period of publication, it shall be upon oath of the person or persons making the same, and shall show the nature, boundaries, and extent of such adverse claim, and all proceedings, except the publication of notice and making and filing of the affidavit thereof, shall be stayed until the controversy shall have been settled or

decided by a court of competent jurisdiction, or the adverse claim has been waived. It shall be the duty of the adverse claimant, within thirty days after filing his claim, to commence proceedings in a court of competent jurisdiction, to determine the question of the right of possession, and prosecute the same with reasonable diligence to final judgment; and a failure to do so shall be a waiver of his adverse claim. After such judgment shall have been rendered, the party entitled to the possession of the claim, or any portion thereof, may, without giving further notice, file a certified copy of the judgment-roll with the register of the land office, together with the certificate of the Surveyor General that the requisite amount of cash or labor has been expended or improvements made thereon, and the description required in other cases, and shall pay to the receiver five dollars per acre for his claim, together with the proper fees, whereupon the whole proceedings and the judgment-roll shall be certified by the register to the Commissioner of the General Land Office, and a patent shall issue thereon for the claim, or such portion thereof as the applicant shall appear, from the decision of the court, rightfully to possess.

"B. If it appears from the decision of the court that several parties are entitled to separate and different portions of the claim, each party may pay for his portion of the claim with the proper fees, and file the certificate and description by the Surveyor General, whereupon the register shall certify the proceedings and judgment-roll to the Commissioner of the General Land Office, as in the preceding case, and patents shall issue to the several parties according to their respective rights.

"C. Nothing contained in this section shall be construed to prevent the alienation of a title conveyed by a patent for a mining claim to any person whatever. If, in any action brought pursuant to this section, title to the ground in controversy shall not be established by either party, the jury shall so find, and the judgment shall be entered according to the verdict. In such case costs shall not be allowed to either party, and the claimant shall not proceed in the land office or be entitled to a patent to the ground in controversy until he shall have perfected his title. The adverse claims referred to in this section may be verified by the oath of any duly authorized agent or attorney in fact of the adverse claimant cognizant of the facts stated.

DESCRIPTION OF CLAIMS

"Sec. 10. The description of mining claims upon surveyed lands shall designate the location of the claims with reference to the lines of the public survey. Where such claims are upon surveyed lands and conform to legal subdivisions no further survey or plat shall be required. Where patents have been or shall be issued for claims upon unsurveyed lands, the Surveyor General, in extending the public survey, shall adjust the same to the boundaries of said patented claims so as in no case to interfere with or change the true location of such claims as they are officially established upon the ground. Where patents have been issued for mineral lands, those lands only shall be segregated and shall be deemed to be patented which are bounded by the lines actually marked, defined, and

established upon the ground by the monuments of the official survey upon which the patent grant is based, and Surveyors General in executing subsequent patent surveys, whether upon surveyed or unsurveyed lands, shall be governed accordingly. The said monuments shall at all times constitute the highest authority as to what land is patented, and in case of any conflict between the said monuments of such patented claims and the descriptions of said claims in the patents issued therefor the monuments on the ground shall govern, and erroneous or inconsistent description or calls in the patent descriptions shall give way thereto. Where by the segregation of mineral lands in any legal subdivision a quantity of agricultural land less than forty acres remains, such fractional portion of agricultural land may be entered by any party qualified by law, for homestead or pre-emption purposes.

SURVEYS

"Sec. 11. The Surveyor General of the United States may appoint in each land district containing mineral lands as many competent deputy surveyors as shall apply for appointment to survey mining claims. The expenses of the survey of mining claims, together with the cost of publication of notices, shall be paid by the applicants, and they shall be at liberty to obtain the same at the most reasonable rates, and they shall also be at liberty to employ any United States deputy surveyor to make the survey. The Commissioner of the General Land Office shall also have power to establish the maximum charges for surveys and publication of notices under this act; and, in case of excessive charges for publication, he may designate any newspaper published in a land district where mines are situated for the publication of mining notices in such district, and fix the rates to be charged by such paper; and, to the end that the Commissioner may be fully informed on the subject, each applicant shall file with the register a sworn statement of all charges and fees paid by such applicant for publication and surveys, together with all fees and money paid the register and the receiver of the land office, which statement shall be transmitted, with the other papers in the case, to the Commissioner of the General Land Office.

VERIFICATION OF AFFIDAVITS. NOTICE OF CONTENT.

"Sec. 12. All affidavits required to be made under this act may be verified before any officer authorized to administer oaths. All testimony and proofs may be taken before any officer authorized to administer oaths within the land district where the claims may be situated, and, when duly certified by the officer taking the same, shall have the same force and effect as if taken before the register and receiver of the land office. In cases of contest as to the mineral or agricultural character of land, the testimony and proofs may be taken as herein provided on personal notice of at least ten days to the opposing party; or if such party cannot be found, then by publication of at least once a week for four consecutive weeks in a newspaper, to be designated by the register of the land office as published nearest to the location of such land; and the register shall require proof that such notice has been given.

LAND REQUIRED FOR MINING PURPOSES OTHER THAN IN MINERAL CLAIMS

"Sec. 18. A. Where unoccupied land belonging to the public domain, not contiguous to a mining claim, is required by the proprietor of such claim for mining or metallurgical purposes, such non-adjacent land may be located and may be embraced and included in an application for a patent for such claim, and the same may be patented therewith, subject to the same preliminary requirements as to survey and notice as are applicable to mining claims; but no location hereafter made of such non-adjacent land shall exceed ten acres, and payment for the same must be made at the same rate as fixed by this act for a mining claim. The ten acres of non-adjacent land provided for in this section must be in the form of a square, two sides of which must coincide with lines of the public survey. The owner of a mill, or reduction works, now owning a mine in connection therewith, may also receive a patent for his mill site or works sites as provided in this section.

"B. Where unoccupied land belonging to the public domain, either contiguous or non-contiguous to a mining claim, is needful in large areas for mining and metallurgical purposes, the surface rights of such land may be acquired in parcels or lots, conforming to the lines of the public surveys, without limit as to aggregate area, providing the application has been approved by the Secretary of the Interior. Land thus located and acquired under the provisions of this article shall be subject to the same provisions as to survey and notice as are required for the location and purchase of mineral lands in this statute; provided, however, that no land that has been officially classified by the Federal Government as being capable of irrigation from any known source may be located under the terms of this article. Lands located under this article shall be paid for at the rate of ten dollars per acre.

"C. The tenure of the surface provided for in Article B of this section refers solely to the occupancy of the surface, and the mineral rights underlying land thus acquired shall be in all cases reserved and shall be subject to location and patent under regulations and provisions promulgated by the Secretary of the Interior in harmony with the general provisions of this act governing the location of mineral lands.

MINERAL DEVELOPMENT FUND

"Sec. 14 All moneys paid into the United States Land Office in lieu of annual labor or improvements and for extension of tenure beyond five years where no discovery has been made, as provided for in this act, are hereby reserved, set aside, and appropriated, as a special fund in the Treasury, to be known as the 'Mineral Development Fund,' to be used and expended, under the direction of the Secretary of the Interior, within the state or territory, and as nearly as practicable within the mining district, from which payments were made, for general purposes of developing the mineral resources of the several mining districts.

SPECIAL PROVISIONS

"Sec. 15. Whenever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized

and acknowledged by the local customs, laws, and the decisions of courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes herein specified is acknowledged and confirmed; but whenever any person, in the construction of any ditch or canal, injures or damages the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage.

"Sec. 16. All patents granted, or pre-emption or homesteads allowed, shall be subject to any vested and accrued water rights, or rights to ditches, and reservoirs used in connection with such water rights, as may have been acquired under or recognized by the preceding section.

"Sec. 17. The President is authorized to establish land districts, and to appoint the necessary officers under existing laws, wherever he may deem the same necessary for the public convenience in executing the provisions of this act.

"Sec. 18. Subject only to such general limitations as may be necessary to exempt navigation from artificial obstructions, all land and shoal water between low and mean high tide on the shores, bays, and inlets of Behring Sea, within the jurisdiction of the United States, shall be subject to exploration and mining for gold and other precious metals by citizens of the United States, or persons who have legally declared their intentions to become such, under such reasonable rules and regulations as the miners in organized mining districts may have heretofore made or may hereafter make governing the temporary possession thereof for exploration and mining purposes. Provided: That the rules and regulations established by the miners shall not be in conflict with the mining laws of the United States; and no exclusive permits shall be granted by the Secretary of War authorizing any person or persons, corporation, or company to excavate or mine under any of said waters below low tide; but citizens of the United States or persons who have legally declared their intention to become such shall have the right to dredge and mine for gold or other precious metals in said waters, below low tide, subject to such general rules and regulations as the Secretary of War may prescribe for the preservation of order and the protection of the interests of commerce; such rules and regulations shall not, however, deprive miners on the beach of the right hereby given to dump tailings or pump from the sea opposite their claims, except where such dumping would actually obstruct navigation; and the reservation of a roadway sixty feet wide, under the tenth section of the act of May fourteenth, eighteen hundred and ninety-eight, entitled 'An act extending the homestead laws and providing for right of way for railroads in the District of Alaska, and for other purposes,' shall not apply to mineral lands or town sites.

"Sec. 19 No act passed at the first session of the Thirty-eight Congress, granting lands to states or corporations to aid in the construction of roads or for other purposes, or to extend the time of grants made prior to the thirtieth day of January, eighteen hundred and sixty-five, shall be so con-

strued as to embrace mineral lands, which in all cases are reserved exclusively to the United States, unless otherwise specially provided in the act or acts making the grant.

"Sec. 20. No possessory action between persons, in any court of the United States, for the recovery of any mining title, or for damages to any such title, shall be affected by the fact that the paramount title to the land in which such mines lie is in the United States; but each case shall be adjudged by the law of possession.

"Sec. 21. The Secretary of the Treasury is hereby authorized and directed to pay, out of the moneys heretofore or hereafter covered into the Treasury from deposits made by individuals to cover cost of work performed and to be performed in the offices of the United States Surveyors General in connection with the survey of mineral lands, any excess in the amount deposited over and above the actual cost of the work performed, including all expenses incident thereto for which the deposits were severally made or the whole of any unused deposit; and such sums, as the several cases may be, shall be deemed to be annually and permanently appropriated for that purpose. Such repayments shall be made to the person or persons who made the several deposits, or to his or their legal representatives, after the completion or abandonment of the work for which the deposits were made, and upon an account certified by the surveyor general of the district in which the mineral land surveyed, or sought to be surveyed, is situated and approved by the Commissioner of the General Land Office.

"Sec. 22 Where by special act of Congress land has been opened to exploitation under the mineral land laws of the United States but subject to any special limitation or condition expressed in such special act, this act shall not be construed as waiving such limitation or condition.

"Sec. 23. So much of the act of August fourth, eighteen hundred and ninety-two (Twenty-seven Statutes at Large, page 348) as provides for the entry of lands chiefly valuable for building stone under the provisions of the law relating to placer mining claims is hereby amended by striking out the word 'placer' and hereafter this act shall be substituted for the placer mining law in the making of such entries:

"Sec. 24. The provisions of this act shall not apply to public lands in the states of Michigan, Wisconsin, Minnesota, Missouri, Kansas, or Alabama.

REPEALING SECTION

"Sec. 25. The following sections of the Revised Statutes, that is, Section 2320, relating to the size of lode claims; Section 2322, relating to rights in mining claims; Section 2323, relating to tunnel rights; Section 2338, relating to rights initiated prior to May tenth, eighteen hundred and seventy-two; Section 2329, providing for the location of placer claims; Section 2330, relating to placer claims; Section 2331, relating to the survey and segregation of mineral lands; Section 2332, relating to claims held for a statutory period and to liens on claims; Section 2333, relating to the patenting of placer claims; Section 2336, relating to intersecting veins; Section 2338, relating to state rules for working mines; Section 2341, relating to pre-emption and homestead entries of

lands designated as mineral lands; Section 2342, relating to the designation of agricultural lands; and Section 2344, relating to rights acquired under prior existing law; also the act of Congress approved June sixth, eighteen hundred and seventy-four (Eighteen Statutes at Large, page 61) relating to expenditures of labor and improvements on mining claims; and the act of Congress approved February eleven, eighteen hundred and seventy-five (Eighteen Statutes at Large, page 315) relating to tunnel work, are hereby repealed: Provided, that nothing contained in this act, except as expressly provided, shall be construed to affect any right heretofore initiated."

Mesabi Operators Refuse To Pay Village Tax

Oliver, Shenango and M. A. Hanna Companies Claim Part of Chisholm Levy Is Illegal—Interesting Fight Expected

Three iron-mining companies owning property in the village of Chisholm, Minn., on the Mesabi Range, have refused to pay in full the real-estate tax levy of the village as of November, 1920, on the ground that a part of it was unauthorized and illegal. The companies in question, namely, the Oliver Iron Mining Co., the Shenango Furnace Co. and the M. A. Hanna Ore Co., offered to pay the state, county and school district levy, which was a little less than half of the total assessment, but the treasurer of St. Louis County stated he could not accept any part payment of the tax.

