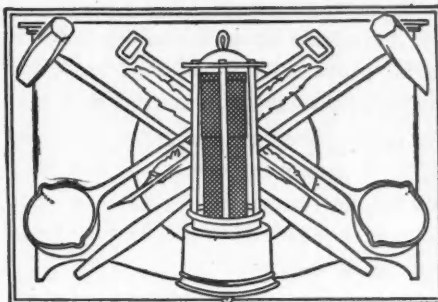


THE ENGINEERING AND MINING JOURNAL

PUBLISHED WEEKLY

By the Hill Publishing Company, 505 Pearl Street, New York • John A. Hill, president; Robert McKean, secretary • London Office, 6 Bouverie Street, London, E. C., German Office, Unter den Linden 71, Berlin, Cable: Engminjour, N. Y. • Subscriptions payable in advance, \$5.00 a year for 52 numbers, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii, or the Philippines, \$6.50



in Canada • To foreign countries, including postage, \$8.00 or its equivalent, 33 shillings: 33 marks: or 40 francs • Notice to discontinue should be written to the New York Office in every instance • Advertising copy should reach New York Office by Thursday of week before date of issue • Entered at New York Post Office as mail matter of the second class.

VOL. 90

DECEMBER 24, 1910.

NO. 26

CIRCULATION STATEMENT

During 1909 we printed and circulated 534,500 copies of THE ENGINEERING AND MINING JOURNAL.

Our circulation for November, 1910, was 39,500 copies.

December 3.....	11,000
December 10.....	9,500
December 17.....	9,500
December 24.....	9,500

None sent free regularly, no back numbers. Figures are live, net circulation.

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*Illustrated.

The Matter of Reporting Ore Reserves

Our readers are acquainted with the position that we have held for many years, in fact, throughout our history of 45 years, with respect to publicity by mining companies, including frequent statements as to ore reserves and prospects. We have witnessed a remarkable enlightenment in this matter, first among London mine managements and later among American, and nowadays the company that does not report monthly as to its production and annually as to its ore reserves is apt to be regarded somewhat askance. There is apt to be a suspicion of some sinister reason for secrecy, which suspicion is strengthened by such revelations as have been made during 1910. Of course, we are now referring to the public companies, i.e., those whose shares are offered to the public and are the subject of trade in the open market. Of course, there is no reason why a private company like Senator Clark's United Verde should take the public into its confidence, nor is there any demand that it should. But while it is undeniable that public companies ought to estimate and publish their ore reserves, that dictum must be qualified by the proviso "if they can." There are many thoroughly honest concerns that do not attempt to communicate such information for the excellent reason that they can not do so intelligently, and might do harm to their stockholders if they tried to. Who, for example, could in any way estimate the ore reserves of Batopilas, or do justice to the probabilities of Butte or Nipissing? Apropos of this subject we received

recently a communication from a distinguished engineer who is at the head of a mining enterprise of the first order, which is deserving of careful consideration. He wrote:

"There is one thing that embarrasses me in reporting about our mines and that is the utter futility, in my opinion, of endeavoring to measure the ore in sight in the exceedingly irregular deposits that we have. I do not take a great deal of stock in drilling in a camp like this, and I can find no inducement to extend development years in advance in soft ground that requires constant expense for maintenance of drifts. I find that a great deal of my development work is done through stoping. As a consequence, on the one hand I feel the danger of doing a mine absolute injustice in estimating in a cold-blooded way, according to the technical meaning of 'ore in sight,' and on the other hand the danger of wildcatting in being too liberal with the use of that technical term. While there can be no doubt that the stockholders are entitled to full information, and while there are cases where regular orebodies can be measured with approximate accuracy, there are some deposits whereof an engineer would lay himself open to injustice to his stockholders by being overconservative, and to wildcatting if he did not use the strict interpretation of the words 'ore in sight.'

"The developments at my mines, for instance; have been remarkably encouraging during the last year, yet the openings have been in ore deposits irregular, both as to shape and the distribution of value; and while I am satisfied that we

have opened up a tonnage vastly in advance of our rate of consumption, I can only make a statement of this kind as an opinion and not as a hard and fast engineering fact.

"I write at this length because I know that the JOURNAL is striving for the publication of full information regarding reserves, and I thoroughly sympathize with it in that position. I am simply calling attention to the impracticability of it in many instances. We are all aware of the absurdity of the United States mining law, yet the law was an intelligent one provided the premises on which it was laid out had been correct. With the knowledge obtainable by Congress when the law of 1872 was passed, it was assumed that Nature had built ore deposits in a geometrical shape, and had this premise been correct and had the geometrical figures occupied approximately a vertical position with relation to their length, the law would have been an ideal one. Unfortunately the premises were incorrect. A broad deduction was made with an insufficient knowledge of facts and about as bad a law was enacted as was possible, considering the developments that followed.

"Such peculiar conditions as we have here exist in some other camps, but not in all other camps. I wish to lay stress on my opinion, that in a camp like this an engineer would be doing an absolute injustice if he made a statement of reserves based on the technical meaning of 'ore in sight,' whereas if he included probabilities in the definition of 'ore in sight' he would depart from the realms of engineering into that of promotion. It would be well enough to say that one could state the technical tonnages and qualify the statements with a description of probable ore, but the minute we get into such a position we are departing from matters of fact into matters of opinion, wherein personal equation enters heavily, which would be an exceedingly dangerous precedent to establish."

We do not think that aught but indorsement can be given to the views so lucidly expressed by our correspondent, save perhaps with respect to his concluding remarks anent "probable ore." The question of "ore in sight" has been fully threshed out, and by some persons, particularly by some of our British friends, has been too severely construed in the first emphasis upon the importance of declaring

ore reserves. We think that the term "ore in sight" should be confined strictly to its technical meaning, and the engineer should not depart from it, but we are not disposed to agree that either as an examining or as an operating engineer he should refrain from expressing himself as to "probable" or "indicated" ore. The stockholder is as much entitled to a conservative opinion in that particular as he is to a statement of the ore actually blocked out, providing the data for such an opinion exist. If the data do not exist, nothing is to be said.

The stockholders of mining companies should, of course, take the trouble to learn something about the mines in which they are interested and should discriminate between those possessing ore deposits capable of development far ahead and of measurement; and those that are not of this type. As to managers the question is not one of asking them to do the impossible or inadvisable, but broadly speaking is simply a question of being "on the square," which requires no definition. Our correspondent, in his own excellent, official reports finds no difficulty in telling his stockholders frankly about operations and prospects, even if he cannot estimate ore reserves a long way ahead. However, he tells what he knows, which is all that anyone can expect, and is quite a different matter from the cases of those managers who *do not* tell what they know.

Silver Movement for Eleven Months

The silver movement in the United States this year has shown little variation from 1909 in values, though there has been some gain over 1908. The imports and exports for 11 months were:

	1908.	1909.	1910.
Exports.....	\$47,111,382	\$52,294,344	\$51,299,913
Imports.....	37,814,676	41,984,006	41,479,718
Net exports....	\$ 9,296,706	\$10,310,338	\$ 9,820,195
App. ounces.....	17,587,000	20,021,000	18,390,000

The report gives the values; we have added the approximate quantities, calculated on the average price of silver in New York. The imports of silver are largely in the form of base bullion which comes to this country to be refined and passed on elsewhere. The proportions from the principal contributing countries this year were 60 per cent. from Mexico, 28 per cent. from Canada, and 9 per cent. from South and Central America.

This year about 81 per cent. of the exports went to London, while only 9 per cent. were sent to China direct from San Francisco. The exports from London to the East for 11 months were, in values:

	1908.	1909.	1910.
India.....	£8,369,640	£5,955,500	£6,555,600
China.....	571,400	1,829,300	1,328,500
Total.....	£8,941,040	£7,784,800	£7,884,100
App. ounces.....	87,944,000	78,634,000	76,840,000

The present has been accounted a fairly prosperous year in India; yet the sale of silver to that country, while £600,000 more in value than in 1909, was still £1,814,000 less than in 1908.

The Alaska Coal Lands

The Congressional committee investigating Mr. Ballinger has made its report (exonerating him), the matter of the Alaska coal lands is again becoming a subject of discussion, Mr. Pinchot is giving signs of an eruption; and consequently we may expect soon to be regaled *ad nauseam* with further revelations of the "Guggenheim" plot to gobble Alaska, the principles of conservation, the welfare of posterity, etc.

In reality the agent that is conserving the Alaska coal is California petroleum. The trouble with Alaska is that it has not yet got the railways that it needs. Until it obtains them the failure to develop its coal mines is no retardation of the "proper and desirable development of the Territory." If the coal, or some of it, can be bestowed so as to facilitate railway building that would best be done.

But when the railways are built they will be used to carry in California petroleum, which will conserve the coal. The man who puts his money into Alaska coal lands is likely to find that it will be tied up for a long time, which means that present value of such property is low. The "billions of treasure" were in the mind's eye of a poorly informed magazine writer and in the fantastic imagination of Messrs. Pinchot and Glavis. We have always considered the Cunningham claimants to be rather unfortunate persons. Certainly they have been ill-treated. In proposing to give them their rights, Mr. Ballinger was aiming simply to do what was proper. As for the "Guggenheims," their heirs or assigns, they will be lucky if they recoup the millions of real money that they have put into Alaska.

By the Way

The building trade in New York and vicinity is reported to be in a bad way, with large numbers of bricklayers idle and little prospect of an improvement. Consequently, the bricklayers' unions have decided to demand 75c. per hour instead of 70c. that they are getting under the present agreement.

"Nothing lost here but squeals," says the pork packer. "Are you as economical in conducting your business?" "Just about," answered the visitor. "I am a lumber manufacturer; nothing wasted but the bark." "Mere child's play," said a Broad Street professional. "I can take a mine with no ore and produce gold—from the suckers."

Pittsburg telegraphs, Dec. 19, that "prices of finished steel are again being reported cut, but this is believed to be exaggerated. When manufacturers are assured that business will be attracted by lower prices, concessions will be made." The modern commercial psychologist apparently wants the assurance of business where his forerunner boldly cut prices to create it.

Before criticizing the few deficiencies of our Daily Consular and Trade Reports, we should consider that our system is the object of envy to the *Chemical Trade Journal*, of London. "What is wanted is a system of daily consular reports, such as is issued at Washington, giving up-to-date information concerning improvements, discoveries and trading conditions all over the world."

The New York *Evening Sun* remarked that the annals of pure philanthropy have recorded nothing more touching than the dinner at Sherry's, Dec. 12, where the benevolent gathered for the purpose of devising plans to make Christmas happy for the copper industry. It is a worthy object that the good people have before them and they deserve to succeed in their efforts. Pleasantest of all it is to note that the Philanthropist Emeritus (to whom even the Laird of Skibo must give place) was an honored guest. The Era of Good Feeling has begun and 19 days ahead of the schedule.

Some of the species of cactus in Mexico contain a notable percentage of oxalate of lime. This substance gathers in the stocks in decay and during certain stages in the life of the plant and can be gathered in small quantities. The Indians sometimes burn the cactus to secure the lime for use in the domestic process of preparing the corn. The lime is found as small nodules in the ash. It has been suggested that possibly the presence of this lime compound in the cactus accounts for some of the alleged remedial properties which cactus is reputed to have had in the primitive metallurgy of the Mexicans.

Thomas W. Lawson, who previously had not been heard from in a long time, is reputed to be the author of the following communication to the press: "While I have nothing to say against, and every reason to be pleased at, the coming big story detailing the heading of the Completed Coppers—half sister to Steel—by Perkins, I strenuously object to the present intention of the publicity agent of starting off the revelation with the announcement that I am responsible for its premature publication. It should be known by this time that I never leak until leaking time comes. P. S.—I rush this preliminary denial through fear that the story may come tomorrow." Tut, tut! Mr. Lawson.

An interesting side light on India's consumption of silver is afforded by the report that her secreted wealth is now venturing into the open. A short time ago a financial adviser in northern India made the suggestion that all the existing railway lines be converted into companies for the purpose of "unearthing India's hoarded millions," the reason for the unwillingness of the natives to invest their money being, in his opinion, their lack of a ready means of selling out in time of need. But it is the Coöperative Credit Societies that have enticed the savings from the hiding places. The lieutenant-governor of the Punjab, in his review of the working of these societies in his province during the last year, states that bags of rupees crusted with mold have been deposited in the banks established in connection with these societies.

The consumption of silver in the photographic industry is probably seldom thought of by the average mining man, but it is likely that at least 4,000,000 oz. are annually consumed in this industry. A letter from George Eastman, of the Eastman Kodak Company, of Rochester, N. Y., says: "Replying to your letter we beg to say that we are now using about 125,000 oz. of silver bullion per month. We have no accurate means of estimating the total amount of silver used in our industry in the country, or in the world, but should imagine that altogether it would aggregate several times this amount." It should be remembered that the silver consumption of this industry is not like that of the Government for coinage purposes, but represents actual consumption from which there will be no ultimate recovery of silver, at least not in our generation.

Those who wonder whence comes the supply of shareholders for the innumerable enterprises launched in the East upon a foundation of loosely woven facts, should recall that all phenomena seem most wonderful to those who have the least knowledge of the subject. Persons who know nothing about mining will buy stock in a company which claims to have a mountain of ore rich

enough to pack across the desert on burro back, and the more thousands of dollars per ton that the ore is reported to run, the more pleased they are. Some of these investors, however, are good losers as witness the following quip from *Puck*: "How about that gold mine you bought stock in last year?" "Why we have called it the Bulldog. It is the bravest little mine you ever heard of." "Bravest?" "Sure. There isn't a yellow streak anywhere in it."