The assessment against real estate by the village for all village purposes was 32.7 mills in 1919, as compared to 50.2 mills in 1920, an increase of 17.5 mills. The total number of mills levied against the mining companies by the state, county, village and for the school district was 92.1 mills divided as follows: Village of Chisholm 50.2 mills; school district; 26.5 mills; St. Louis County, 9.98 mills, and the State of Minnesota, 5.42 mills. The Oliver Iron Mining Co., with a total assessment of \$625,000 against it, offered to pay \$301,569.56; the Shenango Furnace Co., with a total assessment of \$22,000, offered to pay \$10,000, and the M. A. Hanna Ore Co. offered \$10,000 exclusive of the tax levied against it by the village.

The mining companies contend that 20 mills is the limit the village can levy for its general fund, and this has not been exceeded in this particular fund, but other departments were created which were not authorized, therefore creating unlawful levies. The companies were not explicit in their charges and stated that the matter probably would be taken to the courts if the village does not make a change.

Arrested for Amalgam Theft

C. J. Sinclair, of Denver, Col., was arrested on May 25 at Deadwood, S. D., charged with the theft of amalgam from the Homestake Mining Co.'s mills at Lead. It is said that the thefts extend over a period of ten years.

Dardanelles Mine at Chloride, Ariz., Opened Rapidly

Over 12½ per Cent of Initial Expense Already Returned by Ore From Development and Exploration

The property of the Dardanelles Mining Co., embracing five claims covering about seventy-five acres and known as the Memphis group, lies about one mile north-northeast of Chloride, Ariz., on the western slope of the Cerbat Range. Numerous veins pass through the claims, and the activity of the early prospectors is shown by a dozen or fifteen shallow shafts, pits, and adits. In none of these was found sufficient encouragement for more thorough development. Portions of the surface are covered by a deep gravel wash. This

Preliminary examination and trenching disclosed a promising vein running practically north and south through the ground. Apparently this vein had produced ore beyond the limits of the Memphis group in both directions. Further trenching uncovered a branch vein striking toward the large vein with the probable intersection or junction under the gravel wash.

A shaft was started, with windlass, at about the point of intersection. Bedrock and vein matter were encountered at a depth of 26 ft. At 50 ft. there was a considerable flow of water, and at that stage a 15-hp. gasoline hoist and 30-ft. headframe were installed.

The first station was cut at the 100 level. The water flow at this point was about 20,000 gal. per twenty-four hours, which was handled with a bailer.



SHAFT AND DUMP, DARDANELLES MINING CO., NEAR CHLORIDE, ARIZ.

was responsible for the part now being worked escaping the attention of later-day miners. Several years ago the group was taken over by Anna E. Durkee, through whose efforts a company was formed and financed, Etienne A. Ritter, of Colorado Springs, having made a favorable report on the property.

In a district notorious for complex ores and known as a producer of lead-silver, the Dardanelles has proved the existence of an orebody whose values are in gold with some silver and practically no lead and zinc. Active work was begun in October, 1919, and has continued to date without interruption. The ore from development and exploratory work at a comparatively shallow depth that has been shipped to the smelter has thus far returned over 12½ per cent of the amount spent in opening up the property. The company has accomplished a large amount of development work in a short time and at comparatively small outlay. Operations have been in charge of S. Ford Eaton, the engineer and manager. H. L. McCarn is consulting engineer. The necessary financing has been accomplished privately. The company maintains no office.

A 12-ft. crosscut to the west tapped the spur vein and opened up a lens of ore 30 ft. wide. Samples of this ore assayed as high as \$60 per ton in gold and silver, with no zinc and lead. This particular lens of quartz ore in the vein matter was found to be about 25 ft. long and averaged 20 in. in width. A small quantity of this ore was shipped.

Drifts were then driven north and south on this spur. About 50 ft. to the south the junction with the main vein came into evidence. Crosscutting there showed the vein matter to be 20 ft. wide, with broad bands of high-grade occurring throughout nearly the entire width. From these lenses samples ran as high as \$334 in gold and silver. From the development work on the level in this shoot three carloads of ore were shipped to the smelter. Returns showed a value of about \$50 per ton. This ore shoot proved to be about 40 ft. long. Continued drifting both north and south on the 100 level opened up no more ore shoots, but proved the continuity of the vein.

In July, 1920, a gasoline-driven plunger pump was added to the equipment, and sinking was resumed. Water increased steadily, until at a depth of

180 ft. the daily flow was about 80,000 gal. The handicap with the small equipment being too great for further sinking, a level was started at the 160-ft. mark.

Thirty feet of crosscutting to the west brought the face into the vein at a lean portion. A drift to the south, however, entered the main ore shoot at 75 ft. Crosscutting showed up vein matter for a width of 18 ft., with high-grade lenses similar to those on the 100 level in evidence. The south drift has been advanced a total of 270 ft., showing the vein structure to be consistent.

A raise was driven to the 100 level in the main ore shoot. Two sublevels proved the continued occurrence of

double-compartment shaft. This will be used as the permanent working shaft.

According to H. L. McCarn, the formation at the Dardanelles is granitic, gneissic and schistose phases predominating, with hornblende (?) as the main dark silicate. As a whole, schist is the dominant rock, but acidic bands and segregations are common, though, on the other hand, portions of the formation approach amphibolite in denseness and basicity.

Close folding and strain are noticeable, and along the main fissure, opened by the work in progress, crushing and movement are evidenced in a most pronounced manner. No post-mineral faulting—at least no marked displacement of ore streaks—has been observed, but the oblique and lateral movements previous to ore deposition have permitted much irregular mineralization to extend out into the country rock adjacent to the vein.

The metallic values are found in a fine-grained pyrite, slightly cupriferous, with galena and blende in almost negligible amounts, and more or less vein quartz. These minerals have replaced susceptible portions of the strained rock. In much of the ore, replacement of the sinuous bands of the schist by a fine bronze-like pyrite, with little or no secondary quartz, is characteristic, and such ore is usually rich both in gold and silver. The replacement and preservation of the schistosity or other original or induced structure (extending even to the minute texture of the rock), and the conversion of the rock into high-grade ore make this an interesting type of replacement orebody.

In parts of the vein where there has been less movement and crushing there is a larger development of secondary or vein quartz with disseminated pyrite and arsenopyrite. This ore, usually of lower grade than the "soft" ore to which reference has been made, is probably due, in part at least, to the more common processes of vein filling. Where the quartz is dark in color the gold contents are greater.

The course of the vein on which the principal work has been done is approximately N. 25 deg. W., with easterly dip averaging between 70 and 75 deg., but changes in dip and the influence of intersection fractures cause curves in the horizontal plane of the vein. In most places the foot wall is well marked, and when the vein is not more than five or six feet wide the hanging wall is sometimes definite, but where the replacement is most intense ore has been found to extend into the hanging wall a distance of 15 ft.

Independents Cut Wages in Lake Superior District

10 Per Cent Reduction Makes Scale 5 Per Cent Lower Than That Paid by Oliver Company

All independent iron mining companies in the Lake Superior district have posted notices of a decrease in wages of 10 per cent for all labor, effective from June 1. This decrease, combined with the one of Feb. 1 for 15 per cent, makes a total of 25 per cent. Wages have therefore declined from peak prices of \$5.33 to \$4 a day at present, the latter also being the rate of pay in the latter part of April, 1918.

This decrease brings the scale of wages paid by the independent mining companies 5 per cent below that established by the Oliver Iron Mining Co. which took effect May 16. Salaried men were not affected by this last cut, as their wages had not risen in proportion to those of labor.

Great Lakes Ore Transportation Rate Fixed

The transportation rate on iron ore on the Great Lakes has been fixed on a basis of 80c. a ton free from port at the head of Lake Superior. On this basis the carrying charges will be 72c. from Marquette, 60c. from Escanaba to Lake Erie ports, and 48c. from Escanaba to South Chicago. The charges for this season are the same as in 1919, but much lower than they were in 1920, when the season chartering was done on a basis of \$1.10 free from port from the head of Lake Superior.

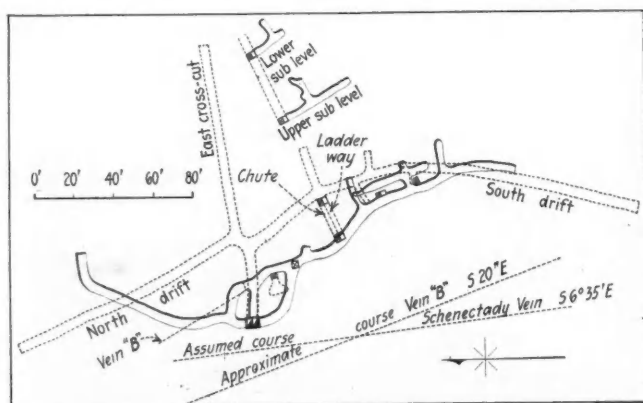
Utah Apex Files Exceptions to Utah Con. Accounting

The Utah Apex Mining Co., of Bingham Canyon, Utah, has filed exceptions to the accounting of the Utah Consolidated Mining Co., for ore extracted from disputed ground, claiming a value of \$1,180,937 for ore extracted thus interest of \$240,530, making a total of \$1,421,467. This is in comparison with figures compiled by the Utah Consolidated showing \$658,986 for ore extracted plus interest.

Utah Compensation Rating Bureau Appointed

A compensation rating bureau has been created in Utah, which is to cooperate with the state industrial commission in fixing rates and other duties. Classifications and rates as published by the National Council on Workmen's Compensation Insurance have been adopted by the commission as standard rates for insurance companies operating in Utah, carrying workmen's compensation.

The imports of magnesite averaged 3,797 tons monthly over a period of ten months ended with April. During April the imports were 326 tons. During March the imports were 6,931 tons, but the total imports during 1920 were 43,154 tons, an average of practically 3,500 tons monthly.



MAP OF 100 AND 160 LEVELS, DARDANELLES MINE

high-grade lenses and considerable milling ore. Several more car lots were shipped, and the ore held well above the \$40 mark.

A drift has been driven to the north in the vein on this level for 150 ft. In this working the vein has averaged 5 ft. in width. General samples run from \$4 to \$20 per ton in gold and silver. In the last 40 ft. the vein matter has widened considerably, values in the lenses running as high as \$300 per ton.

A raise has been started on the foot-wall quartz. The last three samples taken from 30 in. of this quartz ran \$31.60, \$57.20, and \$61.40, respectively. Development work to date includes a 180-ft. shaft, 800 ft. of drifting, 170 ft. of raising and 250 ft. of crosscuts.

A partial analysis of the last car lot of ore was: Gold, 1.45 oz.; silver, 14.85 oz.; lead, none; zinc, 1.3 per cent; copper, trace; insoluble, 66.6 per cent; sulphur, 7.6 per cent, and iron 9.2 per cent. The values are distinctly associated with the iron, making the ore amenable to concentration.

On the 160 level the vein has been opened up for 400 ft., being 3 to 18 ft. wide, with two pronounced shoots carrying high-grade lenses. The work has been done with gasoline power and hand steel. Working conditions are good. The ground is somewhat inclined to cave, but if promptly timbered holds well. Labor troubles have been conspicuous by their absence. The company plans to install complete electrical equipment and to sink a large

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Federal Department of Mines Proposed

Senator Nicholson Introduces Bill Seeking Proper Recognition of Mining Industry's Importance—Cabinet Representation a Feature

With the introduction on June 6 by Senator Nicholson, of Colorado, of a bill (S 1957) to establish a department of mines the first gun has been fired in the campaign which has for its object the securing of recognition on the part of the Federal Government commensurate with the importance of the mining industry. Mining and agriculture constitute the country's basic industries. Agriculture long has had representation in the Cabinet of the Chief Executive. Senator Nicholson believes that the time is ripe to make another effort with the object of securing equal recognition for the mining industry.

The Nicholson bill recites that the scope of the department shall include all the metal-mining industries, and all the non-metallic mining and quarrying activities. The coal, petroleum and gas industries are also to be included in the department.

The department of mines, as proposed by Senator Nicholson, is to be made up of four bureaus and three divisions. One bureau will be that of mining technology, which will cover the field now regarded as that of the Bureau of Mines. A bureau of mining and applied geology will handle the work now being done by the Geological Survey. A bureau of the public mineral domain would have as its field "the classification of public lands, the carrying out of the mineral leasing regulations, the recording of mineral claims and the granting of patents and all other similar activities pertaining to the public domain." The fourth bureau is one of mineral markets, which would have as its function "the investigation of the problems of marketing the crude metals and mineral products of the United States." The bill specifies that this bureau's study is to include foreign as well as domestic markets.

The three divisions proposed in the bill are to be responsible directly to a secretary of mines. They are to be known by the following names: "Mineral Statistics," "Publications," and "Accounting and Disbursing."

In addition to the taking over of the Bureau of Mines and the Geological Survey, the General Land Office, and the War Minerals Relief organization are to be absorbed in the proposed department.