To get off a "sucker list," *Collier's Weekly* gives the following recipe: If you are unfortunate enough to have your name entered upon the list of possible purchasers of mining or oil stocks, fly-by-night railroad and industrial enterprises promoted by such busy experts as the postoffice authorities have lately been arresting, you are in for a vast and constantly flowing stream of literature. For "sucker lists," as the promoters call the roster of victims, actual and prospective, are traded and passed on from one flim-flam artist to another. Here is the way to stop the annoyance: Meet the letter carrier, or go personally to the postmaster, and refuse formally to receive mail from the promoter. The carrier or postmaster will then report to Washington that the addressee refuses mail. In turn, Washington notifies the promoter not to send any more mail to the address. This is an effective way to protect yourself from the numerous gold-brick financiers against whom the postoffice authorities have not as yet secured evidence enough to justify arrest and prosecution for the fraudulent use of the mails.

Mining engineers are continually astonished in finding so many capable business men engaged in mining enterprises of a character—to put it kindly—at least highly speculative; enterprises in which a mining engineer would invest only surplus funds such as he might consider he could use in a wide-open gamble. The business man, however, has the impression that he has made a mining investment offering large profits and not what should be called a speculation, or gamble. We have even known where they have made a cursory investigation of the cost of mining by a few evenings of reading, and then have predicated operating costs at some remote property upon the cost of mining and milling at the Homestake. (Ever read a gold-mining prospectus in which the operating costs were not based on those of the Homestake—or lower?) "A little learning is a dangerous thing" in mining as well as in other professions. The tyro who is about to make mining investments will do well to ponder over the advice given by Dr. Marcus Herz, of Berlin. He is credited with saying to a patient who read medical books diligently in order to prescribe for himself: "Be careful, my friend. Some fine day you'll die of a misprint."

CORRESPONDENCE and DISCUSSION

Views, Suggestions
and Experiences of Readers

The Closed Door Policy

The most natural and interesting way for the engineer, who is held over a day or so in a mining camp, to put in his spare time is in visiting the operating properties. All of us, I believe, realize the great advantage to be gained from a free exchange of ideas with other men in the profession. And by observation of the way another carries out his ideas we can quickly judge of their value to us. Furthermore, if I have to examine a property in a district that is new to me, I always like to visit the nearby mines and learn what I can from their experience. This is important in any examination.

Realizing the benefit I derive from seeing the work of others I have always been willing to do all in my power to afford similar facilities to others. Yet, how often is it the case that, when asking permission to go through a mine, a curt, "it is against the policy of this company to allow anyone underground" is the reply. I have always contended that by a policy of frankness and openness as to its operations a company justly gains the confidence of the public. (I, of course, realize that it is necessary to guard closely certain metallurgical processes.) To support this statement I can only ask you who have been lucky enough to experience the courteous treatment and assistance afforded those who desire to inspect the underground operations at the Goldfield Consolidated, Bunker Hill & Sullivan, North Star, or Homestake, to contrast the feeling of confidence you have in those companies with the way you regard certain of the Bingham Cañon, Michigan, or Shasta County copper companies which hold to the "closed-door" policy. Are you not rather inclined to believe all the tales you hear of uneconomic methods and disregard for the safety of employees at the mines that deny you admission? I am.

In the majority of cases where I have been refused admission to a mine it has been on account of a ruling of the company which took the matter of decision out of the superintendent's hands. I wonder how many directors realize the position in which they place their superintendent by taking this matter of who shall be admitted in the mine out of his hands. The directors expect their manager or superintendent to keep posted on modern mining methods, etc., and to do so he probably visits the operations

of other nearby camps whenever the opportunity presents. Yet, when the men who have extended the *entrée* to their properties to him return the visit, he is forced to admit that his company does not allow anyone underground. This comes pretty close to admitting that the directors of the company do not credit him with having sufficient discretion to look after the company's interest in this matter. Rather than be so humiliated many times I believe that most of us would lose all interest in other operations than our own. And this does not mean increased efficiency but getting into a rut, working out the problems that have already been solved elsewhere—in the end, a loss to the company.

There is also, I admit, the type of superintendent who desires an absolute company ruling in this matter so as to take the responsibility from his shoulders. I need not discuss this phase of the subject for, from what I know of this type of man, I feel sure that his mine will have little to teach, at least in the line of mining methods.

To me the "closed-door" policy and ambiguous yearly reports indicate the same condition—something to hide—and, although this may not always be true, I, for one, am certainly inclined to base my judgment of a company upon its policy in these matters.

J. K. HUDSON.

San Francisco, Cal., Dec. 10, 1910.

Will Mining in Colorado Be Restimulated?

In an editorial that appeared under the above head in the JOURNAL of Nov. 26, 1910, it was stated that: "Any mine than cannot be worked profitably under present market conditions is not worth considering.

Nor is there much to be hoped for a further reduction in smelting and railway rates." No mention is made of important changes that are making possible the profitable operation of mines that cannot be worked profitably under existing conditions. One of these changes is described in detail in a recent address¹ by Philip Argall. Mr. Argall notes a reduction in the cost of treatment from \$15 a ton in 1894 to \$1.50 per ton in 1910, and he predicts a further reduction to \$1.25 and \$1 per ton. What has been accomplished at Cripple Creek has been possible because some of the Cripple

¹"Decreasing Mining Costs and Increasing Profits," published on page ??? of this issue of the JOURNAL.

Creek companies have had the capital and the material necessary for milling on a large scale. Mr. Argall points out the same thing can be done, through consolidation or coöperation, by the smaller companies. With consolidation of ownership and coöperation in the construction of milling plants, there is possible a large increase in the field of profitable operation at Cripple Creek, and a still larger increase in other mining districts of Colorado.

Other changes are all the time adding to the number of mines that can be worked at a profit. Among them are connections with the Newhouse tunnel in Gilpin county, the extension of the distributing lines of the power companies in Boulder and other counties, the construction of a tramway to the Montezuma and Argentine districts in Summit county. Much has been done, and much remains to be done, in milling complex sulphide ores, notably those carrying zinc. The same is true of tungsten and vanadium ores. Even in smelting, the possibilities of local plants producing a low-grade matte have not been exhausted. Alma has a new smeltery, the Golden plant is in successful operation, and Red Mountain will have one completed next year.

Although, as the JOURNAL says, not much is to be hoped in the further reduction of railway and smelting rates, other changes here noted are constantly making orebodies valuable that hitherto have not been attractive for profitable mining.

CARL H. PADDOCK,

Mining Representative of the Colorado State Board of Immigration.

Denver, Colo., Dec. 5, 1910.

Company Reports

After reading with great interest a large number of company reports published in the JOURNAL, I am impressed with the unsatisfactory nature of the most of them. I fail to understand how stockholders are satisfied with abstruse statements which really give no definite information as to actual financial status. A simple statement of the profit and loss realized from the year's operations would be much more valuable to the investor than unintelligible financial statements, or even descriptions of geologic formations, high extractions, etc. The extraction of net profit is the interesting fact to the stockholder.

J. T.

New York, Dec. 18, 1910.

QUESTIONS and ANSWERS

HEATING ZINC-ORE BINS

We have fitted our zinc-ore bins with live-steam coils in which the pressure ranges from 20 to 100 lb. Is the sulphur in the ore likely to take fire from the heat of these pipes? F. M. C.

If the steam is not superheated, even at 100 lb. per sq.in., it will not set fire to pure zinc blende, as it requires about 550 deg. C. to start the combustion of the blende, while steam at 100 lb. gage pressure has a temperature of 170 deg. C. If there is pyrite associated with the blende, the kindling temperature will be lowered, but you probably need have no fear with any commercial zinc ores.

IRON AND STEEL DIRECTORY

Have you the latest edition of Swank's "Directory of Iron and Steel Works in the United States" and does it give the officers and directors of the different companies? C. S.

"The Directory of the Iron and Steel Works of the United States is published by the American Iron and Steel Association, 261 South Fourth street, Philadelphia. It gives full details concerning officers, directorates, capitalization, equipment and production of all the iron and steel companies of the United States, along with much general statistical information.

ANTIMONY ORE

We wish that you would inform us where we can find a purchaser for a quantity of antimony ore. We notice that it is quoted each week in the JOURNAL, but have not been able to find any customers for it. E. W. S.

It is doubtful whether you can find a purchaser for it in this country, as there is no antimony ore smelted in the United States. If you will communicate with the firm of Edw. Hill's Sons & Co., 71 Pine street, New York, you can secure information as to whether it is possible to secure a market abroad for it. The price quoted in the JOURNAL is for metallic antimony, and includes an import duty of 1.5c. per lb. and the ocean freight.

RECOVERY OF CADMIUM

What is the method generally adopted for the extraction of cadmium? A. E.

The usual process for the production of cadmium depends on the differences between the reduction and the distillation temperatures of zinc and cadmium, the latter being found as a minute impurity in zinc ores. At the temperature at which zinc begins to reduce, cadmium is

reduced rapidly, while the boiling point of the former is above, and of the latter below the reduction temperature. Consequently, the first distillate in the condensers and the powder or metal in the prolongs show a high concentration of cadmium, and the pure cadmium is obtained by repeated redistillation of these portions.

Metaux et Alliages recently described an interesting new process said to be used at Marienhütte, for the production of cadmium from the solutions intended for the production of lithophone, to which cadmium gives a yellow color. The impure solutions are electrolyzed, using a zinc anode and lead cathode. The impurities, such as iron, manganese and cadmium deposit on the cathode in the form of a slime, from which the cadmium is extracted by distillation.

GOLD DREDGING COMPANIES

Will you please send me the names of the companies that are operating gold dredges in California, also in Colorado, Idaho and British Columbia, if any? L. A. P.

The following is probably not a complete list, but includes the leading companies of California: Natomas Consolidated of California, Folsom, Cal.; Yuba Consolidated Gold Fields, Hammonton, Cal. and Oroville Dredging, Ltd.; Oro Water, Light and Power Company; Leggett Gold Dredging Company; El Oro Dredging Company; "Gardella" (private dredge); Cherokee Gold Dredging Company; Pacific Dredging Company; Ophir Gold Dredging Company; Pennsylvania Gold Dredging Company; all of Oroville, Cal. In Colorado, the Colorado Gold Dredging Company, of Breckenridge; in Idaho, the Boston-Idaho Gold Dredging Company at Idaho City; and in Alaska, the British Columbia & Yukon company, and the Yukon Gold Company are all operating dredges. The most recent literature on this subject is "Gold Dredging in California," issued as *Bull. No. 57* by the California State Mining Bureau, Ferry Building, San Francisco; costs \$1.50 paper, or \$2 cloth, plus \$0.20 postage; Mr. Tyssowski's paper on this subject in the JOURNAL of Oct. 15, 1910; also a paper by George B. Massey II, in the JOURNAL of Oct. 29, 1910, on "Gold Dredging in the Seward Peninsula." If North American dredging is under consideration, the important work of the Courey Placer Mining Company, near Ruby, Mont., should not be overlooked.

INFUSORIAL EARTH

Can you put me in touch with some users of infusorial earth, and advise me of the amount imported by the United States? F. H. B.

The following are dealers in infusorial earth: W. H. Whittaker, 245 Front street, New York; Hammill & Gillespie,

240 Front street, New York; T. Van Amringe, 241 Water street, New York. The prices for infusorial earth range from 1¼c. to 8c. per lb. depending on color, etc. The chief consumers are explosive makers, and manufacturers of non-heat-conducting materials and cleansing compounds. Of course the price paid to the miner will be in strict proportion to the quality of infusorial earth he can deliver. We are unable to answer your question as to the amount imported as this material is grouped in the Government reports under miscellaneous earths, of which the United States imported 26,700 tons in 1909. Possibly you could get this information by writing to the Bureau of Commerce and Labor, Washington, D. C.

COLLOIDAL GOLD

Can you inform me of a form of gold known as "colloidal," and can you refer me to any publication or book that describes it? I am told that it can be extracted from certain ores by electro-cyanidation. W. W. M.

The adjective "colloidal" is applied to those substances which, in solution, either will not pass, or pass only with difficulty through a porous membrane such as filter paper, etc., gelatin and the allied substances being the standard examples. It is possible to subdivide metals to such an extent that the particles suspended in water behave as do the solutions of gelatinous substances above referred to, and these metals are then said to be in the colloidal state.

Such a colloidal solution of gold may be produced by electric sparks between gold electrodes immersed in water¹, or by pouring an ethereal solution of gold chloride (the chloride having previously been heated to 170 deg. F.) into acetylene water containing ether². Some of the interesting properties of colloidal solutions of metals are that each particle carries a negative electric charge, and that they are precipitated by solutions of electrolytes. Other references can be found below³.

We may add that M. Carey Lea, of Philadelphia, has done a great deal of work on colloidal gold and silver, but we are unable to give you the exact references to his published articles. Perhaps you can find them in your public library.

If your question means that the gold exists in the rock as "colloidal gold," and can be extracted only by electro-cyanidation, the statement concerning the "colloidal" state is open to doubt, and seems to be a new disguise for "green" gold, etc. If it means that during electro-cyanidation the gold is at some time in the colloidal state, this is quite possible, although what advantage this can be, if any, we are unable to determine.

¹London, Edinburgh and Dublin Phil Mag., Vol. XI, p. 426.

²Am. Journ. Sci., Vol. XVI, p. 381.

³Am. Journ. Sci., Vol. XVI, p. 433. Pop. Sci. Monthly, Vol. LXVII, p. 268.

DETAILS of PRACTICAL MINING

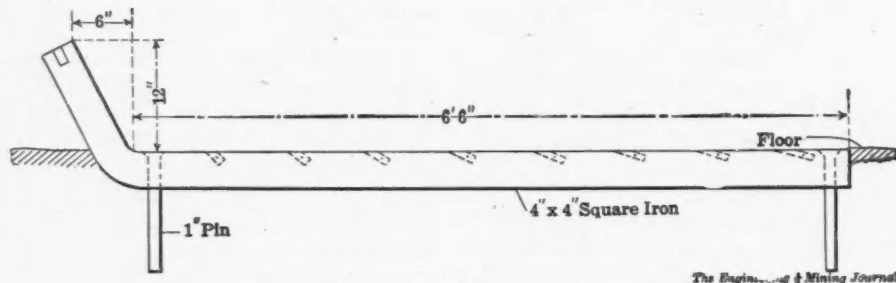
Notes of Interest to Prospectors and Operators of Small as Well as Large Mines. Things That Have to Be Done in Everyday Mining

Handy Drill Sharpening Device

BY LEE L. WILCOX*

In a shop where the drills are sharpened by hand, the device illustrated has been of great assistance. A 4x4-in. bar of square iron is bent up at one end as shown in the sketch. Holes are then drilled along the top at an angle, so that the shank of a drill inserted in the hole will lie across the horn of the anvil. These holes can be spaced according to the different lengths of drills used. In our case we use a 9-in. spacing. A hole is also drilled in the top of the end turned up, for the short starting drill. Holes are also drilled for pins, one at each end. One-inch pins, with countersunk heads are inserted in these.

The whole device is set flush with the



HANDY DRILL-SHARPENING DEVICE

blacksmith-shop floor and, as said above, in such a position that a drill, placed in any one of the holes, will lie across the horn of the anvil.

In using the device, the blacksmith places the drill in one of the slanting holes, places his sharpening tool on the bit and his helper pounds away with no inconvenience whatever to the blacksmith. It not only saves time in sharpening, as the helper can strike good hard blows, but it takes away the jar on the blacksmith's arm.

Rust Remover

For removing rust, a French contemporary advises, instead of emery, the following: Moisten with a 50 per cent. solution of potassium ferrocyanide, then rub with a paste consisting of potassium ferrocyanide, 60 parts; soft soap, 60 parts, and calcium carbonate, 120 parts, to which is added enough water to make a thick paste.

*Mining engineer, Gilbert, Minn.

Lighting Haulage Ways

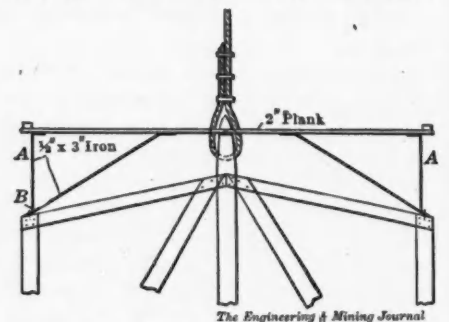
If electric light were more used in main tramping drives, filling and tramping would be effected more rapidly, defective rails could more easily be detected and attended to, and there would be far less risk of collisions or other accidents during tramping operations. R. G. Mackie discusses this subject at length in the *Journ.* of the Transvaal Institute of Mechanical Engineers, Oct., 1910. He states that the great waste of candles occurring on account of the movement of trucks or the natural air current in the drives would also be obviated. The tramping cost per ton would, it is certain, benefit considerably by the application of plenty of light to tramping roads.

A 2000-volt current could be taken to central stations and transformed for light-

the shaft. Good supervision of a bend also tends to minimize the wear of the hoisting ropes. At present it is impossible to see if the pulleys revolve freely from the ladder, and hoisting has, therefore, to be stopped in order that the bends, pulleys, etc., may be safely, carefully and systematically examined. This inconvenience tends toward the neglect of the shaft. The placing of lights in a shaft bend would require them to be securely protected on the top from falling stones or other objects.

Platform for Shaft Repair Work

The accompanying sketch shows a platform that is used at some of the Michigan iron mines for repair work in shafts. The platform is made of 2-in. plank with an iron leg *A* just high enough to support



PLATFORM FOR SHAFT REPAIRING

ing purposes. Due consideration would have to be given to the proximity of blasting operations when installing electric light underground. The lighting of a colliery is a simpler matter than the lighting of the Rand mines; the concussion here due to blasting is greater, than in coal mines. The filament for the lamps would require to be well stayed for underground work, and the lamps switched off during blasting. The metallic-filament lamp would not, I am afraid, be suitable for underground lighting purposes. If it could withstand the vibration caused by blasting, a great saving in power and copper would result. The system has a continuous current supply at 500 volts on the main conductors with two 250-volt lamps in series. The risk of accidents with this arrangement is considerable and its use should not be permitted by law.

If the bends or compound shafts were well illuminated by electric light, a defective pulley or a loose angle iron or rail could be noticed by anyone passing on the ladder way, and accidents to the skips avoided at this most particular portion of

the plank at the same level as the bail of the cage. The platform is made in two sections and is fastened together in the center near the cable. The iron legs may also be temporarily bolted to the top of the cage at *B*, thus making it perfectly secure.

Cleaning Grease from Glass and Metals

The difficulty of completely removing grease from laboratory apparatus or metals to be electroplated is well known to all workers along these lines. The trouble is that even if the greasy matter be completely soluble in alcohol or other solvent, the residual portion of the solvent left on the surface to be cleaned will quickly evaporate and again leave a small deposit. C. Benedicks suggests (*Engineering*, Nov. 11, 1910) that if the object to be cleaned be held inverted while cold over alcohol heated by means of a water bath, the alcohol vapor will condense, run down and clean the surface.

As soon as the object to be cleaned attains the temperature of the vapor, condensation will cease, and it must be removed and cooled, if it is not already clean, and the process repeated.

Mine Model for Inclined Veins

The ordinary mine map is so confused with the many workings that are projected from the different levels on one plane that it is difficult to get a good understanding of the workings as a whole. Models are, in many instances, quite useful in planning development work. In steep veins, glass models are generally used, but these are not so well adapted to flat veins.

At the North Star mines an ingeniously constructed model is used, and it gives an excellent idea of the vein. The levels only are shown, and only a portion of the different stopes on a level are represented. An accompanying halftone en-

ordinate plane is easily determined by the elevation of the working as shown in the level-book notes and projected on a longitudinal vertical plane. The co-ordinate planes are painted black, so that they do not show well in the picture, and they look crooked owing to the angle from which the picture was taken.

Tube Mill Power

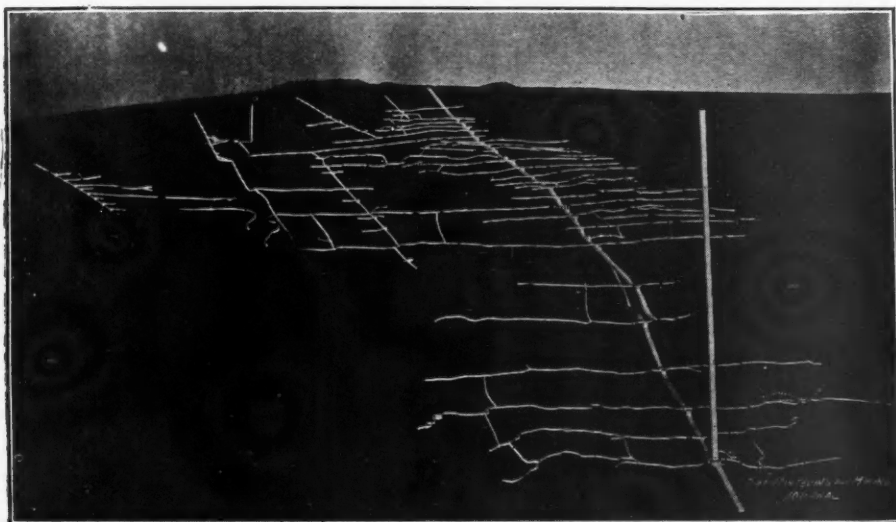
BY H. E. WEST*

Considerable misconception exists with regard to the power necessary to drive tube mills. Usually the power is under-

POWER CONSUMPTION OF TUBE MILLS, EL ORO MINING COMPANY, AUGUST, 1910.

Mill Number.	Type.	Rated Horsepower of Motor Drive.	Actual Kilowatts.	Hours.	Kilowatt-hours.	Corrected Line Load.	Cost.
1	Abbé.....	50	35	737	25,795	26,886	\$201
2	Abbé.....	50	35	707	24,745	25,790	193
3	Krupp.....	..	30	732	21,960	22,890	171
4	Krupp.....	..	40	651	26,040	27,150	203
5	Krupp.....	..	67.5	711	47,992	50,000	374
6	Krupp.....	75	46	707	32,522	33,900	254
7	Krupp.....	75	42	732	30,744	32,040	239
8	Krupp.....	75	44	592	26,048	27,150	203
9	Krupp.....	75	42	720	30,240	31,520	236
10	C. & W.*.....	..	73	730	53,272	55,740	414
11	C. & W.*.....	..	72	724	52,160	54,370	406
12	C. & W.*.....	..	79	731	57,696	60,136	450
4, 5, 6	Shafting.....	..	24	735	17,640	18,390	137
.....	.....	..	..	.....	.....	.....	\$3481

*Chalmers & Williams bevel-gear.



MODEL OF NORTH STAR MINE, GRASS VALLEY, CAL.

graving does not do justice to the model, which is one of the most intelligible that I have seen.

The levels are made of copper wire painted white. As the wire is easily bent, the different levels are readily brought up to date by taking the level wire off the model and laying it on the model map, kept especially for the purpose. The new footage is easily added by brazing the new piece of wire to the old one after it has been bent so as to conform to the level as shown on the model map.

The different wires representing the levels are held loosely in notches cut in vertical pieces of board, which represent one set of the coördinate planes used on the map. New notches are cut in the supports by simply measuring from the model map the points at which the new workings cut the different coördinates. The height at which they cut the co-

The shafts are represented by means of strips of wood sawed by a scroll saw to conform to the dip of the shaft. The model is brought up to date once every six months, and the great advantage of this type of model is the ease with which it is brought up to date, owing to the fact that the part representing any working can be taken out quickly and replaced. The copper wire lends itself readily to the representation of the different workings. The general scheme of the model and the details of its construction were worked out by A. D. Foote, the manager of the North Star Company at Grass Valley, California.

An electro-cyanide process is being tested by John R. Parks in an experimental plant erected at Hollywood, near Los Angeles. A current varying from 9 to 14 volts and from 2½ to 3 amp. per sq.ft. of anode surface is used.

estimated. It is therefore of interest briefly to examine the recorded power consumption of any installation, such as that given in the accompanying table, which is the Aug., 1910, record of the El Oro Mining Company, El Oro, Mexico.

In the third column is given the rating of the motor driving the mills, each of which has its own motor, except Nos. 3, 4 and 5, which are driven from a line shaft. The last three have bevel-gear drive in contradistinction to the plain gear of the others. In size the first three are approximately equal to the Krupp No. 3 mill (old classification), 4½x16 ft. long; No. 5 mill, which is a Krupp No. 5 size, is 5x26 ft. The remainder of the Krupps and Nos. 10, 11 and 12 are equal to Krupp No. 4, 5x21 feet.

It will first be noticed that, with rare exception, all mills worked practically full time. It will next be noted that the power varies considerably. This is particularly seen in the last three mills, with the bevel-gear drive. Doubtless this drive contributes decidedly to the extra power consumed, as does also the heating of the roller axles supporting the tire end, through insufficient area. In addition these mills are well loaded with crushing rock, working on the reground sand. It should also be noted that the ribs in the El Oro lining lift the pebbles high.

All these motor-driven mills are belt connected. At the Mexico and Esperanza mills, the drive is direct through a flexible leather-link coupling, which is preferable. The mills are continually fed by hand with regrounding rock, introduced through the lower end by means of a worm feed, so that the load is fairly constant.

Power at El Oro, supplied by the

*Mining engineer, 375 Sutter St., San Francisco, Cal.

Mexico Light and Power Company from Necaxa, 175 miles distant, costs \$50 per horsepower-year. This low rate permits the extensive use of tube mills, which, as shown, are large consumers of power. Where power cost is high, through unfavorable local conditions, the extensive use of tube mills is questionable. There is considerable difference in the performance of these mills. I have had experience with tube mills of diverse makes, and my own preference is unqualifiedly given to the Krupp mills.

For machines of such simple construction, it is surprising what inherent defects rapidly manifest themselves in both inferior design and workmanship. The heavy weight of the mills, lining, pebbles and charge, with the rapid rotation, from 27 to 32 r.p.m., are doubtless integral factors in testing both design and construction, affording, at the same time, explanation of the large power consumption.