Alaska Legislature Makes Recommendations to Washington

Resolutions by the Legislature of the Territory of Alaska have been presented by the Vice-President to the Senate with the following objects in view: Establishment of Government radio stations at various points convenient to mining and oil districts; an amendment to the mining law allowing dredging or hydraulicking of mining claims by groups; substitution of road work for the assessment fee on unpatented mining claims; an appropriation which will enable the Geological Survey to determine more exactly the extent of coal, oil, and other mineral resources in Alaska; dependable ocean transportation for ores and other Alaska products; an investigation by the Federal Trade Commission as to smelter charges and practices at the Tacoma smelter; and change of the assessment work year to a fiscal, rather than an annual basis.

Arno C. Fieldner Appointed Head of Pittsburgh Station

The important post of superintendent of the Pittsburgh station of the U. S. Bureau of Mines has been filled by the appointment of Arno C. Fieldner. Mr. Fieldner has been the acting superintendent of the station since June, 1920. An administrative assistant will be employed, so that Mr. Fieldner may carry on the greater part of his research work. He will continue to discharge the duties of supervising chemist. As superintendent, Mr. Fieldner will receive a salary of \$5,000.

While Mr. Fieldner has demonstrated that he has unusual executive ability, he has been disinclined to accept an administrative position. Former Director Cottrell, of the Bureau of Mines, and Director Bain each has been anxious that Mr. Fieldner should continue uninterruptedly on his research work. A determined effort has been made to secure a properly qualified person, other than Mr. Fieldner, for the position. The difficulty is, however, that such engineers are unwilling, or are not in a position, to make the sacrifice.

Mr. Fieldner formerly was a member of the U. S. Geological Survey. He went with the Bureau of Mines the time its work was separated from that of the Geological Survey. During the war, he was transferred to the Chemical Warfare Service, where he attained the rank of major. On June 13, 1919, he was re-transferred to the Bureau and was made supervising chemist at Pittsburgh. Since the promotion of E. A. Holbrook to be assistant director of the Bureau, Mr. Fieldner has acted as superintendent at Pittsburgh.

One-Man Administration Likely for War Minerals Act

Secretary Fall Offers Position to Ira E. Robinson, Lawyer, of West Virginia

In all probability the administration of the War Minerals Relief Act will be lodged in the future in a single individual. It is understood that Secretary Fall has tendered this position to Ira E. Robinson, of Grafton, W. Va. It is Secretary Fall's desire to complete at the earliest possible moment the settlement of all war minerals claims. As most of the work in this connection has been done, he believes that it will be unnecessary to continue the commission form of administration.

Secretary Fall has pointed out the possibility that the existing law may be capable of more liberal interpretation than was accorded it by the commission appointed by his predecessor. This doubtless accounts for his desire to place this work in the hands of an attorney of learning and reputation, such as is Mr. Robinson.

Mr. Robinson was born in 1869. He began the practice of law in Grafton in 1891. He was a member of the Senate of the West Virginia Legislature from 1902 to 1904. In 1907 he was appointed a judge on the bench of the Supreme Court of Appeals of his state. He attained the rank of Chief Justice in 1910, a position he retained for five years. Since that time he has devoted his chief attention to lecturing before the West Virginia University College of Law. Mr. Robinson is known nationally as a result of his contributions to legal periodicals. As this is written, Mr. Robinson has not indicated his acceptance of the position tendered him by Secretary Fall.

Appropriation Allowed To Aid Non-Metallic Industry

Committees Approve of Allotting \$35,000 for Scientific and Technologic Investigation

The Bureau of Mines will receive a supplemental appropriation of \$35,000 for "scientific and technologic investigations concerning the mining, preparation, treatment, and utilization of heavy clay products, cement, feldspar, slate, and other non-metallics." The item was not seriously questioned in the House, but the Senate committee eliminated it from the bill. The committee was urged by Senators Pomerene, of Ohio; Underwood, of Alabama, and McNary, of Oregon, to allow this assistance to be extended to the non-metallic industries and finally withdrew objections.

NEWS BY MINING DISTRICTS

London Letter

East Rand Proprietary's Serious Position—Naraguta Tin Mines Issues Report on Company's Gold Operations

BY W. A. DOMAN

London, May 24—Kept alive for more than a year past by the high price of gold the East Rand Proprietary Mines is now beginning to show the red light. Not that the danger signal was invisible before, but the time has arrived when some definite step must be taken in regard to the future. The management have never concealed the seriousness of the position, either from themselves or the shareholders. They have indicated the difficulties, and in some respects the shareholders used to think the bad points were over-emphasized.

The gold "premium" benefits no longer. It scarcely meets the increased costs that were stuck on by everyone when the embargo on selling was lifted. The Union Government does not like the idea of the mine closing down, as in addition to loss of revenue there would be industrial and economic troubles. A committee therefore was appointed to study the question. The only conclusion it seems to have reached is that the life of the mine could probably be prolonged for a time—beyond nine months now suggested—if the East Rand Proprietary be amalgamated with the Cinderella Consolidated and the Witwatersrand Deep, two neighboring properties.

It is all a question of working costs. The ore is there, but the gold cannot be economically extracted at the present level of working expenses. The Cinderella and the Witwatersrand Deep are somewhat as broken reeds, though the former cannot be said to have had a fair chance. It ran up against the East Rand Proprietary Mines seven or eight years ago in regard to the question of pumping, and as agreement could not be reached and funds ran out the Cinderella ceased operations. The East Rand Proprietary Mines is now feeling the burden of water, and last year spent nearly £110,000 in keeping the mine clear. It is suggested that the government should subsidize the company to the extent of the pumping charges. No decision has yet been reached. If an amalgamation of the three companies should be carried through it would entail a tremendous scaling down of capital. The following table shows how the matter stands:

	Cinderella	E. R. P. M.	Wit. Deep
Issued capital	£1,159,450	£2,445,897	£550,000
Debentures...	£500,000	£693,780	.....
Rate of interest	5½	5	.....
No. of claims..	2,101	4,412	420
Ore reserves, tons.....	466,500	2,410,850	1,018,390
Value, dwt....	7.1	6.1	6.3

Full details of the scheme have not yet reached this side; it is obvious however that not one of the companies has anything like the number of workable claims shown above.

The Naraguta (Nigeria) Tin Mines has issued a report by Clyde Allan, a member of the Institution of Mining and Metallurgy, and supported by F. O. D. Bourke, the general manager, dealing with the gold discoveries on the company's property. Although reference has been made to alluvial gold in the past, it is only now that anything like real importance seems to be attached to gold at all. One of the company's properties is called Birnin Gwari, and here both alluvial and lode gold is found. Hitherto attention has been confined to the alluvial, but the deposit has proved disappointing, and operations have been concentrated on the lode. In one spot at a depth of 6 ft. below the surface some "good-grade ore" was cut. The description is by no means definite. A shaft "A" was sunk to 50 ft., or 2 ft. below water level, and a crosscut put out to the east cut the shoot which had dipped out of the shaft at 35 ft. The shoot was 12 ft. wide and ranged in value "from 3 dwt. to 10 oz. per ton," the value at water level being much higher than near the surface. Water was too strong for the shaft to be sunk below 60 ft., but a sample obtained at this depth showed 30 dwt. The shoot "is not very long," but "everything points to it lengthening as it goes down." From the shoot at 50 ft. 14½ cwt. of ore yielded 8 oz. gold. Though there is nothing at the moment to enthuse about, owing to the vagueness of the report, the results obtained are to be considered as distinctly encouraging.

I learn that the Central Mining & Investment Corporation report, which is about to make its appearance, will show that if it had not been for the gold "premium" the whole of the group of companies which the Central Mining controls would have shown a small loss last year—taking crushings in the aggregate. The important item is that of wages.

AUSTRALIA

Queensland

Mount Morgan Must Cut Wages 25 Per Cent to Break Even—Accountants Verify Company's Statements

Brisbane, April 30—Mount Morgan, the last of the copper-producing companies in Queensland and the last but one in Australia to cease operations, has now been closed for nearly six weeks, and is still inoperative. The company said there must be a reduction of 20 per cent in wages before it can carry on. The matter was referred to

the Industrial Arbitration Judge, who, at the men's request, appointed two mining accountants to examine the books of the company, and these experts have just made their report, which more than bears out what the company has said. In a few days a ballot is to be taken by the employees to decide whether they will accept the proposed reduction and go to work or allow the mine and works to remain idle indefinitely.

CANADA

British Columbia

Sale of Standard Silver-Lead Said To Be Arranged

Silverton—It is understood that negotiations have been completed providing for sale of property here of the Standard Silver-Lead Mining Co., to at present unknown interests. The consideration involved is reported as \$75,000. The Standard's holdings consist of a number of Crown granted claims, extensively developed, and which rank among the premier dividend-paying operations in the province, shareholders having realized about \$2,700,000 in profits since operations under company account were begun over ten years ago. The immense bonanza orebody, noted for its high-grade silver-lead contents, appeared near exhaustion a year or so ago, and since that time activity has gradually dwindled until latterly a few lessees have been stopping out small bodies of ore not considered sufficiently large to mine under company account. There yet remains an extensive tonnage of low-grade zinc-bearing ore in some of the lower levels. The milling plant is complete, possessing a larger capacity than any other mill in the Slocan. It is understood the present arrangements are subject to ratification by shareholders at a special meeting to be held later.

Salmo—Following the amalgamation of Motherlode and Nugget mines under a plan of operation providing for the milling of Nugget ore by the Motherlode mill, operations that began May 1, have since been maintained, about eighty tons per day being handled.

Stewart—Labor trouble, growing out of a reduction of wages, has stopped work at the Premier mine, in the Salmon River district. Dale L. Pitt, the manager, recently announced a cut which would make the pay as follows: Miners, \$5.50 a day; muckers, \$5; laborers, \$4.75 and \$5. The men claim that this is too drastic a change, that it means a reduction ranging from 75 cents to \$1.25 a day, and that there has not been a corresponding drop in the board and lodging charge of \$1.25 a day. According to reports, the men held a meeting at Stewart to voice their

protest and to organize for a strike. Resolutions were passed providing for housing the strikers and for picketing the road to the mine. It was also decided that no freight for the Premier would be handled at the dock and that the workmen on the tramway would be interviewed. The mill crew and the tram workers, from last advices, are not affected. Two hundred tons of ore was shipped south by the "Prince Albert," which left Stewart some time ago, the same having been loaded by men who had not joined the strike.

Trail—Ore shipments received at the Consolidated smelter during the week ended May 31 were as follows:

Mine	Locality	Tons
Chatterboy	Danville, Wash.	53
Knob Hill	Republic, Wash.	35
Last Chance	Sandon	47
Company Mines		7,783

Ontario

Several Gold Discoveries Made Recently in Northern Part of Province

During the last few weeks several gold discoveries have been made throughout northern Ontario, and there is a great deal of activity in the bush. More prospectors are out than at any time in the last two years, owing to the lower costs of supplies, and particularly to the great interest being taken in gold properties.

Cobalt—During the week ended May 27 the La Rose Mines was the only shipper from Cobalt, sending out 84,000 lb. of concentrates.

Porcupine—It is understood that for the fiscal year ending June 30, the McIntyre Gold Mines, of Porcupine, will show an increase of about \$1,000,000 in ore reserves. Last year the average of the ore reserves was \$11.13 a ton.

Development work is being pushed on the Crown vein of the North Crown Mines, in Porcupine, but the mill will not be reopened until a sufficient supply of ore is assured for continuous operations.

The Marcus Daly Estate, through its representative, James W. Gerard, former American ambassador to Germany, has obtained the control of the Goldale Mining Co. C. H. Poirier, of New York, has concluded his examination of the company's properties and is now arranging for beginning mining operations.

The Hollinger Reserve, lying west of Hollinger Consolidated, has been purchased by a syndicate headed by E. A. Osler & Co., of Toronto. The new company to be organized will be known as the McEnaney Gold Mines.

At the Vipond meeting last week no definite progress was made in the matter of raising funds for reopening the property. A committee has been appointed to study ways and means for raising money and to take the necessary steps.

It is stated that arrangements have been made to finance the reopening of the Miller-Independence property in Boston Creek. An issue of \$50,000

bonds has been partly subscribed for by the shareholders.

Larder Lake—The mill of the Larder Lake Gold Mines was recently destroyed by fire, with a loss of \$60,000. It will be rebuilt, and some new equipment has already been bought.

Kirkland Lake—It is expected that by the middle of June cement will be poured for the foundations for the new Ontario Kirkland mill. The first deliveries of machinery will be made within a few days.

MEXICO

Coahuila

La Parrena Company Shuts Down San Salvador and Encantada Mines—Work Stopped in La Constanca

Sierra Mojada—The American Smelting & Refining Co. is carrying on development work in the San José mine and is retimbering the shaft in the Fronteriza mine, on which a lease has been renewed. Between fifty and sixty men are employed. W. B. Gates is superintendent.

The Cia. Minera La Parrena has suspended work in the San Salvador and Encantada mines because of the decline in price of silver and lead. An exploratory crosscut is being extended toward the contact to the north in the Almaden mine for the purpose of locating the extension of the Trinidad orebody toward the west of the Trinidad mine. The Cia. Minera de Peñoles owns a 50 per cent interest in the Parrena company. I. Ragaz is in charge.