Starting a Ventilating Fan Automatically

BY J. H. DIETZ*

I note on page 896 of the JOURNAL, Nov. 5, 1910, a description of a device for starting a ventilating fan automatically, and for the benefit of others who may have read this would call their attention to a similar, but different, installation made at the coal mine of the Laning-Harris Coal and Grain Company, at Wellington, Missouri.

The fan at this mine is of the propeller type, belt driven by a 15-h.p. direct-current motor, and is placed directly in the air course, 1500 ft. from the mouth of the slope. The motor is operated by a type 70 Cutler-Hammer self starter, which replaces the elaborate mechanism Mr. Worcester has attached to his ordinary starting compensator. The simple solenoid, drawing the starting switch slowly over the contacts as soon as the current is turned on, takes the place of the counterweight, oilcan, 6-in. pipe and system of levers described in the article mentioned. The fan can then be stopped or started from the engine room simply by opening and closing the switch, which is equipped with a counterweight for closing, operated by a string attached to the winding stem of an ordinary one-dollar alarm clock. This enables the fan to be started from the engine room at any predetermined time, and makes a simpler, cheaper, more convenient and reliable arrangement than described by Mr. Worcester, with the advantage that it can be purchased properly made and ready to install.

VARIABLE-SPEED CONTROLLER ON MOTOR

The fan was manufactured and the starting arrangement installed by the

*Mining engineer, Fort Scott, Kan.

Eagle Foundry and Machine Company, of Fort Scott, Kan. In addition to the equipment described, the motor is supplied with a variable-speed controller, without release, so that the fan can be operated with a 50 per cent. variation in speed, depending on the weather conditions and the mine resistance. This fan requires no attention, except for oiling, and is equipped with special self-oiling boxes, so that one trip a week is sufficient attention for the entire equipment.

When the fan was installed, there was a delay in shipment of the speed controller, and the fan was connected direct and run at the normal speed of the motor.

The fan gave so much air that it became necessary to cover one-half of the discharge opening with a temporary wood brattice to enable the miners to hold a light anywhere in the workings. The fan is now running at minimum

engineers, \$4.04; track men, \$2.10; surface foremen, \$3.37; pit foremen, \$4.13.

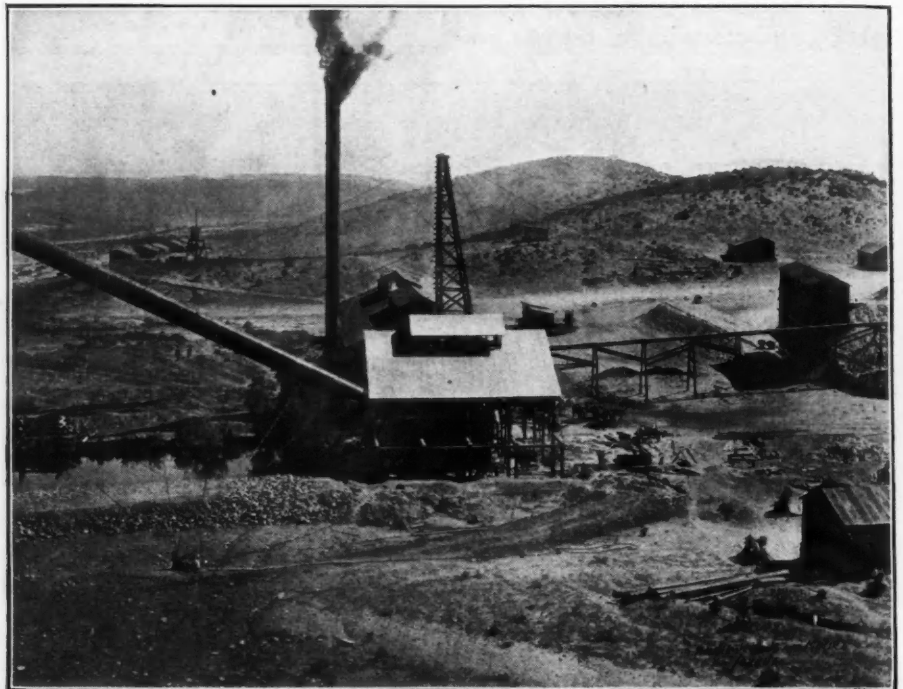
The wages paid for underground employees are as follows: Mine captain, per day, \$5.04; shift boss, \$3.10; contract miners, \$2.80; miners on company account, \$2.44; timber men, \$2.73; motormen, \$2.38; rock pickers, \$2.15, and \$2.30 for general labor.

Raising a Smokestack

BY GEORGE A. LAIRD*

How large a stack can be hoisted as a unit, and what size stack must be built up?

As illustrating what can be done with no other equipment than usually at hand at almost any mine the Candelaria Mining Company at San Pedro, Chihuahua, has just successfully raised, in one



HOISTING SMOKESTACK AT CANDELARIA MINE, SAN PEDRO, CHIHUAHUA, MEX.

speed, with capacity for 50 per cent. increase, to take care of the future growth of the mine.

Wages Paid on the Mesabi Range

The following figures are taken from the county mine inspector's report for the year ended June 30, 1910. The wages are the average for the mines in St. Louis county, Minn.: Mining engineers, per 10-hour day, \$3.84; assistant engineers, \$2.57; chemists, \$3.25; carpenters, \$3.12; masons, \$3.68; machinists, \$3.53; blacksmiths, \$3.16; steam-shovel engineers, \$6.26; crane men on steam shovels, \$4.52; firemen on locomotives, \$2.53; locomotive

piece, a stack 6 ft. in diameter and 120 ft. long. The stack was elevated 6 ft., shifted to one side 8 ft. and set down on a cast-iron bedplate with a 2-in. ring inside.

The tower shown in the accompanying photograph is 80 ft. high, built of 2x6-in. timbers with a sheave on top over which passed a 3/4-in. steel rope. The pull, a 5-strand 1/2-in. plow-steel rope to men. The stack is built of 40 ft. 5/16-in. steel, 40 ft. of 1/4-in. steel, and 40 ft. of 3/16-in. steel, and weighs 15 tons. The end thrust at the first pull was sufficient to cut an 8x8-in. Mexican pine timber into three pieces, each side of the stack going clear through.

*Mining engineer, San Pedro, Chihuahua, Mexico.

Innovations at the Simmer & Jack Mine

The Simmer & Jack property on the Rand was recently visited by the Chemical, Metallurgical and Mining Society of South Africa, to inspect a number of innovations. According to the *South African Min. Journ.*, the sand-filling system was of especial interest. The 60 per cent. of clean sand yielded by the crushed ore occupies about the same space in the mine as the ore before it was mined, a fortnight earlier. The sand drains readily underground, yielding a clear effluent. The bore hole through which the sand pulp is introduced into the mine is about 180 ft. vertical. The thick sludge, which contains only about 30 per cent. moisture, then flows on a wooden launder, and its further incline travel is assisted by the addition of a spray, the consistency then being about 1.4 of water to one of sand,

on the plates in the tube-mill circuit.

In the tube-mill classification one diaphragm-cone classifier, 5x9 ft., is employed for each tube mill. The classifier underflow is about 400 tons of sand per 24 hours, as a pulp containing about 27 per cent. moisture.

BATTERY SAND CLEANUP PLANT

The plant for the reduction of the rich mill by-products includes a tube mill, 3 ft. 6 in. x 6 ft., followed by a small shaking amalgamating plate. The fine tailings from this crushing and amalgamation are pumped to two air-lift cyanide vats, 10 ft. in diameter by 18 ft. deep, one of which is used for collecting and the other for treatment. The vats have 60-deg. bottom grade and are filled with Adams cut-off gates. A considerable amount of mercury and amalgam is recovered in these vats, or dissolved in the cyanide solution and subsequently recovered on the zinc shavings, from which

into evaporating beds to concentrate and crystallize under the action of the sun.

In the installation referred to, however, the rock salt is mined directly in its crystal form. The original shaft was sunk with difficulty, as a result of encountering several underground streams, and after mining operations were begun it soon proved impossible for the workmen to stay in the chambers for more than half an hour at a time on account of the sulphurous fumes liberated from the mine water, by the heat from the steam-driven pump, which had to be operated continuously to keep the shaft free of water. As the pump was at the 750-ft. level the large condensation in the steam line also made operation unsatisfactory in point of expense. A compressed-air lift was next considered but this idea, according to the *Electrical World*, was abandoned on account of the inefficient performance of such an installation. Accordingly electric pumping was resorted



CALDECOTT SAND TABLES AND CONE CLASSIFIERS AT SIMMER & JACK MINE, SOUTH AFRICA

by weight. Three more holes are being drilled so that the filling process can be conducted on a larger scale.

CONTINUOUS SAND-COLLECTING PLANT

Three sand filter tables 25 ft. in diameter are installed, of which one is a spare, two readily handling the total production of 1300 tons of sand daily. The sand from the filter tables is transferred with cyanide solutions as a pulp to the cyanide-treatment vats. No washing cones are employed in addition to the four 8x10-ft. diaphragm cones above each table. Six similar return sand cones following the table cones are in use. By means of this installation the renewal of a large number of old wooden vats has been avoided and better extraction obtained.

NO AMALGAMATION AT THE STAMP BATTERIES

Twenty-four sand batteries at the Simmer & Jack mill are equipped with short wooden observation tables only, without amalgamating plates, the pulp being elevated to classifiers for amalgamation

it is obtained later by condensation during calcination of the zinc-gold slime. The cyanide treatment in the air-lift vats yields about 98 per cent. extraction, and comprises repeated agitation by air and the circulating pump, with alternate settlement and decantation of the gold-bearing solution.

Motor Driven Pump in Deep Salt Mine

An unusual installation of a motor-driven pump was recently added to the lines of the Detroit Edison Illuminating Company for freeing one of the salt mines of the Detroit Salt Company from ground water. A wide area in the vicinity of the city contains large deposits of rock salt at a depth of about 750 to 1000 ft. below the surface. The usual method of recovering the salt from these beds is to pump water down wells leading to underground caverns in the rock salt, producing brine by solution, which is returned to the surface, where it is run out

to, and duplicate equipment installed as reserve against possible breakdown.

The pumping units comprise 225-h.p., 440-volt squirrel-cage induction motors, direct connected to six-stage centrifugal pumps delivering 750 gal. per min. against the head of 750 ft. As this installation runs at a comparatively low temperature, the former liberation of the sulphur gases dissolved in the mine water is avoided, and the workmen now remain in the shaft throughout their shifts without sign of discomfort. On account of the destructive action of the sulphur and salt-laden moisture everywhere in the mine, special precautions had to be taken to inclose the motors and protect all wiring in lead-covered cable, and special weatherproof sockets are used in the lighting of the underground passages. The fully loaded pump takes 208 kilowatts.

The Robinson Gold Mining Company, South Africa, reports a working profit for the third quarter of 1910 of 72 per cent. of the total value of the gold recovered. The ore ran \$9.83 per ton, and 161,214 tons were milled.

Fast Driving at the Goldfield Consolidated Mines

BY CLAUDE T. RICE

Some fast driving has been done at the different mines of the Goldfield Consolidated Company during the last few months. All the development in the camp is done by means of small, one-man piston drills. The drills used by the Consolidated company were A50 Ingersoll-Sergeant machines. It is thought that the driving of 260 ft. in a 5x7.5-ft. drift with only one working face, in 30 days is a record for two-shift work with only two men working on each shift, a machine man and a shoveler.

GENERAL CONDITIONS UNDER WHICH WORK WAS DONE

The rock in which the driving was done is dacite, in which the feldspars have been changed to alunite, while there has been an addition of some silica in much of the rock in which these drifts were driven. The rock is in general good drilling and good breaking ground, requiring but little timber as the costs for timbering indicate. But wherever there has not been much silicification of the dacite when it was altered, the rock is dead and will not throw "its mud" on water holes, requiring frequent use of the scraper.

Wet spots were struck in places in all these drifts, but in few instances was there enough water to require the men to wear slickers. While the water hampered the mucker during tramming, owing to the chafing of his body by the wet clothes, this was to a large extent offset by the fact that the moisture "killed" the powder smoke quickly. There was fair air in all the drifts except that driven on the 1000-ft. level where the air was poor at times. The temperature in the drift driven on the 1000-ft. level was above 80 deg. F. and that affected the men somewhat. The tunnel on the 1000-ft. level was driven under worse conditions than prevailed in the other two.

DRILLING OPERATIONS

In all the drifts the machine man drilled from a cross bar and had to make two setups to get in the round. He made it a point to finish the holes drilled from above the bar by noon. In the case of the record drift on the Laguna 600-ft. level, the machine man mucked while the shoveler ate his lunch.

The ground in the different drifts broke with from eight to 10 holes per round. The round as drilled by the men who made the record is fairly typical of the other drifts. They used in most of the ground two roof holes, two breast holes, three cut holes, one easer (drilled

in front of the center cut hole) and two lifters. The easer was drilled about 4 ft. deep; the cut holes about 8 ft. deep and the other holes from 6 to 6½ ft. This required about 65 ft. of holes to be drilled with two setups of the machine to be made each shift, besides tearing down and blasting. The main obstacle in making the record was the mucking, although the ground did not break ahead of the holes. The machine man generally gets the honor of records, but the problem in small drifts, where the rock is of usual hardness, is really to get the broken rock out, rather than the round in. An air pressure of about 80 lb. per sq.in. at the machine was used.