Operations have been suspended in the properties of the Cia. Minera La Constanca since the decline in prices of silver, copper, lead, and zinc. Two 500-cu.ft. cross-compound two-stage steam-driven Ingersoll-Rand air compressors have just been received by the Constanca company, together with full equipment of air drills and other machinery. S. F. Shaw is general manager.

Operations have been suspended at the Veta Rica mine, belonging to the Cit. Metalurgica Mexicana. T. A. Hilbert is superintendent.

ARIZONA

Phelps Dodge To Deepen Two Shafts—C. & H. Completes Headframe at Cole No. 3 Shaft

Bisbee—Some new development work is being started in the Warren district by the Phelps Dodge Corporation. The White Tailed Deer shaft in the Don Luis section is to be sunk further, and additional prospecting is to be done from the deepened shaft.

The Cuprite shaft is to be deepened. The present bottom is at the 300 level. The first operation will be to raise from the 400 level to the 300. When this connection has been made, sinking will be carried below the 400 level. The hoisting equipment has been moved from the Uncle Sam shaft and installed at the Cuprite.

The Calumet & Arizona Mining Co. has finished the erection of a new headframe at the Cole No. 3 shaft. A small amount of repair work is being done in the shaft. After this has been completed a station will be cut at the 500 level and drifts started. No work has been done in this shaft for years. Certain surface showings in the vicinity and the development of ore on the Boras claim near Cole No. 3 ground make prospecting particularly desirable.

The Boras Leasing Co. has cut 20 ft. of high-grade sulphide ore in an intermediate drift 60 ft. above the 700 level. This ore is the downward extension of the sulphide stope on the 600 level. Connection of this intermediate has been made with the winze in which the Night Hawk Leasing Co. recently opened up some high-grade chalcopirite and bornite ore.

The Night Hawk company has resumed sinking of the winze on the Lone Star fraction. The winze continues in good ore.

Jerome—Joseph Irving is engaged in testing the ores of the Dundee-Arizona company to determine their amenability to a leaching treatment.

Duncan—The property of the Duncan Mining & Milling Co. will be sold to the highest bidder, under receivership sale, at the property on July 2. The sale must bring at least two-thirds of the appraised value, which is \$49,000. Assets besides the mine consist of a complete new cyanide mill and complete mining equipment.

H. W. Evans, formerly of the Duncan M. & M. Co., has purchased the lease on the Norman King mine held by Utter brothers. A small force is working.

NEW MEXICO

New Strike of Torbernite Ore Reported at White Signal

White Signal—A strike of torbernite has been made in a claim owned by Dr. S. S. Warren, of Deming, and Willard Holt, of Lordsburg. The vein is 8 in. to 2 ft. wide. A 100-lb. test sample has been sent to the Bureau of Mines at Tucson.

Fierro—A gold strike is reported from Cactus Flat, where Charles Schafer has opened a big quartz vein in rhyolite about half a mile west of the Silver City stage road. Some tellurium is reported. H. A. Hoover, of El Paso, and E. D. McIntosh, of Mogollon, are interested.

Chloride—It is reported that the Silver Monument mine has placed a contract for a 100-ton concentrating-flotation mill with the El Paso Foundry & Machine Co. E. R. Hutchens, formerly of White Oaks, N. M., is manager.

Tonuco—Ben Farrer, Basil Prescott, and William Fink, of El Paso, have taken a lease on the Tonuco fluorspar property. Ten men are working. William Fink will be in charge.

COLORADO

Interesting Ore Occurrence in Hope Company's Tunnel

Aspen—The Hurricane Leasing Co., operating the mines of the Hurricane M. M. & L. Co., have not suspended operations at any time in the last five years. The statement to the contrary in the issue of March 16 was erroneous, according to the company.

The ore discovered in the tunnel of the Hope Mining, Milling & Leasing Co. occurs in the Weber formation, west of the quartz porphyry, in the same *loci* as the ore of the Annie mine at higher altitude. The peculiar feature is that it occurs as wire silver, intermixed with sulphide in the form of polybasite at a vertical depth of 1,600 ft. or 2,200 ft. along the pitch of the vein.

UTAH

Cardiff Hauling Down Big Cottonwood From Lower Bins—Contract Squabble Cuts Park City Shipments

Salt Lake City—The Cardiff has begun hauling ore down Big Cottonwood Canyon from its lower bins, where about 2,000 tons is stored. The road to the mine from the lower bins will not be open before July.

Park City—Shipments for the week ended May 27 amount to 993 tons as compared with 1,651 tons the week preceding. This was due to the absence of ore from the Silver King coalition and Daly West mines, which are engaged in a controversy with the American Smelting & Refining Co. over ore contracts. Shippers were: Ontario, 438 tons; Judge allied companies, 555 tons.

Eureka—Ore shipments for the week ended May 27 amounted to 123 cars, as compared with 128 the week preceding. Shippers were: Tintic Standard, 39 cars; Chief Con., 36; Dragon, 12; Iron Blossom, 7; Iron King, 6; Eagle Blue Bell, 5; Victoria, 3; Gemini, 2; Eureka Bullion, 1; Eureka Hill, 1; Little May, 1; Swansea, 2.

NEVADA

Wages Cut on Comstock Lode June 1—Candelaria To Start Building New Cyanide Plant—Conditions Unchanged at Tonopah

Mina—The Mina Mercury Co. is installing two "D" retorts, with a combined capacity of 3,000 lb. of ore daily, at its mine near Mina. The ore runs about 10 per cent mercury. Wood is to be used as fuel at present, but oil-burning attachments are to be installed later.

Virginia City—In accordance with signed agreement between operators and unions, wages were reduced at both Virginia City and Gold Hill on June 1. By the new scale miners receive \$5 per day and muckers \$4.50.

Alex Wise has resigned the superintendency of the North End Group and

will be succeeded by the president, J. B. Kendall.

Rochester—The rumor that the employees of the Rochester Silver Corporation had gone on strike again has been officially denied. Mine and mill are running to capacity. Wages for underground men at present are: Miners \$5.50 and muckers \$5 per day.

Tonopah—Strike conditions in the Tonopah and Divide districts continue unchanged. The companies are still importing men from outside districts and making an attempt to resume operations. On May 26 all shift bosses of the Tonopah Mining Co. refused to take charge of the strike breakers underground and quit their positions. This act has served to encourage the strikers, although it is generally considered by conservative men that it will tend to hasten the possibility of an indefinite shutdown.

On May 24 Governor Boyle held independent meetings with the operators, strikers, and business men. He expressed himself as believing that a wage reduction is inevitable and urged the strikers' committee to permit a secret ballot by the mine workers as a whole to decide whether or not they would be willing to return to work at the reduced wage, and asked that he be allowed to address the men in open meeting. The following day the meeting was held, but in the meantime the radical element, encouraged by protests from men employed by companies operating under the old wage scale, changed their minds entirely, and the meeting became a farce. A rising vote was used instead of a secret ballot, with the natural result that it was unanimously decided to stay out, and the meeting was purposely adjourned without giving Governor Boyle opportunity to address the men.

SOUTH DAKOTA

Homestake Dividends Likely To Be Increased—Clover Leaf Under Option to Talbot Associates

Lead—Dividends amounting to 25c. per share have been received by stockholders of the Homestake company for the month of May. This is the first dividend paid by this company since September, 1919, and is a forerunner of regular monthly distributions. In all probability the dividends will be increased until the regular dividend of 65c. per share, which was paid before the war, will again be paid stockholders. The property is operating at full capacity.

Deadwood—An option has been taken on the Clover Leaf property at Roubaix by E. W. Talbot and associates, of Deadwood, from the owner, Mrs. Wibaux, of Paris. This property comprises about 800 acres of mineral ground on Elk Creek, eight miles southeast of the Homestake. It is equipped with a hoist, compressor, and a 240-ton stamp mill. It is considered one of the better mining propositions in the Black

Hills. Up to 1904 it was a regular producer of gold, and is credited with a production of several million dollars. It has been idle for seventeen years owing to a change in ownership. Heretofore it has been impossible to secure an option, the owners asking a cash sale price. The new organization will start work immediately under the direction of E. W. Talbot, who had charge of the Millikin interests' operations in this section until work was suspended several years ago. The present mine and mill equipment will be electrified and modernized. Diamond drilling will be started to prospect the known ore-bodies as well as new territory, and this will be followed by the unwatering of the underground workings and extensive mining operations. The mine is very wet, and suitable pumps will be installed to handle the water. It is also probable that the creek which passes near the shaft will be diverted.

Chronology of Mining

May, 1921

May 1—A. S. & R. Co. cut executives' salaries 20 per cent. "Porphyry" copper companies make effective further wage cuts, likewise companies in the Coeur d'Alene district, Idaho, and on the Mother Lode in California. United Verde Extension smelter at Jerome, Ariz., closed down.

May 4—Rochester Silver Corporation in Nevada put into effect 50c. wage cut resulting in strike of 120 employees; men returned, accepting cut, May 11.

May 5—Anaconda Copper Co. resumed limited mining of silver-zinc ore at Butte, Mont.—Oliver Iron Mining Co. began loading ore for shipment.—Jerome Verde Copper sold to Jerome Verde Development Co., controlled by United Verde Extension.

May 6—Mining companies in Slocan district, British Columbia, cut wages 75c.

May 8—Blast furnace of Gulf States Steel Co., Birmingham district, Alabama, resumed operations.

May 9—American Zinc Institute held annual meeting at St. Louis, Mo.

May 10—H. Foster Bain confirmed by Senate as Director of U. S. Bureau of Mines.

May 15—Phelps Dodge Corporation closed offices at Douglas, Ariz.

May 16—Wages cut 20 per cent by Oliver Iron Mining Co. and other U. S. Steel Corporation subsidiaries. A. I. M. E. organized Philadelphia Section.

May 20—Reduced freight rates on Pioche, Nev., high-grade ores became effective, to continue until Nov. 15, 1921.

May 31—Arizona Copper Co., Ltd., closed mines and smelter.—Interstate Commerce Commission, sitting at Chicago, heard complaints by Lake Superior Iron Ore Association concerning freight rates on iron ore in Michigan, Wisconsin, and Minnesota.

THE MARKET REPORT

Daily Prices of Metals

June	Copper, N. Y., net refinery*		Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.	
2	13 @ 13.125	30.25	31.25	4.75	4.60	4.60@4.65	
3	13 @ 13.125	29.75	30.50	4.75	4.60	4.55@4.60	
4	13 00	29.50	30.25	4.75	4.60	4.50@4.55	
6	12.875@ 13	28.875	29.50	4.625@4.75	4.50	4.50@4.55	
7	12.75 @ 13	28.625	29.375	4.50@4.75	4.50	4.50	
8	12.75 @ 13	28.75	29.50	4.50@4.75	4.50	4.45	

*These prices correspond to the following quotations for copper, "delivered": 13.25 @ 13.375; 13.25 @ 13.375; 13.25; 13.125 @ 13.25; 13 @ 13.25; and 13 @ 13.25c.

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

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

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

have been disappointed at losing the business, some of which it is reported has been placed as low as 13c. delivered. Not much copper could be obtained at these prices, but the amount is quite sufficient to supply the current demand. Slightly higher prices are asked for August.

Lead

On Monday, June 6, the American Smelting & Refining Co. reduced its official contract price of lead from 5 to 4.75c., New York and St. Louis. The demand for lead continues very weak indeed, so that even the small quantities pressing on the market are capable of depressing the price to a marked extent. Of course the import price also has some bearing, and it is this which prevents a greater differential between New York and St. Louis. Only certain grades of lead can be obtained at the prices which we quote, as producers of more favored or special brands, who are in a good financial position, continue to quote as high as 5.25c. They are indifferent about booking business at the current low prices, for they feel that the reaction is only a temporary one. The mine production is believed to be considerably less than the smelter production lately, and no large stocks are on hand. White-lead manufacturers report business to be excellent, and electric and cable companies are also using lead in satisfactory quantities. Forward lead is in somewhat greater supply than prompt lead apparently, judging by the higher prices which certain lots of the latter have brought.

London

June	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3 M	Spot	3 M	Spot	3 M
	Spot	3 M							
2	73 1/4	73 3/8	76 1/2	172 1/2	173 3/4	22 1/2	22 1/2	27	27 3/4
3	72 3/8	73 1/8	76	170 1/4	171 1/2	22 1/8	22	26 3/8	27 1/8
4	72 1/2	73	76	168 1/2	169 3/4	22 1/4	22 1/4	26	27
6	72 3/4	73 1/4	76	165 3/8	167	22 3/8	22 3/8	26 1/2	27 1/2
7	72 3/4	73 1/4	76	165 3/8	167	22 3/8	22 3/8	26 1/2	27 1/2
8	73	73 3/8	76	167 1/2	169	22 3/8	22 3/8	26 1/2	27 3/8

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

Silver and Sterling Exchange

June	Sterling Exchange	Silver			June	Sterling Exchange	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
2	388	99 1/4	57 5/8	33 1/2	6	380	99 1/4	57 5/8	34
3	388 1/2	99 1/4	58 1/8	33 7/8	7	377 1/2	99 1/4	58 1/8	34 1/2
4	385	99 1/4	57 1/4	33 3/8	8	377	99 1/4	58 1/8	34 3/8

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, June 8, 1921

The metal market has declined during the last week, along with securities and foreign exchange, the condition being a general one and not due to weakness of any one metal. Consuming demand is generally absent, and no indications of a revival of business activity except for a few specialties are yet in evidence.