TIME AND RATE OF DRILLING

George Fisher and H. Stroeder were the machine men in the record drift, the 302 on the Laguna 600-ft. level. C. M. Woody mucked on one of the shifts all through the 30 days, while on the other shift Paul Zappetini mucked 19 of the shifts and Archie Hopper the other 11 shifts. The advance per shift averaged, during the month, 4 ft. 4 in., but during the last four shifts the men drove the drift ahead 21 ft., or an average of 5 ft. 3 in. per shift. The average amount of waste broken per shift was 13 tons and the shoveler had to tram this waste in cars holding 21 cu.ft., a distance of 800 ft. The men did not do any timbering.

In driving the 466 drift on the bottom level of the Combination mine, A. Fraser ran the drill on one shift through the 27.5 days that the record was made, while F. Stafford ran the machine 22 days on the other shift and A. Smith the other 5.5 shifts. W. Johnston did the mucking on one of the shifts during the 27.5 days, while on the other shift Thomas Main also mucked full time. The men advanced the drift 228 ft. in the 27.5 days, or an average advance of 4 ft. 2 in. per shift. The men also placed five sets of timbers, which was the equivalent of driving another 15 ft. so that their real advance per shift, had they done no timbering would have been about 4 ft. 5 in. or slightly greater than that of the men who made the record of 260 ft. in 30 days. The length of tram in this drift was 1200 ft.; so considering that the main problem in these small drifts is the mucking, this drift, in many respects, represents the best work.

G. W. Walker and Joseph Binder were the machine men and L. R. Cremer and Joseph Didovich were the shovelers on the 602 drift of the Jumbo 1000-ft. level when they advanced the drift 203 ft. in

29 days. This is at the rate of 3 ft. 6 in. per shift. There was a tram of 1200 ft. and the temperature was over 80 deg. F. In all these drifts the men had to lay the track.

PAYMENTS BY BONUS SYSTEM

In this fast driving, the men worked on a day-pay bonus system. Up to an average of 1 ft. of advance per day per man working in the drift (four per day as there were two on each shift in all these instances), the men were paid by the day. For all distance driven above that footage the men were paid a bonus of one dollar per foot per man in the Laguna and Jumbo drifts, while in the Combination drift as the conditions were more favorable, the men were paid a bonus of 50c. per man per foot.

PRICE OF LABOR AND SUPPLIES

In regard to the cost per foot of the drift, it must be borne in mind that at Goldfield framed timbers cost at the rate

COST PER FOOT OF DRIVING DRIFTS, GOLDFIELD, NEV.

	Laguna Drift.	Combina-tion Drift.	Jumbo Drift.
Distance driven, ft.	260	228	208
Number of days of two shifts each worked ..	30	27½	29
Advance averaged per eight-hour shift	4ft. 4in.	4ft. 2in.	3ft. 6in.
Number of men working on each shift	2	2	2
Distance trammed, ft. . .	800	1200	1200
Machine-drill, charge ⁽¹⁾ ..	\$0.41	\$0.37	\$0.51
Timber	0.64	0.26	0.21
Explosives	1.00	0.93	1.02
Labor	4.24	2.91	4.15
Hoisting ⁽²⁾	0.28	0.63	1.02
Total cost per foot ..	\$6.57	\$5.10	\$6.91

¹In calculating the machine cost, which covers the cost of machine-drill repairs, new parts, lubricant and compressed air, the average figure of last year for this item is used, which was \$1.83 per machine shift.

²Part of waste from drift used as filling in the stopes.

of 4c. per board foot; 40-per cent. dynamite costs 14.5c. per lb. at the mine and that the wages are \$4 for machine men and \$3.75 for shovelers per eight-hour shift. The reason that the cost of hoisting is so low in the record drift is that a good deal of the waste was used for filling in stopes below that level. In the other cases all the waste was hoisted to surface. An accompanying table shows the cost per foot of the different items in these three drifts.

It is well to note that these fast records for driving with a crew of only four men were all made under a bonus system. It is only under such a system that a high efficiency can be obtained

among the men, and it is to be hoped that the bonus or else the contract system will become more common in the Western camps, not only for development work, but also in mining. Moreover, many parts of the mill work can be done to good advantage on either the contract or the bonus system. Either method obtains about the same result, provided that the company does not begin to cut down the rates just because the men by exceptionally efficient work make more money than they would when working by the day.

The average cost attained in driving these drifts is not much less than that ordinarily attained in the mines. The main advantage in this instance has been the speed at which the drifts were driven. If it had been low cost that was aimed at the drilling would have been done on one shift and the shoveling on the other. For permission to use these data, I am indebted to J. R. Finlay, manager of the Goldfield Consolidated Mines Company.

Precious Metal Production of the World

The accompanying tables of relative standing of the gold- and silver-producing countries of the world is compiled

GOLD AND SILVER PRODUCTION OF THE WORLD.

GOLD.		SILVER.	
Country.	Per Cent. of Total.	Country.	Per Cent. of Total.
Transvaal.....	32.7	Mexico.....	32.2
United States.....	21.6	United States.....	26.0
Australasia.....	15.5	Canada.....	13.4
Russia.....	8.1	Australasia.....	7.6
Mexico.....	4.9	Germany.....	5.7
Rhodesia.....	2.8	Bolivia.....	3.1
India.....	2.3	Peru.....	2.9
Canada.....	2.2	Spain.....	2.0
China.....	1.1	Japan.....	1.9
All others.....	8.8	All others.....	5.2
	100.0		100.0

from statistics for 1909 in "The Mineral Industry." The predominance of the Transvaal in gold production is overwhelming.

The total value for 1909 of the world's gold production is estimated at \$459,486,282, and of the silver at \$106,806,852. The decline of the former silver treasure houses of Peru and Bolivia is remarkable.

Niagara Alkali Company

H. D. Ruhm, president of the Niagara Alkali Company, sends information as follows concerning this corporation: The new plant at Niagara Falls, which is to take the place of the old Roberts Chemical Company, is nearly completed and will be in operation by Jan. 1, 1911. The company is manufacturing caustic potash, caustic soda and chlorine gas, us-

ing the Biliter cell as developed in Aschersleben, Germany, and Brückl, Austria. This cell is of simple construction, having a horizontal diaphragm, and operates by percolation, thus doing away with the necessity of a circulating brine system, with its attendant objections. The cathode liquor comes off at a fairly high concentration (about 13 per cent.), and free from oil or other inflammable material, as none is used in connection with this cell. The cost of the cell is low, and the current efficiency when operating under commercial conditions, about 97 per cent. The cell operates at 3000 amp. and about 3¾ volts; the production per 24 hours is equal to 330 lb. of solid 90 per cent. caustic potash per cell.

From the chlorine gas muriatic acid is made under the old Roberts patent owned by the Niagara Alkali Company, which produces the hydrochloric acid absolutely free from sulphur and arsenic. A portion of the chlorine gas is liquefied, this end of the business being handled by the Electro-Bleaching Gas Company of New York. Arrangements are also being made to engage in the manufacture of tin chloride, carbon tetrachloride, potassium chlorate and bleaching powder. It is also purposed to engage in the manufacture of acetylene tetrachloride, chlorides and oxychlorides of the metalloids and zinc chloride. The company also an-

3. They should be capable of being placed in water for a certain time without softening.

4. They must resist the influence of steam at 150 deg. C., without crumbling.

5. They must possess a certain amount of porosity in order to allow the carbon monoxide in the blast furnace to penetrate the interior of the briquet, and to exercise its beneficial reducing influence.

6. The binding material, if any is used, should not contain noxious substances (sulphur, arsenic) to such an extent as to be injurious to the quality of the pig iron produced.

7. The cost of producing briquets should not exceed the difference in the prices between lump ore and fine ore.

The Legal Status of Mines and Minerals in New York

In 1799 the State of New York conveyed a large tract of land in Onondaga county to George D. Wickham. Fourteen years later he conveyed part of the tract to David Otis, "with the exception of mines and minerals, which are not hereby intended to be conveyed." Wickham did not suspect that there were minerals under the farm land in question, but he used an English form of conveyance which chanced to make the reservation. Years later owners of land in the locality began to take out gypsum, and it developed that the land conveyed had a rich underlying deposit of gypsum, and litigation arose over the rights to this deposit, which reached the Court of Appeals recently in the case of Ernest I. White vs. Clifford L. Miller. We take this report from a recent issue of the New York Sun.

The testimony showed that through various conveyances of the land until White became the owner the reservation of "mines and minerals" remained. White hunted up the heirs of Wickham, who had reserved the rights, and acquired a majority interest in all the minerals. At the same time Miller acquired the rights from the owner of the land previous to White and went on the land and cut down trees prior to blasting off the top layer of limestone and quarrying the gypsum. White sued for an injunction against a continuing trespass and for money damages for cutting down the trees, and the Court of Appeals sustains his action.

The court decides that Wickham's deed did except from the grant all mines and minerals, including gypsum, but excepting limestone and gold or silver, which by statute were reserved to the State, and that the plaintiff, as the owner of the surface of the farm lands, including the limestone, was not stopped from claiming title to the minerals. The reservation as to mines and minerals is clear and unambiguous, the court says, and the language

nounces that it is in communication with a number of concerns which expect to install a Biliter cell for their own use.

Briquetting Fine Iron Ores

At a recent meeting of the British Iron and Steel Institute, the following rules were recommended for the briquetting of fine iron ores:

1. The iron-ore briquets must have a certain resistance against mechanical influences. They must resist a pressure of not less than 2000 lb. per square inch, and when dropped from a height of 10 ft. on a cast-iron plate they must not fall into dust, although they may break into pieces.

2. They must resist heat. Heated to 900 deg. C., they may commence to sinter, but they must not disintegrate into small fragments.

is too precise to admit of doubt of what the grantor intended to except. While the term "minerals" is comprehensive, speaking generally it signifies "all natural inorganic bodies."

Concerning the propriety of classing gypsum in that exception to the grant, Judge Gray, who wrote the decision, said:

"This mineral is a sulphate of calcium and has become an important article of commerce, its use being formerly for fertilizers and land plasters, and more recently for the manufacture of cement and for kindred purposes. * * * As a mineral it appears that it has been taken out by open quarrying, but it can be obtained by mining as distinguished from quarrying. It is shown to have been mined at points in this State since 1844, and according to the evidence, the date when it was first mined is not known. It underlies the limestone formation upon the premises in ledges at a depth of from 25 to 40 ft., and in places rose in the form of caps to within a foot or 18 in. of the surface of the soil. When taken from the land it appears to have been worked by quarrying after the limestone covering it had first been blasted away, but it would seem to be clear where a mineral formation underlies a bed of limestone at such a depth and in itself of great depth that it would more scientifically, if not ordinarily, be obtained by subterranean work or excavation.

"Whether or not gypsum was particularly in Wickham's mind at the time of his grant to Otis, we cannot say. There is nothing to show that mineral ores were ever found in the vicinity, and there is little to show why the broadness of the exception in Wickham's mind should be restricted. That he meant to except what could legally be defined as minerals is plain, and the only admissible qualifications in this respect would be minerals that were not obtained by mining."

Judge Gray says that under the decisions of the English courts a grant of the minerals in land will include all such as are obtainable beneath the surface of the soil for the purpose of profit in the absence of language or of circumstances which would make a limitation of its import reasonable. In one case a bed of china clay was discovered under the land in a part of England where it was not known to exist. The court held that it was included in the reservation and that a reservation of "minerals" was so sweeping as to embrace "all inorganic substances which might be found beneath the surface and which could be worked at a profit, unless otherwise limited." The court there held that the word "mines" coupled with "minerals" did not limit the meaning of the latter word, as minerals would include open quarrying as well as subterranean working.

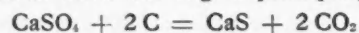
The court concludes that the rule is

that "a grant or an exception of 'minerals' will include all inorganic substances that can be taken from the land, and that to restrict the meaning of the term there must be some qualifying words or language evidencing that the parties contemplated something less general than all substances legally recognizable as minerals. I conclude, therefore, that in Wickham's deed to Otis every mineral was excepted but the surface limestone; that Otis' grantees and successors took only the surface of the land, including its limestone, and that the ownership of both estates in the soil and in the minerals is in the plaintiff."

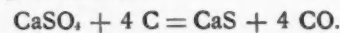
Reduction of Calcium Sulphate*

By H. O. HOFMAN¹ AND W. MOSTOWITSCH²

The reduction of calcium sulphate by carbon monoxide begins at 680 deg. C., but is not complete until 900 deg. C. Solid carbon begins to reduce the calcium sulphate at 700 deg. C., the reaction being practically complete at 1000 deg. C. The reaction below 800 deg. is principally



while above 800 deg. the following reaction predominates:



REDUCTION OF GYPSUM NOT A REVERSIBLE REACTION

While the reduction of calcium sulphate gives calcium sulphide only, the oxidation of calcium sulphide gives a mixture of calcium sulphate and calcium oxide, in the proportions of about three to one, but this is due to the interaction of calcium sulphide and calcium sulphate, a reaction which cannot take place in a reducing atmosphere, but which goes on in an oxidizing or neutral atmosphere, beginning at 800 deg. C. and being complete at 900 deg. C. Calcium sulphide and carbon dioxide are mutually inert up to 400 deg. C., but the reaction was not tried above this temperature.