Copper

That the recent rise in the price of copper was caused entirely by the export demand is plainly evidenced by the quick recession now that foreign orders have practically ceased. It may take some weeks for exchange to climb up to

the figures of two or three weeks ago, and if this is the case copper may fall still further, for the European countries seem to be in no urgent need of the metal, and former purchases no doubt took into account future needs and were made with the possibility of the present unfavorable exchange conditions in mind. Domestic demand has at no time been sufficient to strengthen the market. The large producers are generally quoting 13.50c. delivered, and it is understood that the Copper Export Association has not been offering the metal during the last week for less than 13.875c. delivered in Europe. Some smaller interests which have quoted June or July copper at 13.25 and 13.375c. in the last two or three days

Zinc

Although the market has been more active than for several weeks, and larger tonnages have been sold, the sales were made mainly because of price concessions, and the level is now even below the low prices current in the middle of April, before the market strengthened. In fact, the present price of 4.45c. is the lowest since early in 1908. No early improvement is anticipated.

The zinc and lead markets are now on a par, also an exceptional situation. There has been some inquiry for future zinc, for which a 5-point premium is asked. High-grade zinc is still selling for 6.25c. Zinc is cheap enough to store and hold; at any rate it pays the producers now to buy it rather than to mine it.

Tin

The recession in the price to below the 30c. level was unexpected. It was, of course, brought about by the decline in London and in sterling exchange, and has offered opportunities for considerable speculation. Demand from consumers does not seem to have been stimulated to any appreciable extent,

though tin-plate manufacturers may be slightly more active. One of the largest mills has just suffered a two-million-dollar fire, in which the stock of tin plate was entirely destroyed. Prices for forward delivery continue to be approximately the same as for spot, although slight discounts may be made.

Arrivals of tin, in long tons: Total for May, 1,355; June 1st, London, 75; 3d, London, 75; 6th, London, 130; Straits, 225; 7th, Straits, 125.

Gold

Gold in London: June 2d, 105s. 5d.; 3d, 106s.; 6th, 107s. 7d.; 7th, 109s. 3d.; 8th, 107s. 11d. On June 1st, the gold holdings of the United States were \$3,175,037,198, the greatest in the history of the country.

Foreign Exchange

Sterling has had a violent reaction lately because of money transfers occasioned by German reparations payments. Other exchanges have also generally felt this influence. On Tuesday, June 7th, francs were 8.125c.; lire, 4.895c.; and marks, 1.525c. New York funds in Montreal, 12 per cent premium.

Silver

Sterling exchange continued to decline the last week, touching \$3.76 on June 7, and has seriously affected the export price for silver. The London price has stiffened to offset the decline in sterling exchange, with a sharp advance on June 7 to 34½d. on spot demand and scarcity of offerings. China has been a buyer in the London market, and on June 6 America was reported as a buyer. The Indian bazaars have also been moderate buyers, so that the London market has been steady. There has been some demand in this market for San Francisco shipment the last week. China exchanges show slight improvement. The market closes quiet, with tendency uncertain.

Mexican Dollars—June 2d, 44½; 3d, 44½; 4th, 44½; 6th, 44; 7th, 44½; 8th, 44½.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—List prices of 28@23.5c. are nominal. Outside market, 22@23c. per lb.; 22½c. for imports, duty paid.

Antimony—Chinese and Japanese brands, 5½c.; market dull. W.C.C. brand, 5½@6½c. per lb. Cookson's "C" grade, spot, 9½c. Chinese needle antimony, lump, nominal at 4½c. per lb. Standard powdered needle antimony (200 mesh), nominal at 6@6½c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb₂O₃, wholesale lots, 6½@7c.

Bismuth—\$1.50@1.55 per lb., 500-lb. lots.

Cadmium—Range \$1@1.10 per lb., in 1,000-lb. lots. Smaller quantities, \$1.10@1.25 per lb.

Cobalt—Metal, \$4 per lb.; black oxide, \$3@3.10 per lb. in bbls.; sulphate, \$1.35 per lb. in bbls.

Iridium—Nominal, \$250@275 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, 35@40c.

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

Osmium—\$70@80 per troy oz.

Palladium—\$70 per oz.

Platinum—\$75 per oz.

Quicksilver—Nominally, \$46@48 per 75-lb. flask. San Francisco wires \$48.50.

Rhodium—\$150 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@55c. 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—25c. per unit, seaport; chemical ore (MnO₂) \$55@60 per gross ton, lump; \$70@75 per net ton, powdered.

Molybdenum Ore—85 per cent MoS₃, 55@60c. per lb. of contained sulphide, New York.

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

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

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

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

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.

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

Zinc and Lead Ore Markets

Joplin, Mo., June 4—Zinc blende, per ton, high, \$28.05; basis 60 per cent zinc, premium, \$22.50; Prime Western, \$21; fines and slimes, \$17.50@15; average settling price, all grades of zinc, \$23.10.

Lead, high, \$62.50; basis 80 per cent lead, \$50; average settling price, all grades of lead, \$51.91 per ton.

Shipments for the week: Blende, 4,252; lead, 1,483 tons. Value, all ores the week, \$175,350.

Lead was lowered \$5 again this week, with weak demand. Offerings for zinc blende resolved around \$22.50 for the choicest ores and \$21 for ordinary grades late this afternoon, with light demand, buyers asserting the market should be \$20 basis according to metal prices. This is a drop of \$2.50 per ton for zinc. The production, purchase, and shipments were close during May. Unless buying develops later today June will open with purchases below the production. The Athletic M. & S. Co. has closed down its Fort Smith smelter for wage adjustment.

Platteville, Wis., June 4—No shipments for the week. Shipments for the year: Blende, 11,461; lead, 910 tons. Shipped during the week to separating plants, 293 tons blende.

Non-Metallic Minerals

Asbestos—Crude, No. 1, \$1,700@3,000; No. 2, \$1,200@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. Market dull; little buying and shipping.

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 are \$24.50. Crude quoted \$7 per long ton, f.o.b. Cartersville, Ga. Small lots sell for as low as \$5.

Bauxite—High-grade French bauxite, \$8@12 per ton, Atlantic ports. American quotations the same. Consumers generally well supplied. Prices vary according to grade. Crude, unground, \$16.50 per ton; ground, \$22; calcined, ground, \$35; unground, \$45, f.o.b. plant.

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.

Emery—Turkish emery, 6@6½c. per lb., depending upon fineness. Inferior grades, 3½c., f.o.b. New England points.

Feldspar—Crude, \$7@\$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@\$25 per ton, f.o.b. Illinois and Kentucky mines; acid, glass, and enamel grades, \$40@\$55; ground, suitable for acid, chemical or enameling purposes, \$32@\$35; lump, \$15, f.o.b. Lordsburg, N. M. Ground acid grade, 97 per cent CaF₂, \$32, New Mexico.

Fuller's Earth—16 to 30 mesh, \$21; 30 to 60 mesh, \$23; 60 to 100 mesh, \$19; 100 plus mesh, \$15, f.o.b. plants, Pennsylvania. California grades, \$15@\$25, f.o.b. mines. Imported, English, \$24@\$27, f.o.b. Atlantic ports.

Graphite—Ceylon lump, first quality, 7@7½c. per lb.; chip, 5½@6c.; dust, 3½@4c. No. 1 flake, 6½c.; amorphous crude, 3@2½c.

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, 3 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—Crude, \$12@\$15 per ton. High-grade caustic calcined, lump form, \$30@\$40 per ton. Plastic calcined, \$56 in barrels, carload lots, f.o.b. California points. 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); ground roofing mica, \$25@\$70, 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, \$6.75; 68 per cent, \$6.25; 68@66 per cent, \$6.

Footnote Mineral Co., Philadelphia, Pa.

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

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

Silica—Glass sand, \$2.25 per ton; sand-blast material, \$2.25, both f.o.b. Indiana points. Amorphous or decomposed variety, soft silica, 250 to 500 mesh, \$16@\$30 per ton. Ganister, crude, \$2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, \$2.25@\$3, f.o.b. Pennsylvania points. Market reported dull.

Sulphur—\$16@\$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, 6½c. per lb. in carload lots.

Sodium Nitrate—\$2.85@\$3 per cwt. ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, \$18@\$20 per ton, f.o.b. mines, Idaho and Arizona, spot and six months' contract; \$33@\$35 per ton, New York.

Potassium Sulphate—Powder, domestic, \$1.50@\$1.75 per unit, 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, \$75@\$80, f.o.b. furnace; resale, \$90, delivered; English, \$75@\$80, c.i.f. Atlantic seaports. Spiegeleisen, 18@20 per cent, \$30@\$32, 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, \$45@\$50; 50 per cent, \$75@\$80; 75 per cent, \$140@\$185.

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

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

Ferrovandium—\$5@\$6 per lb. of V

contained, according to analyses and quantity.

Metal Products

Copper Sheets—Current New York list price, 21.50c. per lb.; wire, 15c.

Lead Sheets—Full lead sheets, 8.25c.; cut lead sheets, 8½c. in quantity, mill lots.

Nickel Silver—31½c. per lb. for 18 per cent nickel. Grade "A" sheets.

Yellow Metal—Dimension sheets 17½c.; sheathing, 16½c.; rods, 3 to 3 in., 14½c.

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

Refractories

Bauxite Brick—56 per cent alumina. \$35@\$50 per ton, f.o.b. works.

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, \$60@\$70 per net ton, shipping point; arches, keys, wedges, \$75; splits, soaps, \$85.

Fire Brick—First quality, 9-in. shape \$35@\$40 per 1,000, Pennsylvania, Ohio and Kentucky. Second quality, \$30@\$35.

Magnesite Brick—9-in. straights, \$75 @\$80 per net ton; 9-in. arches, wedges and keys, \$100; soaps and splits, \$110.

Silica Brick—9-in., per 1,000: \$35@\$45 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, June 7, 1921

The steel market has grown duller than was believed possible, being more depressed now than it was expected to become in July, traditionally the dullest month of the year. Such buying as occurs is chiefly in carload lots.

The great majority of steel buyers expect prices to be lower within a short time, say by Aug. 1, but the manner in which prices will go down is not outlined. The statement is not confirmed as to there being a general policy of cutting, but the trend is indicated by a Corporation wire subsidiary, which has met a \$3 price on nails, 25c. under the former market.

Steel ingot production is at the rate of about 25 per cent of capacity, or about half what was considered the minimum percentage possible before the war. The extreme lightness of production encourages the belief that there will be some sort of revival in August.

Pig Iron—Bessemer iron has sold in carload lots at \$23, Valley, this replacing the former nominal quotation of \$24. Basic can be done at \$21.50, or 25c. decline. Foundry remains quotable at \$23, probably because no inquiry has disturbed the quotation. W. P. Snyder & Co. report average prices on actual transactions in Valley iron in May at \$24.25, Valley, for bessemer, and \$21.875 for basic.

Coke

Connellsville—Furnace, \$3.25@\$3.75 foundry, \$4.50@\$5.

War Finance Corporation Act

Government Has Issued a Circular of Information for Loan Applicants

A CIRCULAR has been issued by the War Finance Corporation, Washington, D. C., outlining, in a general way, the requirements of the corporation regarding advances to American exporters, banks, and bankers. It recites the law, gives the procedure that should be followed in making application for advances, and shows the papers, documents, and other evidence required by the corporation. Copies may be obtained free by applying to the corporation, or to the nearest Federal Reserve Bank.

Section 21 of the War Finance Corporation Act, as amended, the provisions of which were the subject of the joint resolution of Congress reviving the activities of the corporation, is as follows:

Sec. 21. (a) That the corporation shall be empowered and authorized, in order to promote commerce with foreign nations through the extension of credits, to make advances upon such terms, not inconsistent with the provisions of this section, as it may prescribe, for periods not exceeding five years from the respective dates of such advances:

(1) To any person, firm, corporation, or association engaged in the business in the United States of exporting therefrom domestic products to foreign countries if such person, firm, corporation, or association is, in the opinion of the board of directors of the corporation, unable to obtain funds upon reasonable terms through banking channels. Any such advance shall be made only for the purpose of assisting in the exportation of such products, and shall be limited in amount to not more than the contract price therefor, including insurance and carrying or transportation charges to the foreign point of destination if and to the extent that such insurance and carrying or transportation charges are payable in the United States by such exporter to domestic insurers and carriers. The rate of interest charged on any such advance shall not be less than 1 per centum per annum in excess of the rate of discount for ninety-day commercial paper prevailing at the time of such advance at the Federal Reserve bank of the district in which the borrower is located; and

(2) To any bank, banker, or trust company in the United States which after this section takes effect makes an advance to any such person, firm, corporation, or association for the purpose of assisting in the exportation of such products. Any such advance shall not exceed the amount remaining unpaid of the advances made by such bank, banker, or trust company to such person, firm, corporation, or association for such purpose.