METALLURGICAL CONSIDERATIONS

In blast-furnace smelting some calcium sulphide will be formed even in the mildly reducing atmosphere of the lead or copper blast furnace, the calcium sulphide thus formed chiefly entering the slag, but also entering the matte to a small extent. In using gypsum as a sulphurizing agent in the blast furnace, the conditions must be such as to insure a reduction to sulphide and to prevent the

*Abstract of a paper in *Bull. A. I. M. E.*, Nov., 1910. The outline here given is by no means a fair representation of the original paper, as it is aimed to reproduce only that portion of it which is of vital interest to active metallurgists.

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²Metallurgical instructor, Imperial Technological Institute, Tomsk, Siberia.

expulsion of the sulphur as sulphur dioxide or trioxide, that is, the requirements are a reducing atmosphere, intimate mixture of the gypsum with the fuel, and a slag of high formation temperature. The calcium sulphide itself, while a powerful sulphurizer, is effective only at low temperatures.

BLAST-FURNACE CONDITIONS FOR GYPSUM AS SULPHURIZER

Hence it is clear that in smelting an oxide ore in the blast furnace with gypsum as flux, the matte to be produced must be formed mainly in the upper part of the furnace, while the charge is still solid; lower down, when the matte begins to fuse, it will trickle through the slag that is still forming and join the melted slag. During its downward passage it will change in composition, becoming richer in any available metal that has a stronger affinity for sulphur than has the lime. The further disadvantages of gypsum as a sulphurizing agent are that it requires special reducing blast-furnace conditions, and that it consumes considerable amount of carbon for its own reduction to calcium sulphide.

California Oil Dividends

The dividends paid in November by the California oil companies listed on the San Francisco Stock Exchange, and their dividends to date, are shown in an accompanying table.

NOVEMBER DIVIDENDS OF CALIFORNIA OIL COMPANIES LISTED ON SAN FRANCISCO STOCK EXCHANGE.

Name of Company.	November, 1910.	Total Paid to Date.
American Petroleum, pfd.	\$16,500	\$296,997
American Petroleum, com.	82,500	1,635,991
Caribou Oil and Mining	20,176	861,938
Claremont	10,100	405,000
Columbia	9,992	444,737
Home	2,000	490,000
Kern River	2,000	116,000
Mascot	20,000	80,000
Monte Cristo	50,000	790,000
Mexican Petroleum	87,693	3,674,886
New Penn Petroleum	5,000	30,000
Palmer	18,020	394,521
Paraffine	3,000	39,000
Record	7,500	115,000
S F & McKittrick	15,000	460,000
Sauer Dough	4,988	564,186
Sesnon	5,000	157,000
United Petroleum	40,376	2,501,963
Union	124,813	7,366,799
United Oil	12,831	72,922
Total	\$549,673	.....

As compared with October this shows a falling off of \$376,602, of which \$300,000 is due to a capital distribution in October by Wabash. The total dividends paid to date by San Francisco listed companies is \$36,806,692, but it must be remembered that by no means all the dividend payers are listed on the San Francisco exchange, or indeed, on any exchange whatever.

November Operations of Goldfield Consolidated

The preliminary report of operations of the Goldfield Consolidated Mines Company for November shows that 24,956 dry tons with a gross value of \$867,450 were mined. Compared with the returns for October, the November figures show a decrease of 108 tons or \$201,598.

NOVEMBER PRODUCTION OF GOLDFIELD CONSOLIDATED.

	Wet Tons.	Dry Tons.	Oz. per Ton.	Value.
Combination.....	5,004	4,778	0.80	\$87,900
Mohawk.....	8,057	7,695	0.87	138,350
Red Top.....	4,437	4,237	1.03	90,200
Jumbo:				
Milling ore.....	8,409	8,031	2.38	395,000
Shipping.....	231	215	35.11	156,000
Total.....	26,138	24,956	1.68	\$867,450

The average assay per ton of ore produced in November was 1.68 oz. gold, as compared with 2.01 oz. for October, and 1.69 oz. for September.

MILLING OPERATIONS

The performance of the mill during November, 1910, was as follows: Dry tons milled, 24,741; average value per ton, \$28.76; total value, \$711,450; loss in tailings, \$55,236; value of bullion, \$656,214; percentage extracted, 92.24. The extraction was a little better in November than in October, when it was 92.12, but still low as compared with, July 94.03; August, 93.43; and September, 93.04.

OCTOBER EXPENSES AT GOLDFIELD CONSOLIDATED.

General:	Amount.	Per Ton.
Bullion tax and marketing bullion.....	\$23,500	
Administration, etc.....	18,000	
	41,500	\$1.66
Mining.....	88,000	3.53
Marketing high-grade ore.....	13,500	0.54
Transportation.....	3,000	0.12
Milling:		
Milling and cyaniding.....	57,500	
Marketing concentrate residues.....	16,500	
	74,000	2.99
Construction.....	4,600	0.19
Net cost.....	224,600	9.00
Loss in tailings.....	55,236	2.21
Total costs and losses.....	\$279,836	\$11.21

A profit of \$23.55 per ton milled was realized. The total value of the ore per ton was \$34.76, and the total profit for the month was \$587,614. The percentage of profit was 67.74, as against 66.80 for October, and 70.05 for September.

MANY CUTS IN EXPENSE PROPHESED

The long period of construction is now in process of winding up. The electric storage-battery plant is in successful operation, and it is expected to effect a saving of \$2500 per month. The new assay office is so far along that the process of

moving in will begin immediately. The new refinery at the mill has been partially tried out and the management is confident of saving \$5000 per month by the use of it. The new heating plant at the mill has apparently already paid for itself by the improvement it has accomplished in precipitation. The new compressor for the mill has been greatly delayed and will not be installed before January 1, 1911.

DEVELOPMENTS

The advance made in the various mines for the month was as follows: Combination, 419 ft.; Mohawk, 1264 ft.; Red Top and Laguna, 857 ft.; Clermont, 1125 ft.; total, 3665 ft. The only new ore of any consequence opened upon new levels during the month was the continued development of the 1000-ft. level in the Clermont. This produced 509 tons of ore that averaged by mine assays 5.01 oz. per ton.

Graphite Operations in Quebec

SPECIAL CORRESPONDENCE

The Bell Graphite Company, a London (England) company, operating three miles from Buckingham, Quebec, has completed its graphite refining plant. Test runs were made and showed the yield of graphite from the rock, a sillimanite gneiss, to be about 8.5 per cent. The milling plant is close to the mine. The process employed is the combined dry and wet one. Three grades are being produced: a No. 1 and No. 2 flake for crucibles and one quality of 150 mesh for lubricants. It is expected that 100 tons of mill rock will yield as an average about six tons of No. 1, two tons of No. 2 and one ton of 150 mesh lubricating graphite. The company started operations six years ago with a small experimental plant. The new refining plant can treat 70 tons of mill rock per day, the average daily yield is expected to be about six tons finished products. It is reported that the organization of a big company, to take over all the holdings is in progress in London. Kosmos Kendall is the manager.

At the graphite mine in Amherst township, P. Q., 90 miles north of Montreal, 30 men are employed. Progress was made during the summer season with development on lot 16 range VI and with exploration work on lots 13, 14, 17 and 18, range VI and lot 19, range VII. The shaft on lot 16 is down 85 ft. and has struck the orebody outcropping on the surface and dipping under an angle of 50 degrees. To the southwest of the shaft the lode has been opened for 150 ft. About 1000 tons of crude and milling ore have been raised. The graphite is exclusively of the flake variety and occurs in a matrix of wollastonite and

pyroxene. On the other adjacent lots the continuation of the lode has been established for almost two miles; on lots 18 range VI and 19 range VII lense-shaped orebodies of almost pure flake graphite were struck. It has been decided to do extensive development on these outcrops next season.

Report of Colorado Gold Dredging Company

The cost sheet of the Colorado Gold Dredging Company, which operates at Breckenridge, Colo., is given in the accompanying table. The dredging season was from March 23, 1910, to Dec. 4, 1910. One dredge operated continuously

COST SHEET, COLORADO GOLD DREDGING COMPANY FOR THE YEAR 1910.

Distribution of Expenses.	Total Cost.	Cost per Yard.
Power.....	\$14,964.33	\$0.0107
Labor.....	9,771.28	0.0069
Repairs and renewals.....	23,544.67	0.0168
Fuel.....	537.58	0.0004
General expense (office, traveling, stable, mint charges, etc.).....	5,394.44	0.004
Taxes.....	7,204.81	0.005
Insurance.....	1,877.01	0.0013
New York office expenses	2,631.07	0.0019

Total expenses from Jan-1, 1910 to Dec. 31, 1910 \$65,925.19 \$0.047 and handled 1,400,554 cu.yd., or 5388 cu.yd. per day at a total cost of 4.7c. per cubic yard. While the dredge was in active service about nine months, the figures given include all expenses for the entire year.

The Potash Salts Question

WASHINGTON CORRESPONDENCE

The potash-salts question has been the subject of active negotiation between the United States and Germany during the past week but no final solution is as yet in sight. Early in the week, there were long consultations between the commercial advisers of the State Department and the higher officers of the Department, including Secretary Knox. On Dec. 17, a cabinet meeting was devoted to the discussion of the question. Representatives of the German Kali-Syndikat have been in the city presenting their case through Dr. J. A. Huston, secretary of the syndicate, while a committee representing the domestic fertilizer interests, headed by Robert S. Bradley, of the American Agricultural Chemical Company, has also been here. Both sides have pressed their views upon the Government with extreme vigor and insistence.

Of the methods which have been considered for forcing the question to a settlement, the predominant one is that of tariff war with Germany through the application of the maximum rates of the Payne-Aldrich law to German goods coming to this country. A second suggested

method is that of attacking the German Kali-Syndikat, which is organized in this country, as an American corporation under the Sherman anti-trust law. Attorney General Wickersham, however, does not consider this latter method feasible. Another method of procedure which has been suggested is that of arbitration; referring the contracts which have formed the bone of contention to an international board for adjudication. The latter plan is looked on with some favor but it is doubtful whether Germany would care to accept it, inasmuch as it involves a question of Germany's internal legislation which is not supposed to be subject to adjudication in a controversy with another country. As for a tariff war, few persons suppose that such an outcome is at all possible as such a course would involve the administration in controversy likely to prove very unpopular, and to give further impetus to the existing feeling against the tariff.

Meanwhile, the domestic and foreign interests are endeavoring to make capital for themselves, the one by showing that the effect of Germany's action will be to raise prices to the American farmer, the other by giving quotations to show that the price will be the same in the future that it has been in the past. Dr. Huston, in a statement issued here, says that the price now made by the German syndicate here for muriate of potash is \$37.50 per ton, which is no higher than has been charged in the past.

A Bill Relating to Alaska Placer Claims

WASHINGTON CORRESPONDENCE

Delegate Wickersham, of Alaska, has offered an important bill to modify the mining laws of the United States in their application to the territory of Alaska. The bill provides that no association placer-mining claim shall hereafter be located in Alaska in excess of 40 acres, and on every placer-mining claim hereafter located in Alaska not less than \$100 worth of labor shall be performed, or improvements made, during each year for each and every 20 acres or excess fraction thereof in such claims. Section 3 of the bill reads as follows:

That no person shall hereafter locate, or cause or procure to be located, more than two single 20-acre placer-mining claims in any calendar month, and not more than 24 in any calendar year; nor shall any person locate, or cause or procure to be located, for himself in Alaska, more than 24 placer-mining claims in any year, including therein those located as association and as single 20-acre claims or fractions: *Provided*, That no single placer-mining claim hereafter located in Alaska shall be patented which shall contain a greater area than is fixed by law nor which is longer than three times its width.

Clancy Process of Ore Treatment

Before the meeting of the New York section of the American Electrochemical Society, held Dec. 16 at the Chemists' Club, John Collins Clancy read a paper descriptive of his researches culminating in the discovery of the new process for the treatment of so called refractory ores without roasting or concentration and for the treatment of ordinary ores which are amenable to straight cyanidation.

The paper opened with a discussion on the treatment of Cripple Creek so called refractory ores and showed that straight cyanidation did not extract over 60 per cent. of the content without roasting or concentration of the undressed ore. The object of his first researches was to find a suitable alkaline solvent which would dissolve the tellurium, in combination as the gold telluride.

It is shown that sodium hypochlorite, sodium hypiodite and sodium hypobromite were all solvents for the tellurium in combination with the gold; on account of the cheapness of the hypochlorite of sodium, this compound was tried and gave good results, but the necessity of using two sets of solutions, the fact of the remnant hypochlorite remaining in the ore pulp, and that this process required two sets of filtering apparatus caused the abandonment of these tests for the time. Tests preliminary to cyanidation with hypochlorite of sodium on the telluride ore gave extractions of from 85 to 90 per cent. of the gold. The next method tried was the employment of a soluble persulphate in conjunction with a cyanide solution containing a soluble iodide, which gave good results, but the present cost of the persulphate made this method prohibitive.