(b) The aggregate of the advances made by the corporation under this section remaining unpaid shall never at any time exceed the sum of \$1,000,000,000.

(c) Notwithstanding the limitation of Section 1, the advances provided for by this section may be made until the expiration of one year after the termination of the war between the United States and the German government as fixed by proclamation of the President. Any such advance made by the corporation shall be made upon the promissory note or notes of the borrower, with full and adequate security in each instance by indorsement, guaranty, or otherwise. The corporation shall retain power to require additional security at any time. The corporation in its discretion may upon like security extend the time of payment of any such advance through renewals, the substitution of new obligations, or otherwise, but the time for the payment of any such advance shall not be extended beyond five years from the date on which it was originally made.

Latest Transvaal Gold Production

The following table summarizes Transvaal gold production since 1917:

RAND GOLD OUTPUT 1917-1921, IN FINE OUNCES					
	1921	1920	1919	1918	1917
January.....	681,382	670,503	676,059	714,183	782,634
February.....	671,123	625,330	636,728	659,759	721,321
March.....	588,137	707,036	712,379	696,281	787,094
April.....	651,593	686,979	694,944	717,099	742,778
May.....	699,041	724,995	741,217	729,385	729,385
June.....	715,957	702,379	727,696	759,724	759,724
July.....	736,099	725,497	736,199	757,890	757,890
August.....	702,083	706,669	740,210	756,658	756,658
September.....	682,173	698,558	708,206	738,231	738,231
October.....	662,472	723,722	679,764	751,290	751,290
November.....	633,737	677,970	658,701	722,839	722,839
December.....	632,215	650,191	641,245	722,419	722,419

Movements of Ores and Metals

Imports and exports of the more important metals and ores as reported by the Bureau of Foreign and Domestic Commerce for April, 1921, and the figures for April of 1920 as finally revised, are as follows:

IMPORTS, APRIL 1920 AND 1921		
(In Pounds, Unless Otherwise Stated)		
	April, 1920	April, 1921
Antimony ore, contents.....	19,457	26,400
Antimony matte, regulus or metal.....	2,062,022	5,223,381
Brass, fit only for remanufacture.....	3,788,761	612,939
Copper:		
Ore, contents.....	4,508,154	2,086,083
Concentrates, contents.....	1,498,321	3,647,147
Matte, regulus, etc., contents.....	1,759,982	805,775
Imported from (in part):		
Canada.....	1,954,266	252,677
Mexico.....	2,775,763	2,636,950
Cuba.....	125,440	1,375,104
Chile.....	278,563	832,388
Spain.....	122,090	274,870
Unrefined, black blister, etc.....	14,182,933	10,109,145
Refined, in bars, plates, etc.....	5,677,419	19,070,079
Old, etc., for remanufacture.....	38,542	389,339
Composition metal, copper chief value.....	146,221	.....
Lead:		
Ore, contents.....	4,667,636	988,534
Bullion, contents.....	10,212,502	11,380,892
Imported from (in part):		
Canada.....	809,928	496,181
Mexico.....	10,616,142	11,562,680
Chile.....	685,590	234,627
Pigs, bars and old.....	962,474	4,558,440
Imported from (in part):		
Spain.....	.....	2,199,302
Mexico.....	958,889	2,359,138
Canada.....	3,240	.....
Manganese ore, long tons.....	35,088	47,260
Imported from (in part):		
Cuba, long tons.....	3,030	.....
Brazil, long tons.....	22,035	31,350
British India, long tons.....	2,150	14,910
Tungsten ore, long tons.....	29	108
Pyrites, long tons.....	21,882	24,059
Imported from:		
Spain, long tons.....	19,005	21,609
Canada, long tons.....	77	.....
Tin ore, long tons.....	1,394	607
Tin bars, blocks, pigs, etc.....	10,345,130	2,483,655
Imported from (in part):		
United Kingdom.....	937,601	605,203
Straits Settlements.....	6,930,919	1,814,441
Hongkong.....	781,314	43,838
Zinc:		
Ore, contents.....	6,993,054	88,283
Imported from:		
Canada.....	34,935	.....
Mexico.....	4,510,839	88,283
Blocks, or pigs, and old.....	1,718	6,269,176

EXPORTS OF COPPER, LEAD AND ZINC

(In Pounds)		
	April, 1920	April, 1921
Copper:		
Ore, contents.....	105,400	167,900
Unrefined, black, blister, etc.....	1,412,318	.....
Refined, in ingots, bars, etc.....	58,112,481	40,256,030
Exported to (in part):		
France.....	10,889,955	10,800,273
Germany.....	14,003,294	15,837,896
Netherlands.....	2,727,689	1,166,600
United Kingdom.....	8,798,829	7,976,634
Canada.....	2,210,644	1,541,713
Composition metal, copper chief value.....	17,870	68
Old and scrap.....	1,220	40
Pipes and tubes.....	193,687	184,046
Plates and sheets.....	678,275	342,813
Wire, except insulated.....	3,949,038	711,858
Lead:		
Pigs, bars, etc.....	775,675	136,641
Produced from domestic ore.....	5,894,164	448,077
Produced from foreign ore.....	.....	.....
Exported to (in part):		
Canada.....	667,128	18,983
Argentina.....	365,163	224,077
Japan.....	448,000	224,000
United Kingdom.....	1,288,000	.....
Zinc:		
Dross.....	1,314,461	.....
Produced from domestic ore.....	28,994,101	115,838
Produced from foreign ore.....	1,698,670	.....
Exported to (in part):		
Mexico.....	9,837	2,618
Japan.....	168,059	112,000
United Kingdom.....	18,373,026	.....
In sheets, strips, etc.....	3,082,185	388,412

COMPANY REPORTS

Granby Consolidated Shows Deficit

A report of operations of the Granby Consolidated Mining, Smelting & Power Co., Ltd., for 1920 states that 25,744,327 lb. of copper, 1,054 oz. of silver, and 9,481 oz. of gold were produced. Copper totaling 19,464,796 lb. was sold at an average price of 17.85c. per lb. Cost of production was 15.94c. per lb. f.o.b. smelter. Comparative income account follows:

	1920	1919
Gross receipts	\$6,684,123	\$6,561,099
Gross operating cost	6,323,814	6,660,054
Net operating profit	\$360,309	(a) \$98,955
Interest, etc.	507,775	120,884
General expenses and taxes	539,546	764,570
Deficit	\$687,012	\$984,409
Dividends		1,312,537
Surplus	497,298	1,124,409
(a) Loss.		

Tonopah Extension Dividends, \$258,542

A report of operations of the Tonopah Extension Mining Co. for the fiscal year ending March 31, 1921, states that 1,150,963 oz. of silver and 11,324.4 oz. of gold were produced in the period covered by the report. Income account follows:

Mining	\$573,411.81	Sales of silver and gold	\$1,283,520.72
Milling	365,544.73	Less treatment and transportation charges	24,056.11
Depreciation of plant	52,673.76		
Administrative expenses	34,354.54		
Balance carried down	229,336.57		
	\$1,255,321.41	Less bullion in process—decrease	4,143.20
			\$1,251,178.21
Balance brought down			229,336.57
Interest received on investments			32,279.22
Net income for year			\$261,615.79

Surplus March 31, 1920, was \$1,693,726.88. Adding net income, \$261,615.79, gives a total of \$1,955,342.67. Deducting depletion, \$197,633.28, and dividends totaling \$258,542.48, leaves a surplus March 31, 1921, of \$1,499,166.91. Capitalization, 2,000,000 shares of \$1 par; 1,292,800 shares outstanding.

Silver King Coalition Surplus Increased

A report of operations of the Silver King Coalition Mines Co. for 1920 states that 10,604,650 lb. of lead, 629,929 oz. of silver, 1,385.5 oz. of gold, and 230,619 lb. of copper were produced in the year. Profit and loss account follows:

Earnings		
Ore sales	\$1,006,687.27	
Lessee's royalties	36,723.92	
Interest on bonds	3,820.37	
Miscellaneous income	8,809.99	
Total income		\$1,056,041.55
Expenses		
Development	\$78,345.45	
Ore extraction	208,774.23	
Drainage	6,956.03	
Haulage and hoisting	114,177.82	
Milling	59,125.34	
Marketing expense	26,929.85	
General surface expense	21,566.58	
General mine expense	41,882.70	
Mine concentrators	6,488.90	
Miscellaneous supplies	227.59	
Taxes	26,698.04	
Insurance	3,771.64	
Total operating cost at mine	\$594,944.17	
Salaries, office administration and general expense at Salt Lake City	18,019.87	
Legal expense, personal injuries, donations, etc.	31,988.11	644,952.15
Net profit before depreciation		\$411,089.40
Less depreciation		52,729.79
Net profit to surplus		\$358,359.61

Surplus Jan. 1, 1920, was \$164,106.45; less 1917 income tax of \$10,700.32 and plus profit for 1920 of \$358,359.61 gave surplus Dec. 31, 1920, of \$511,765.74. No dividends were paid.

Mother Lode Coalition Mines Co.

A report of operations of the Mother Lode Coalition Mines Co. for 1920 states that 8,737.26 tons of copper and 134,943 oz. of silver were produced, at a cost of 8.66c. per lb. delivered, for the copper, after charging depreciation, taxes, and crediting silver, but excluding depletion. Income account follows:

Operating revenue (Ala ka)		
Copper sold — 13,803,911 lb. @ 16.932c.		\$2,337,226.53
Silver sold — 133,775.35 oz. @ 1.0079c.		134,831.24
		\$2,472,057.77
Operating cost		
Mining and milling	\$424,397.93	
Treatment, refining and freight	659,521.15	
Selling and delivery charges	123,820.94	
General expense	12,863.85	1,220,603.87
Miscellaneous income at mine		\$1,251,453.90
		2,415.54
Profit on metals sold		\$1,253,869.44
Interest		4,517.50
Total income for year		\$1,258,386.94
Deduct		
Interest on first mortgage 6 per cent ten-year gold bonds	\$60,000.00	
Taxes	29,737.07	89,737.07
Balance to undivided profits		\$1,168,649.87
		Undivided Profits
Debit balance Dec. 31, 1919	\$50,601.17	
Income for year, as above	1,168,649.87	\$1,118,048.70
Depreciation of construction and equipment	\$108,621.92	
Depletion for year	1,102,242.28	1,210,864.20
Debit balance of undivided profits		\$92,815.50

Capitalization, 2,500,000 shares, no par value, valued at \$16,822,274.21; first mortgage 6 per cent, ten-year sinking fund gold bonds, \$1,000,000.

North Star Mines' Deficit Increases

A report of the operations of the North Star Mines Co. for 1920 indicates that a deficit of \$51,415.19 was incurred by the year's operations.

RECEIPTS		
Balance at end of 1919		\$973,069.61
Production		
North Star mine, California	\$718,286.33	
Champion mines (tons crushed, 17,626)	102,843.17	
Total production		821,129.50
Champion mines account		10,534.25
Interest and dividends received		39,786.85
Total		\$1,844,520.21
DISBURSEMENTS		
Operating expenses		
North Star mine	\$510,319.79	
Development expenses		
North Star mine (7,285 ft.)	135,180.28	
Total operating and development		\$645,500.07
Champion mines		
Operating expenses	\$109,338.19	
Development expenses	3,622.84	
	\$112,961.03	
Less old material salvaged	13,465.79	99,495.24
Improvement		
North Star		13,223.70
Property purchase		1,363.08
Investment accounts, profit and loss		11,685.00
Dividend (No. 57), 3 per cent		75,000.00
Balance, Dec. 31, 1920		
Cash	\$254,615.58	
Investment account	589,657.54	
Bills receivable	55,000.00	
Materials and supplies	98,980.00	998,253.12
Total		\$1,844,520.21

Surplus account deficit on Dec. 31, 1919, was \$321,751.55; on Dec. 31, 1920, \$373,166.74, derived as follows: Production for the year, \$821,129.50, plus interest and dividends (\$36,786.85), amounted to \$860,916.35; deducting operating and development expenses (\$744,995.31), investment account loss (\$11,685), depletion (\$122,800), and depreciation (\$32,851.23), gave a net loss of \$51,415.19 carried to surplus.

MINING STOCKS

Week Ended June 4, 1921

Stock	Exch.	High	Low	Last	Last Div.	Stock	Exch.	High	Low	Last	Last Div.	
COPPER						GOLD						
Adventure	Boston			*50		Alaska Gold	New York	1 1/2	1 1/2	1 1/2		
Ahmeek	Boston	52 1/2	51 1/2	51 1/2	Sept. '20, Q	\$0.50	Alaska Juneau	New York	1 1/2	1 1/2		
Alaska-Br. Col.	N. Y. Curb						Carson Hill	N. Y. Curb	14 1/2	14 1/2	14 1/2	
Allouez	Boston	21	21	21	Mar. '19	1.00	Cresson Consol. G.	N. Y. Curb	1 1/2	1 1/2	June '20, Q	
Anaconda	New York	41	39 1/2	40	Nov. '20, Q	1.00	Dome Extension	Toronto		*75		
Arcadian Consol.	Boston	2 1/2	2 1/2	2 1/2			Dome Mines	New York	18 1/2	18 1/2	Apr. '21, Q	
Ariz. Com'l.	Boston	9 1/2	8 1/2	8 1/2	Oct. '18,	.50	Golden Cycle	Colo. Springs	7 1/2	7 1/2	Dec. '20, Q	
Big Ledge	N. Y. Curb	1 1/2	1 1/2	1 1/2			Goldfield Consol.	N. Y. Curb	*7	*6	Dec. '19,	
Bingham Mines	Boston	10	9 1/2	10	Sept. '19, Q	.25	Hollinger Consol.	Toronto	7.27	7.15	7.15	
Calumet & Arizona	Boston			50	Mar. '21, Q	.50	Homestake Mining	New York	57	57	57	
Calumet & Hecla	Boston	252	248	248	June '20, Q	5.00	Kirkland Lake	Toronto	*48 1/2	*47 1/2	*47 1/2	
Canada Copper	N. Y. Curb			*13			Lake Shore	Toronto	1.20	1.20	1.20	
Centennial	Boston	7 1/2	7 1/2	7 1/2	Dec. '18, SA	1.00	McIntyre-Porcupine	Toronto	1.97	1.94	1.94	
Cerro de Pasco	New York	28 1/2	27 1/2	27 1/2	Mar. '21, Q	.50	Porcupine Crown	Toronto	*23	*21	*21	
Chile Copper	New York	11 1/2	11 1/2	11 1/2			Portland	Colo. Springs	5 1/2	5 1/2	5 1/2	
Chino	New York	25	23 1/2	24	Sept. '20, Q	.57 1/2	Reorgan. Booth	N. Y. Curb	*4	*3	*3	
Columbus Rexall	Salt Lake			*26 1/2			Silver Pick	N. Y. Curb	*5	*4	*5	
Con. Arizona	N. Y. Curb				Dec. '18, Q	.05	Teek Hughes	Toronto	*14 1/2	*14 1/2	14 1/2	
Con. Copper M.	N. Y. Curb						Tom Reed	Los Angeles	2 1/2	2 1/2	2 1/2	
Copper Range	Boston	35	34 1/2	34 1/2	Sept. '20, Q	.50	United Eastern	N. Y. Curb	2 1/2	2 1/2	2 1/2	
Crystal Copper (new)	Boston Curb	*31	*28	*31			Vindicator Consol.	Colo. Springs	34 1/2	34 1/2	34 1/2	
Davis-Daly	Boston	6 1/2	6 1/2	6 1/2	Mar. '20, Q	.25	West Dome Consol.	Toronto	*8	*8	*8	
East Butte	Boston	9 1/2	9	9	Dec. '19, A	.50	White Caps Mining	N. Y. Curb	1 1/2	1	1	
First National	Boston Curb	*71	*52	*60	Feb. '19, SA	.15	Yukon Gold	N. Y. Curb	1 1/2	1	1	
Franklin	Boston	2 1/2	2 1/2	2 1/2			SILVER					
Gadsden Copper	N. Y. Curb			*25			Arizona Silver	Boston Curb	*28	*24	*26	
Granby Consol.	New York	22	22	22	May '19, Q	1.25	Batopilas Mining	New York			Dec. '07, I	
Greene-Cananea	New York	23 1/2	23 1/2	23 1/2	Nov. '20, Q	.50	Beaver Consol.	Toronto	*32 1/2	*32	*32	
Hancock	Boston	3 1/2	3	3			Coniagas	Toronto	1.70	1.70	1.70	
Howe Sound	N. Y. Curb	2 1/2	2 1/2	2 1/2	Jan. '21, Q	.05	Crown Reserve	Toronto	*12	*11	*11	
Inspiration Consol.	New York	35	33 1/2	34 1/2	Oct. '20, Q	1.00	Kerr Lake	Boston	3 1/2	3	3	
Iron Cap	Boston Curb			6 1/2	Sept. '20, K	.25	La Rose	Toronto			*19	
Isle Royale	Boston	21	21	21	Sept. '19, SA	.50	McKinley-Dar-Sav	Toronto	*18	*18	*18	
Kennecott	New York	20 1/2	20	20 1/2	Dec. '20, Q	.50	Mining Corp. Can.	Toronto			1.08	
Keweenaw	Boston			1 1/2			Nipissing	N. Y. Curb	4 1/2	4 1/2	4 1/2	
Lake Copper	Boston	3 1/2	2 1/2	2 1/2			Ontario Silver	New York			5	
La Salle	Boston	2	2	2			Ophir Silver	N. Y. Curb			2	
Magma Chief	N. Y. Curb			*21			Peterson Lake	Toronto	*5 1/2	*5 1/2	*5 1/2	
Magma Copper	N. Y. Curb	20 1/2	20 1/2	20 1/2	Jan. '19, Q	.50	Temiskaming	Toronto	*17	*17	*17	
Majestic	Boston Curb	*8	*8	*8			Trethewey	Toronto	*17	*17	*17	
Mason Valley	Boston	1 1/2	1 1/2	1 1/2			GOLD AND SILVER					
Mass Consolidated	Boston	2 1/2	2 1/2	2 1/2	Nov. '17, Q	1.00	Atlanta	N. Y. Curb	*1 1/2	*1 1/2	*1 1/2	
Mayflower-Old Col.	Boston	4 1/2	4	4 1/2			Barnes-King	Butte	1 1/2	1.10	1.10	
Miami Copper	New York	23	21 1/2	22 1/2	May '21, Q	.50	Boston & Montana	N. Y. Curb	*70	*63	*63	
Michigan	Boston	2	2	2			Cashboy	N. Y. Curb	*6	*4	*5	
Mohawk	Boston	52 1/2	51	51	Nov. '20, Q	1.00	El Salvador	N. Y. Curb			1	
Mother Lode (new)	N. Y. Curb	5 1/2	5	5 1/2			Jim Butler	N. Y. Curb	*10	*8	*8	
Nevada Consol.	New York	11 1/2	11	11 1/2	Sept. '20, Q	.25	Jumbo Extension	N. Y. Curb	*7	*4 1/2	*5	
New Baltic	Boston Curb			3			Louisiana Con.	N. Y. Curb			1	
New Cornelia	Boston	15 1/2	15	15	Aug. '20, K	.25	MacNamara M. & M.	N. Y. Curb	*16	*15	*16	
Nixon Nevada	N. Y. Curb			*5			Open Mar.	N. Y. Curb	110 1/2	110	110	
North Butte	Boston	10 1/2	10 1/2	10 1/2	Oct. '18, Q	.25	Tonopah-Belmont	N. Y. Curb	1 1/2	1 1/2	1 1/2	
North Lake	Boston			1 1/2			Tonopah-Divide	N. Y. Curb	1 1/2	1 1/2	1 1/2	
Ohio Copper	N. Y. Curb			1 1/2			Tonopah-Extension	N. Y. Curb	1 1/2	1 1/2	1 1/2	
Old Dominion	Boston	22 1/2	21	21	Dec. '18, Q	1.00	Tonopah Mining	N. Y. Curb	1 1/2	1 1/2	1 1/2	
Oseola	Boston	30	28	28	June '20, Q	.50	West End Consol.	N. Y. Curb	1	1	1	
Phelps Dodge	Open Mar.	1160	1150	1150	Apr. '21, Q	1.00	SILVER-LEAD					
Quincy	Boston	39 1/2	39	39	Mar. '20, Q	1.00	Caledonia	N. Y. Curb	*10	*8 1/2	*9 1/2	
Ray Consolidated	New York	14 1/2	13 1/2	13 1/2	Dec. '20, Q	.25	Cardiff M. & M.	Salt Lake	2 1/2	2 1/2	2 1/2	
Ray Hercules	Boston Curb			*35			Chief Consol.	Boston Curb	2 1/2	2 1/2	2 1/2	
St. Mary's Min. Ld.	Boston	38	38	38	June '20, K	2.00	Consol. M. & S.	Montreal	16 1/2	16	16	
Seneca Copper	Boston			16 1/2			Daly Mining	Salt Lake	1.50	1.50	1.50	
Shannon	Boston	0.90	0.90	0.90	Nov. '17, Q	.25	Daly-West	Boston			3	
Shattuck Arizona	New York	6 1/2	6 1/2	6 1/2	Jan. '20, Q	.25	Eagle & Blue Bell	Boston Curb			2 1/2	
South Lake	Boston			1			Electric Point	Spokane	*7 1/2	*7	*7	
Superior Copper	Boston	4 1/2	3 1/2	3 1/2	Apr. '17,	1.00	Federal M. & S.	New York			6 1/2	
Superior & Boston	Boston	1 1/2	1 1/2	1 1/2			Federal M. & S., pfd	New York	25	24 1/2	24 1/2	
Tenn. C. & C. cfs.	New York	9	8 1/2	8 1/2	May '18, I	1.00	Florence Silver	Spokane			*12 1/2	
Toulumne	Boston	*65	*60	*64	May '13,	.10	Grand Central	Salt Lake	1	1	*07 1/2	
United Verde Ex.	Boston Curb	25 1/2	25	25 1/2	May '21, Q	.25	Hecla Mining	N. Y. Curb	4	3 1/2	3 1/2	
Utah Consol.	Boston	4	4	4	Sept. '18,	.25	Iron Blossom	N. Y. Curb			*20	
Utah Copper	New York	55 1/2	51 1/2	52 1/2	Mar. '21, Q	1.00	Judge M. & S.	Salt Lake	3.00	3.00	3.00	
Utah Metal & T.	Boston	1 1/2	1 1/2	1 1/2	Dec. '17,	.30	Marsh Mines	N. Y. Curb	*7 1/2	*6	*6 1/2	
Victoria	Boston	1 1/2	1 1/2	1 1/2			Prince Consol.	N. Y. Curb	*37 1/2	*28	*37 1/2	
Winona	Boston			*40			Rambler-Cariboo	Spokane	*5	*4	*4	
Wolverine	Boston	11	11	11			Rex Consol.	N. Y. Curb	*10	*9	*10	
NICKEL-COPPER						QUICKSILVER						
Internat. Nickel	New York	15 1/2	14 1/2	14 1/2	Mar. '19,	.50	New Idria	Boston	150	150	*50	
Internat. Nickel, pf.	New York			82 1/2	May '21, Q	1.50	VANADIUM					
LEAD						ASBESTOS						
National Lead	New York	76	76	76	Mar. '21, Q	1.50	Asbestos Corp.	Montreal	60	60	58	
National Lead, pfd.	New York			102	Mar. '21, Q	1.75	Asbestos Corp., pfd.	Montreal			80	
St. Joseph Lead	New York			12	Mar. '21, Q	.25	MINING, S | ELTING AND REFINING					
Stewart Mining	Boston Curb			*6	Dec. '15,	.05	Amer. Sm. & Ref.	New York	42 1/2	40 1/2	40 1/2	
ZINC						U. S. SM. R. & M.						
Am. Z. L. & S.	New York	9 1/2	9 1/2	9 1/2	May '20,	1.00	Amer. Sm. & Ref. pf	New York	77 1/2	76 1/2	76 1/2	
Am. Z. L. & S., pfd.	New York			29	Nov. '20, Q	1.50	Am. Sm. pf. A.	New York			72	
Butte C. & Z.	New York	4 1/2	4 1/2	4 1/2	June '18,	.50	U. S. Sm. R. & M.	New York	33	32 1/2	32 1/2	
Butte & Superior	New York	13 1/2	13	13	Sept. '20,	1.25	U. S. Sm. R. & M. pf.	Boston			41	
Callahan Zn-Ld.	New York	5	4 1/2	5	Dec. '20, Q	.50	U. S. SM. R. & M. pf.					
New Jersey Zn.	N. Y. Curb	127	126	126	May '21, Q	2.00	Amer. Sm. & Ref.	New York	42 1/2	40 1/2	40 1/2	
Success	N. Y. Curb	*3	*2	*3	July '16,	.03	Amer. Sm. & Ref. pf	New York	77 1/2	76 1/2	76 1/2	
Yellow Pine	Los Angeles	1		*60	Sept. '20, Q	.03	Am. Sm. pf. A.	New York			72	

* Cents per share. † Bid or asked. ‡ Quotations missing. Q, Quarterly. SA, Semi-annually. BM, Bi-monthly. K, Irregular. I, Initial. X, Includes extra.

INDUSTRIAL NEWS

Portable Column Hoists

Small Type of Compressed-Air or Steam-Driven Hoisting Machines Form Necessary Part of Mine Equipment

The demand for a small and powerful hoist which would be suitable for mine use has resulted in the development of several types and sizes of portable machines that are operated by compressed air or steam and can be easily set up on the ordinary drill column. Owing to the conditions imposed on these machines while in service it has been necessary to combine durability with portability and also to provide a simple means of operation so that the work to be done could be performed by unskilled labor if necessary.

In the mine the uses of such types of hoists are many: The hoisting of ore, rock, timber, tools and machines in raises, winzes and shafts; the hauling of tram cars and the bailing of water. In mills there is considerable use for the portable hoists, and in such work as the moving of stamps and other machinery they will be found invaluable. They have been used to a considerable extent about quarries for haulage and other purposes.