USE OF CYANAMIDE

Mr. Clancy's equations representing the different reactions in cyanogen-bearing solutions during the process have already been described in previous articles. He then described the employment of the crude cyanamide of commerce, at present used only as a fertilizer. He showed that by dissolving the crude cyanamide of commerce in water (in which it is soluble to the extent of 50 to 60 per cent.), a solution could be obtained which in conjunction with other cyanogen-bearing compounds, together with electrolysis of the solutions, would dissolve the precious metals in chemical combination within a few hours. Mr. Clancy explained that when cyanamide is electrolyzed the cathodic hydrogen reduces the cyanamide to cyanide and the anodic oxygen oxidizes the cyanide to cyanate, and that cyanate formed with the cyanamide a compound—mono-potassium diamidocyanate. To prevent this oxidation of the already produced cyanide, it was shown how the

addition of a soluble sulphocyanide prevented the oxidation of the said cyanide. It was also shown how the cyanide which had been formed into nonavailable cyanide compound could be regenerated into available cyanide, by increasing the alkalinity of the solution and continuing electrolysis.

IRON OXIDE ELECTRODES USED

Mr. Clancy further showed that employment of graphite electrodes, while standing up fairly well as anodes in the above solutions, were worn away by the attrition of the ore particles against the said electrodes which were not capable of standing a higher current density than, say, 10 amp. per sq.ft. of electrode surface. He then showed by the use of melted iron-oxide electrodes, that it was possible to obtain a current density of considerably over 50 amp. per sq.ft. of electrode surface. These electrodes were so hard and refractory that they were not worn away by the attrition of ore particles.

ESTIMATED COST OF CYANAMIDE AND ELECTROLYSIS

The present cost of cyanamide is less than 3c. per lb., and it is estimated that when this is in general use for metallurgical purposes, it may be produced at even a lower cost, and as Mr. Clancy indicated that it would require but two pounds of cyanamide in conjunction with nonavailable cyanogen-bearing solutions to do their work of the usual 1 to 12 lb. of cyanide.

Added to this cost is the cost of electrical energy necessary for the electrolysis. The cost of electrical energy for this purpose is said to work out at about 10c. per ton of ore treated. This added to the cost of cyanogen-bearing material and regeneration, makes a total of about 16c. per ton of ore.

The subject was briefly discussed by Dr. John Woods Beckman, chemical engineer of the American Cyanamide Company, of Niagara Falls, Ont.; by Dr. N. S. Keith, of Philadelphia, and by Prof. J. W. Richards.

At the same meeting the "Fixation of Atmospheric Nitrogen," was reviewed by Dr. E. F. Roeber, and the subject formed the occasion of extended discussion by the members of the society.

The Hungarian Government last year bought extensive coal-mining areas in Transylvania and Croatia, and about \$6,000,000 is to be spent in connection with these properties under the direction of the Minister of Finance. Manufacturers of machinery will consequently be interested in the international exposition to be held at Budapest during May and June, 1911; the principal mines taken over last year were in the *comitats* of Baranya and Veszprém.

Reducing Mining Costs and Increasing Profits

Remarkable Reduction Has Been Made in Cost of Treatment of Sulpho-Telluride Ores of Cripple Creek District. Further Reduction Predicted

BY PHILIP ARGALL*

We are here tonight to help celebrate, starting into successful work the second unit of Stratton's Independence mill. We thus reach an important point, not alone in the history of our own mine, but also in the history of the Cripple Creek district; the pioneer work is accomplished and wet milling of \$3 sulpho-telluride ores established as a profitable industry, away up here in the mountains where milling supplies are charged all the traffic will bear.

Most of you have contributed, in one way or another, your knowledge, strength and experience to help obtain this great result; though several of those who started out with us in the summer of 1907, in what was then called by hotel experts and club loungers "the metallurgical impossibility," have moved to other scenes and assumed new responsibilities, while others again are of the "eleventh hour," having but recently joined our ranks and taken up their positions in the mill; to these younger men we look with expectant interest, for new ideas and for renewed energy which may lead to greater efficiency in all departments.

At such a time as this one may be pardoned for pausing in retrospective mood to view again the point from which he journeyed and perhaps push the tentacles of thought out into the uncertain future, to see in vision, as it were, the ultimate metallurgical destiny of wet milling the sulpho-telluride ores of Cripple Creek.

EARLY WORK IN CYANIDATION

Eighteen years ago I first became interested in cyanidation and soon thereafter accepted the position of consulting engineer to the company holding the McArthur-Forrest patents for America. I made my initial trip to Deadwood, S. D., to examine into, and advise on unexpected troubles that cropped up in the first cyanide mill built in the Black hills, the ores of which were so favorable to cyanidation; nevertheless, the first mill erected was for a time a failure and but few, if any, foresaw the brilliant future for the cyanide process in that great mining district. My second trip was to Cripple Creek, where a small cyanide plant had been erected, later called the Brodie mill. This mill failed to give the results ex-

pected, as had also the one at Deadwood, and for precisely the same reason. The ground ore could not be leached. Improved crushing machinery, however, solved the problem in both cases, and the Brodie mill struggled along for some time at a capacity of 15 tons per day, later raised to 30 to 50, and ultimately, I believe, to 100 tons per day.

In the spring of 1894 we had no difficulty in procuring a full supply of ore for the Brodie mill, containing about 1 oz. per ton, for which the mill received \$15 per ton treatment charge and needed every cent of it. My connection with this mill, though short, was ample to convince me that cyanidation had a great future in the metallurgy of Cripple Creek ores. I consequently experimented quite extensively with the telluride ores; worked out, wrote up and published the identical method of treatment now in use at Stratton's Independence mill and proclaimed the cyanide process the most suitable all-round method for treating Cripple Creek ores, a thesis I stoutly maintained with tongue and pen against all comers, until the use of cyanide became universal in the milling of Cripple Creek ores.

INTRODUCTION OF ROASTING

The fall of 1904 found me engaged in building the first large custom mill for the direct cyanidation of telluride ores, while the following year I introduced roasting as an important step in cyaniding sulpho-tellurides.

The Metallic works, also a pioneer in Cripple Creek metallurgy, ultimately reached a capacity of 10,000 tons per month and at the close of my engagement, January, 1901, had treated almost half a million tons of Cripple Creek ore, mostly by the roasting process, and had from the first earned good dividends on the investment, and this in the face of a steadily decreasing treatment charge.

From my first connection with Cripple Creek milling to the close of 1900, the average treatment charge had been reduced 50 per cent. and it must be conceded that the works of the Metallic Extraction Company were an important factor in this great reduction. Were I relating a personal narrative or holding forth on my varied experience in cyanidation, I would next direct your attention to Mexico, to Canada and to other countries. I am, however, merely tracing the progress in cyaniding Cripple Creek ores and incidentally, though briefly, noting my own pioneer work in that connection. Suffice it to say then, I returned to this

field of activity in 1906 and early the following year took up the greatest ore-treatment problem of my life. To understand it clearly, it might be permissible to say that at the Metallic Extraction Company's works near Florence, where fuel and general supplies were reasonable, the climate mild and water abundant, I had gotten the ore-treatment cost down to what I then considered a low figure.

PROBLEM AT STRATTON'S INDEPENDENCE

The problem involved in Stratton's Independence dump, however, contemplated the profitable treatment of an ore—including mining it in the dump and conveying it to the mill—the total value of which was less than our average cost for treating a ton of ore in the Metallic works in the year of grace, 1900. Here, then, was a problem of some magnitude and I will frankly admit that it was only the quantity available in the dump, something like a million tons, that induced me to tackle the problem at all. Roasting was, of course, out of the question on account of the cost; so I went back to my old concentration tests of 1894, and found that modern concentrators and fine grinding, then possible, gave encouraging results, a long series of experiments proving to my satisfaction that 35 per cent. of the gold value could be removed as concentrate from average dump ore, and, strange to say, cyanide would extract a similar percentage. Next came the cost of the method, to determine which I had to draw on previous experience in concentrating and cyaniding on a large scale.

Finally having proved my experimental work in all particulars, I cabled the company, in March, 1907, that a mill of 10,000 tons monthly capacity could treat the dump ore by the proposed method at a cost of \$1.50 per ton, obtaining a yield of 70 per cent. of the contained gold. Those figures, as you know, have been exceeded in actual milling results, and still higher extraction is attainable by finer grinding, but with the present cost of power and supplies is scarcely justified from a commercial point of view.

The method used in our mill—we have never called it a process—is but a combination of well known devices and chemicals to obtain the desired end; we have no secrets, chemical or otherwise, and from the first day the plant has been open to the inspection of metallurgists and all information or data asked for by responsible men have been frankly supplied.

NOTE—Address at banquet in celebration of first month's run of the second unit of Stratton's Independence mill.

*Consulting engineer for Stratton's Independence, Ltd. (Philip Argall & Sons, Majestic building, Denver, Colo.)

COSTS REDUCED FROM \$15 TO \$1.50 PER TON

The stride from a \$15 per ton milling cost in 1894 to a cost of \$1.50 per ton in 1910 is a great and never-to-be-repeated one. Still, I believe the milling of low-grade sulpho-telluride ore is today in its infancy; improvements in machinery and methods will come along as surely as day follows night, making toward higher efficiency, better extraction and lower working cost. For the straight wet milling of sulpho-telluride ores a \$1.25 working cost is now in sight on a basis of treating 10,000 tons per month, while the dollar milling cost is perhaps not far distant and could possibly be attained in a well designed plant treating not less than 15,000 tons per month; in neither estimate, however, is amortization taken into account; they cover only the bare milling and maintenance cost.

INDEPENDENCE MILL TREATING OLD DUMPS

Stratton's Independence mill, delayed for a time through financial reasons, started up in April, 1909, with a nominal capacity of 4500 tons per month, enlarged in December of that year to 7000 tons, and with the addition of the complete second unit last month, reached a capacity of 9000 tons.

The mill, through the energy and ability of the staff, was profitably operated from the start, and is now earning 10 per cent. per annum on the capital of the company, and has treated to date 120,000 tons of dump rock, sufficient, I believe, to take it out of the class of "metallurgical impossibilities," if not establish it as one of the chief industries of the Cripple Creek district. We all, more or less, realize what the local milling of the low-grade ores means to Cripple Creek. It does not offer a large or immediate reward to the mine owner, but on the contrary calls for a considerable expenditure of capital; hence, the development of low-grade ore milling must proceed conservatively along the lines of consolidation of small properties or joint milling on a coöperative basis. Milling the low-grade ores in the district does, however, mean the maintaining of, and possibly an increase in, the output of shipping ore; the prolongation of the life of the camp, I might say, indefinitely; the steady employment of large numbers of men in the mines and mills and the purchase of vast quantities of supplies. In a word, high-grade production tends to make millionaires; the low-grade, a populous, prosperous and permanent community. The Cripple Creek district will, I hope, continue to give us both.

I believe, gentlemen, you will ever find cause for congratulation in the fact that you were pioneers in this low-grade milling industry. Your work has shown that sulpho-telluride ore can be concentrated,

that the tailings from the concentrator can be cyanided and ores running less than \$3 per ton can be milled at a profit; and I sincerely thank you for your coöperation and assistance in this great work—second to nothing that has ever been undertaken in the Cripple Creek district—where you blazed the way others can safely follow, successfully copy and, let us hope, in time improve.

VALUE OF AN INTELLIGENT BOARD OF DIRECTORS

Nevertheless, I would not have you forget that great as has been our responsibility and arduous the work, yet I believe the ultimate credit is due to the directors of Stratton's Independence, Ltd., who eight years ago, realizing that one-fifth of the production of their mine was finding its way into the ore-house dump, started research work looking toward its recovery; first, by electro-cyanide methods, later by erecting and operating an experimental plant at a cost of nearly \$60,000, and experimenting in various ways for fully four years; lastly, sanctioning the expenditure of more than a quarter of a million dollars in the plant we erected and are now operating.

At all times I felt I had in our board real men behind me, gentlemen who supported and encouraged me at every step and who never lost confidence in the ultimate outcome of the undertaking, even when advised by interested people from this district that they were wasting their resources in metallurgical impossibilities. To these gentlemen is due, then, the full credit for introducing low-grade milling into the Cripple Creek district and it is through their keen business acumen that success has been achieved and that we are here tonight to celebrate it, even at a time when others continue to use their low-grade ore to ballast railways and fill waste places along the right of way. Much has been said and written of late about the great and little-understood doctrine of conservation, but here is true conservation, the creation of a great and profitable industry from the waste rock of yesterday. A new era is dawning over the Cripple Creek district, local milling is firmly established by two great mills, the largest ever erected in the district. This, however, is but the beginning of home treatment, which, I believe, will rapidly expand in the near future and soon cover the entire field. Cyanogen is king!

A subsidiary company of the St. Ives Consolidated Mines, in England, is now extracting radium from pitch-blende ores from the Treuwith mines in Cornwall. A process devised by Sir William Ramsay is used, and it is claimed that radium can be extracted about six times as fast as by the best Continental processes.

Exploration of Oil Lands

WASHINGTON CORRESPONDENCE

Senator Smoot has introduced a bill (S 904) to provide for permits to explore for oil and gas on unappropriated and withdrawn lands. The bill provides:

"That the Secretary of the Interior is hereby authorized, under such regulations as he may prescribe, to grant to any person, association or corporation qualified by law to acquire title to mineral lands of the United States a permit to explore and prospect for oil or gas, or both, upon any land of the United States open to mineral exploration, including lands withdrawn pending legislation: *Provided, however,* That the lands covered by any such permit shall be in a compact body, not over four miles in extreme length, and shall not exceed 1280 acres, and no more than one permit shall at any one time be held by any person, association, or corporation: *Provided; further,* That no person who is a member or stockholder of any association or corporation which holds any permit, or extension or renewal thereof, nor any association or corporation any member or stockholder of which is the holder of any such permit or renewal or extension thereof, shall be qualified to apply for or hold a permit, or to apply for or hold any renewal or extension of a permit: *Provided further,* That the applicant shall at the time of filing the original application pay to the register and receiver a fee equal to 5c. per acre of the lands upon which permit to explore and prospect is sought."