In this review a number of types are described in a general way and a comparative table showing the essential specifications of each is given. The machines are as follows: The "Little Tugger," manufactured by Ingersoll-Rand Co., New York; "Turbinair," Sullivan Machinery Co., Chicago; "Waughoist," Denver Rock Drill Manufacturing Co., Denver; "Little Giant Universal," Chicago Pneumatic Tool Co., New York; "Leadville," Hendrie & Bolthoff, Denver, and the "Holman" Stretcher Bar hoist, which is supplied

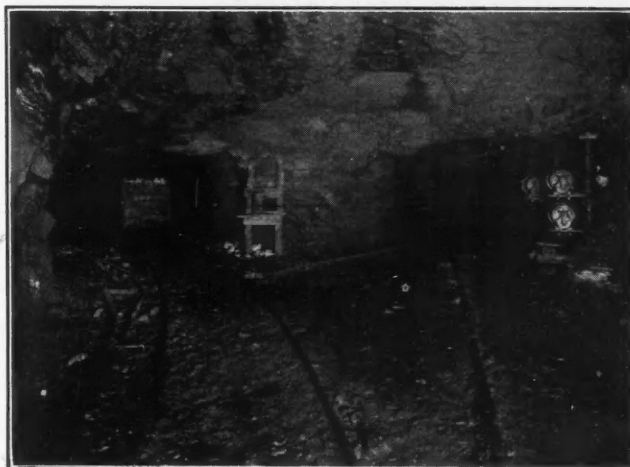
by the Mine & Smelter Supply Co., Denver.

The "Little Tugger" engine is of the square piston type and gives four impulses per revolution. There are no dead centers and the machine will start in any position. The engine, which is reversible, is controlled by a small lever, which, when thrown forward, causes the hoist to wind over, and a reverse movement secures action in the opposite direction. This arrangement can also be used for braking purposes and is as safe as the brake itself. When the operator releases the throttle it returns automatically to the central position, shutting off the air and stopping the hoist. The engine operates the drum through the medium of a clutch and gears, lever controlled. The drum is entirely free when the gears are released. This feature is especially valuable where a hoist is to be used in locations where assistance is not at hand, as one man can carry the rope any distance without the necessity of having another man at the hoist to pay out the rope under power. The gears are inclosed in a dust-proof case and run in oil, which also lubricates the various bearings. Lubrication is provided by means of an automatic heart-beat lubricator, which operates by the pulsation of air at alternate movements of the piston.

The "Turbinair" hoist consists of a cylindrical drum mounted on a steel frame and completely inclosing the operating mechanism. This comprises a Sullivan "Turbinair" motor and reduction gearing which drives the drum

shell. The motor consist of two cylindrical rotors, which are provided with right and left helical flutes or vanes converging to spur teeth in the center. The two rotors mesh together as they revolve under the influence of the incoming air, and this action secures higher economy, long life, and sustained efficiency. The air is used expansively.

The drum is provided at one end with a hand friction clutch, which permits variable control in hoisting. At the other end is a friction brake by which the hoist is controlled while lowering



HAULING CARS WITH "LITTLE TUGGERS"

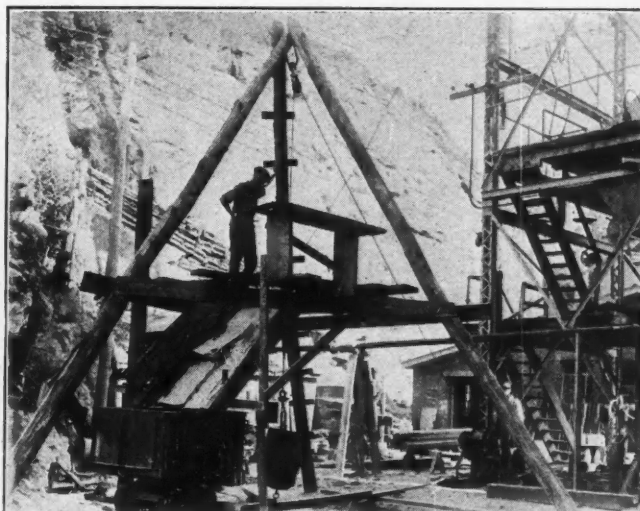
or paying out the rope from the drum.

The air is admitted at the axis of the drum through a hollow shaft. Ball bearings are employed throughout, oiled by grease plugs, and the engine and gearing are lubricated by an automatic oiler.

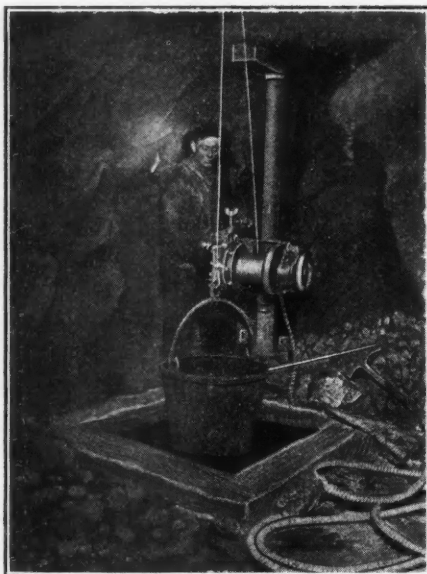
The principal parts of the "Waughoist" engine, which is of the rotary-reciprocating type, are the motor housing, the distributor, the cylinder block, the spider, the spider shaft, and the pistons. The entire engine revolves within the motor housing, an oil- and air-tight casting, which protects the engine from the atmosphere and also



"TURBINAIR" HOIST USED IN SLUSHING

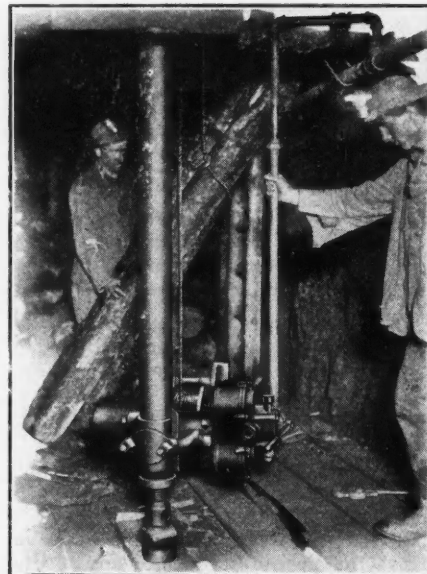


SHAFT SINKING WITH A "WAUGHOIST"



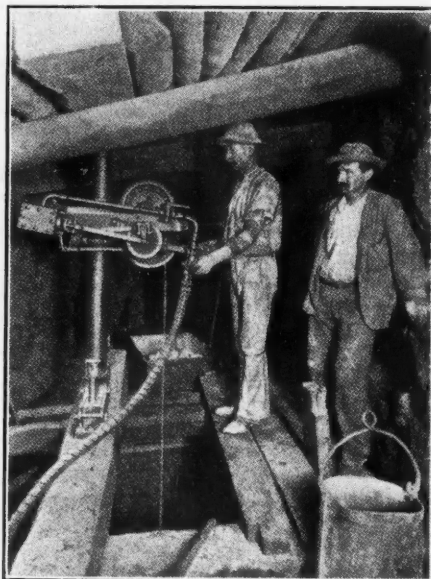
held in place by heavy springs. The motor drives the hoist through a chain of gears. The air is controlled by a slide valve and the direction of the rotation is determined by the direction in which the valve is thrown by the operating handle. The valve is self-closing and returns to the neutral position when the handle is released. The load is lowered on the engine by reversing, and the speed of descent or "paying out" is controlled by the operator on the throttle. The throttle is held in a neutral position by heavy centering springs that prevent accidental opening, and when the throttle is closed the "plugged" motor acts as an effectual brake and a load can be held suspended without danger of creeping.

The engine used in the Model "B" "Leadville" type is inclosed and is reversible by a slight movement of the throttle. In effect it is equivalent



LEADVILLE HOIST USED IN SINKING serves as an oil reservoir. The distributor, through which the air is supplied to the cylinders, serves not only as a distributor of power but as a support for the cylinder block as well. Fixed to the spider shaft is the spider, a drum-shaped casting which revolves within the motor housing and within which the cylinder block also revolves. Around the inner side of the spider four hardened and ground steel tracks are mounted on which the piston rollers run. The spider hub is mounted on a ball bearing. The cable drum revolves upon the spider shaft and a clutch pinion is mounted on the small end of the spider shaft so that the cable drum gearing can be disconnected from the engine and the drum permitted to run free where desired. Within the four cylinders are four pistons which, as the cylinder block revolves, work in the cylinders and at the same time roll the piston rollers along the track plates on the inner side of the spider, thus practically eliminating sliding surface friction.

The "Little Giant Universal" hoist consists of two double-acting oscillating cylinders set at right angles in a closed case. The cylinders are automatically adjustable to their seats, being



HOLMAN HOIST ON A WINZE

to a pair of double-cylinder, double-acting reciprocating engines, and hence cannot get or center. It is of the square piston type, containing but three movable parts—two pistons and the crank pin. The covers are fitted with ground joints, no gasket is used, and

A "LITTLE GIANT" HOISTING TIMBER there are no stuffing boxes or glands. The brake consists of a powerful double-acting steel band, lined with "Raybestos." The main gear is bolted to the drum, and the engine shaft is supported by a long bronze sleeve, oiled automatically from the engine. The drum is mounted on the exterior of this sleeve. The flywheel carries the sliding pinion for releasing the drum and a spring ball catch holds it in either position.

In general appearance and construction Model 5 is similar to the Model "B," although the former is of greater capacity and the increase in size has permitted some change in details.

The Holman Stretcher Bar hoist differs from the other types which have been described, in that the driving mechanism is uninclosed. An ordinary type of cylinder is employed, and this is attached to a frame, which also supports the drum, gearing, and other complementary parts. The frame may be bolted to a column in the same manner as that employed in other types of portable hoists. Three designs are furnished. One makes use of a single cylinder and the two others are provided with two cylinders, one on either side of the drum and equidistant from the center of the drill column.

ESSENTIAL DETAILS OF VARIOUS TYPES OF DRILL COLUMN HOISTS

Details	Ingersoll-Rand Little Tugger		Sullivan Turbinair	Denver Rock Drill Waughoist	Chicago Pneumatic Little Giant	Hendrie & Bolthoff Leadville Model "B"		Mine and Smelter		
	Nos. 1 H. and 11 H.S.	Nos. 11 H. and 11 H.S.				Model "B"	Model 5	Holman Single Cylinder	Stretcher Double Cylinder	Bar Double Cylinder
Net work delivered, hp.	2½	2½	9½	5 (d)	2	2½	4½	2	4	6
Size of drum, rope space, diameter, in.	6	7	9½		6	5	6	6	6	7½
Size of drum, between flanges, length, in.	7	17	9½		8	5	7	7	7	9
Depth of flanges, in.	3	5			2½	3½	3½	2½	2½	3½
Rope capacity, maximum, ft.	¾-in.-450 (a)	¾-in.-300	¾-in.-500	¾-in.-1,000 (e)	¾-in.-325	¾-in.-500	¾-in.-1,080 (l)	¾-in.-200	¾-in.-200	¾-in.-200
Hoisting capacity, lb.	1,000 (t)	600 (f)	1,500 (c)	500-2,000 (d)	650 (g)-1,000 (h)	700 (k)	1,200 (m)	500 (n)	650 (n)	1,000 (o)
Size of column, in.	4½	4½	4½	4-4½	4½	4½	4½	4½	4½	4½
Air connection, in.	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾
Weight, net, lb.	285	358	285	335	300	200	360	360	430	800
Length, in.	21½	31½	22	24½	33	23½	28			
Width, in.	16½	21½	13	17½	17	13	16			
Height, in.	20½	23	15½	19½	19	13½	18			
Speed, maximum load, ft. per minute.			100	68-143						
Size of air hose, in.				1½ (f)						
Gearing ratio.				18 to 1-27.5 to 1	17 to 1			5 to 1	5 to 1	5 to 1
Cylinder, diameter, in.					2½			3	3	4
Length of stroke, in.					2			5	5	5½

(a) ¾-in.-700 ft. (b) Rope speed 85 ft. per min., 80 lb. air or steam pressure. (c) Rope speed 100 ft. per min., 80 lb. air or steam pressure. (d) At 100 lb. air pressure. (e) ¾-in.-465 ft.; ¾-in.-225 ft. (f) Recommended. 1½-in. pipe directly connected. (g) Rope speed 103 ft. per min., 80 lb. air pressure. (h) Rope speed 66 ft. per min., 90 lb. air pressure. (k) Rope speed 80 ft. per min., 70 to 100 lb. air pressure. (l) ¾-in.-680 ft.; ¾-in.-565 ft. (m) Rope speed 100 ft. per min., 80 to 100 lb. air pressure. (n) Rope speed 60 ft. per min., 80 lb. air pressure. (o) Rope speed 70 ft. per min., 80 lb. air pressure.