The United States Geological Survey

The annual report of the director of the United States Geological Survey, for the year ended June 30, 1910, is now in press. It reviews the growth of the Survey's work during the 31 years of its existence. It states that the trend of the day is distinctly toward the economic, and this report endeavors to combine the pure-science work with that which has a strictly utilitarian bearing.

The report reviews the work done in valuing coal lands and placing these on the market on a tonnage basis. The withdrawal of oil lands and power sites and the classification of Western phosphate lands are subjects that are brought out in detail.

The work of the topographic and geologic departments, with special reference to the work in Alaska is given quite fully. It is stated that during the year 36,539 sq.mi. in the United States proper were topographically surveyed, preliminary to detailed geologic investigations.

Hydrometallurgical Operations at Cobalt

Thirteen Operating Mills Treat Over 1000 Tons per 24 Hours. Hand Sorting, Jigging, Table Concentration, Sliming and Cyanidation Employed

BY JOHN TYSSOWSKI*

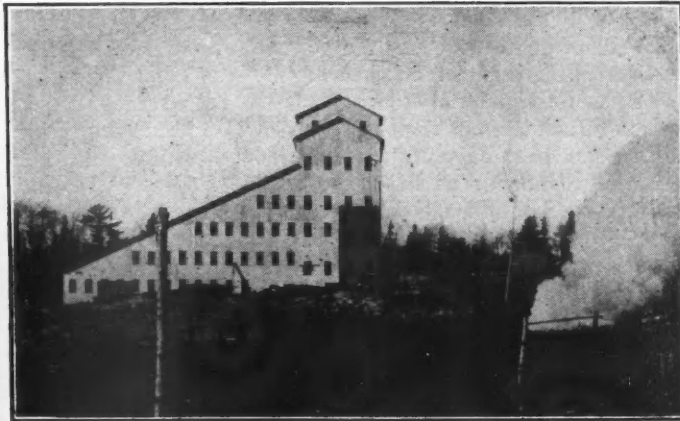
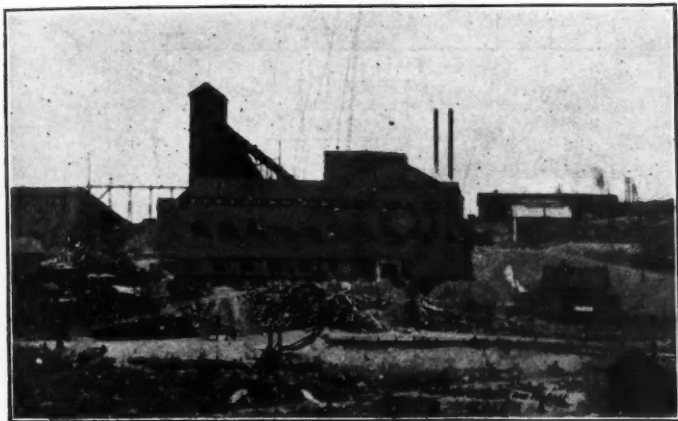
The engineer making his first visit to Cobalt will be surprised at the magnitude and character of the mining and metallurgical operations being conducted there. The surprise will be particularly great to the metallurgist unless he has kept himself exceptionally well posted on Cobalt operations.

THIRTEEN MILLS NOW OPERATING

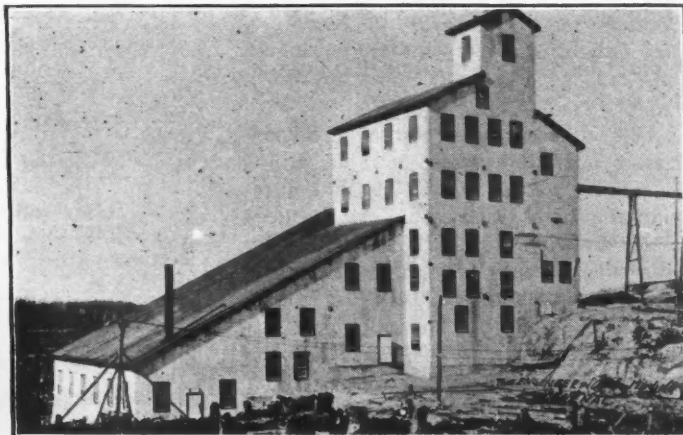
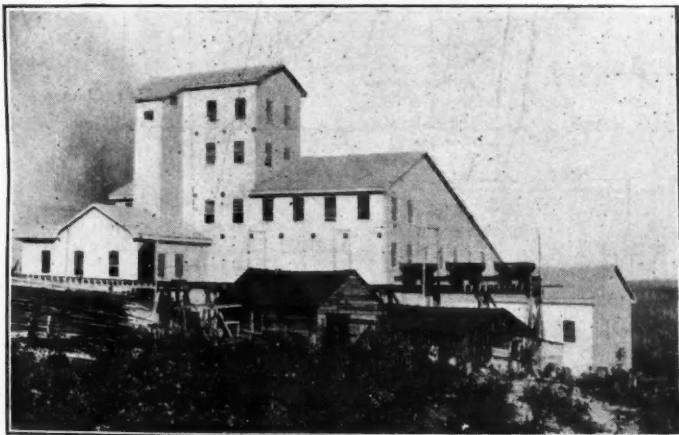
At present there are 13 mills and crushing plants operating in Cobalt. A

Hardinge mills and tables; O'Brien, jigs, 30 stamps, two Hardinge mills and slimes cyanide equipment; Colonial, jigs, 10 stamps and tables; King Edward, jigs, 10 stamps and tables; Silver Cliff, jigs, rolls, Hardinge mill and tables; Nova Scotia, 20 stamps, two tube mills, amalgamating pan and slimes cyanide equipment; Cobalt Central, jigs, rolls, Hardinge mill and tables; Temiskaming, jigs, 30 stamps and tables; Nipissing Reduction Works, jigs, rolls, Hardinge mill and

lurgists at Cobalt, it should be realized that they had to work out and develop their treatment scheme absolutely alone. They had no precedents to guide them for the Cobalt ores are peculiar unto themselves. Smaltite, niccolite, chloanthite, argentite, pyrrargyrite, dyscrasite, erythrite, annabergite, millerite, bismuth, tetrahedrite, mispickel, chalcopryrite, galena and other less common minerals have been identified in the Cobalt ores, but it is, I believe, commonly agreed



CONIAGAS AND TEMISKAMING MILLS



O'BRIEN AND TRETHEWEY CONCENTRATORS, COBALT, ONT.

complete list of these with the equipment of each is as follows: Hudson Bay, jigs, 20 stamps and concentrating tables; Trethewey, jigs, 30 stamps, tables and tube mill; Coniagas, jigs, 60 stamps and tables; Buffalo, jigs, rolls, Chilean mill, Hardinge mill and slimes cyanide equipment; Northern Customs, jigs, 50 stamps (four Nissen) and tables; McKinley-Daragh-Savage, jigs, 30 stamps, tube and

concentrating tables. The total rated capacity of these mills is about 1430 tons, and probably 1000 tons are milled every 24 hours. A description of all the metallurgical operations at Cobalt is impossible here, but I do desire to bring out some interesting notes on Cobalt hydrometallurgical practice.

COBALT A NEW FIELD FOR METALLURGISTS

To appreciate properly the milling problems encountered by the early metal-

lurgists at Cobalt, it should be realized that they had to work out and develop their treatment scheme absolutely alone. They had no precedents to guide them for the Cobalt ores are peculiar unto themselves. Smaltite, niccolite, chloanthite, argentite, pyrrargyrite, dyscrasite, erythrite, annabergite, millerite, bismuth, tetrahedrite, mispickel, chalcopryrite, galena and other less common minerals have been identified in the Cobalt ores, but it is, I believe, commonly agreed

by those who have made careful studies of the mineralogic character of the ores that practically all of the silver occurs in the native state. Sometimes, the silver is so intimately mixed with the smaltite and other minerals as to be indistinguishable from them by the naked eye; but almost always this is a physical rather than a chemical mixture.

As a result of the peculiar and heretofore unknown character of the ore, the metallurgists working independently

*Mining engineer, editorial staff, ENG. AND MIN. JOURN.

evolved various treatment schemes; the problem was approached from many different viewpoints. At first the idea was merely to sort out the high grade for shipment to the smelters, and as a consequence to mine only such ore as would give a profit under these conditions. This policy in most cases soon proved a short-sighted one, and with the mining of ore of lower grade closer extraction was necessitated.

CROWN RESERVE PLANT THE SIMPLEST TYPE

The first stage of the development of Cobalt metallurgical practice is illustrated in the surface plant at the Crown Reserve. At this mine ore from which lumps and sheets of practically pure silver have been picked is put through a No. 2 Austin gyratory crusher, and then screened in a trommel making three sizes; through 1/2 in., through 1 in. and oversize. Ore from the crusher averages about 25 to 40 oz. silver per ton; fines from the trommel, 60 ounces.

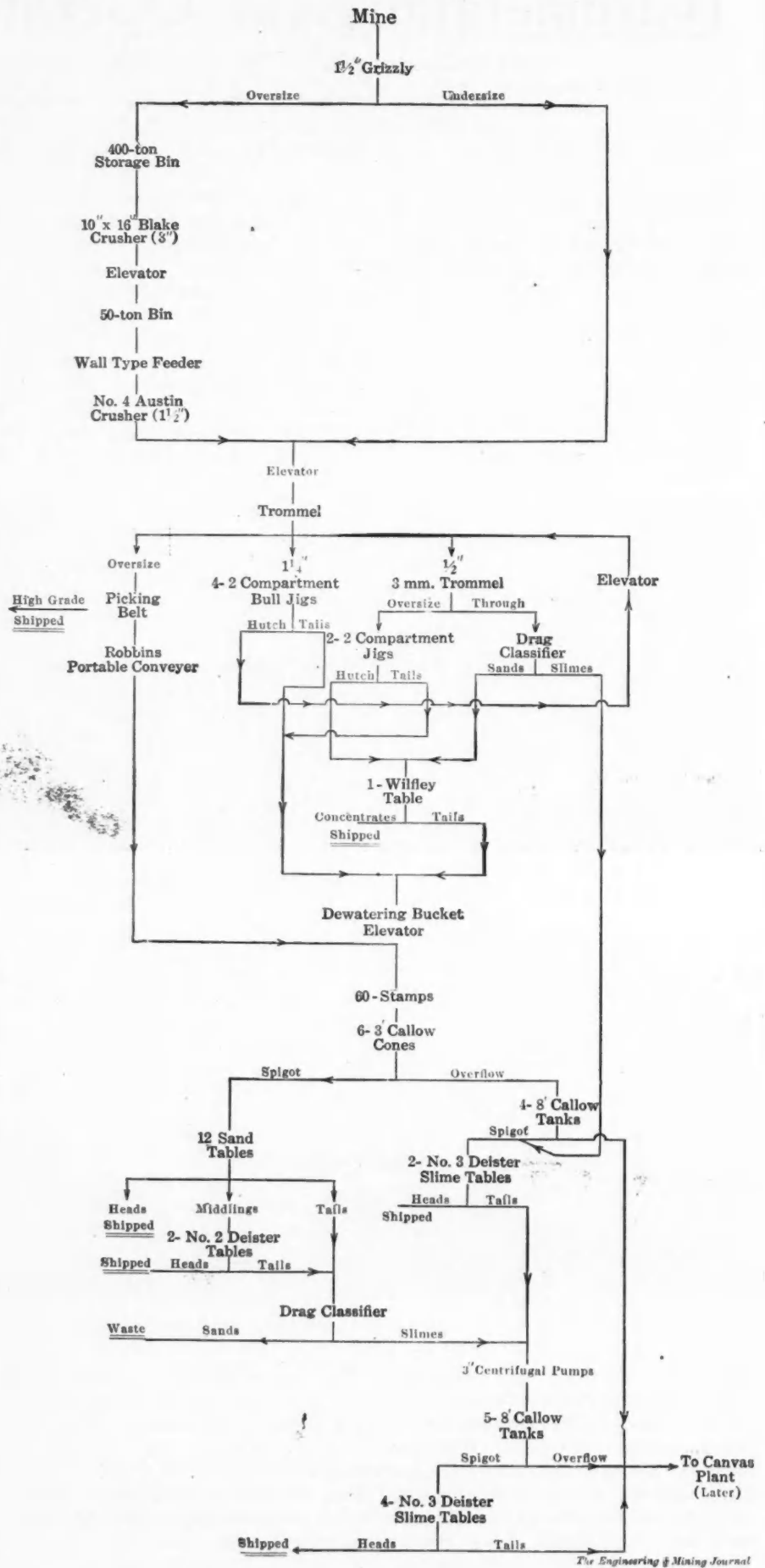
The oversize material is picked and the rejects put on the mill dump, where about 20,000 tons of 15-oz. ore are now stacked for later treatment. The picked ore, which averages close to 5000 oz. per ton, is sacked for shipment. The 1/2- to 1-in. material from the trommel is fed to two Richards jigs. The hutch product from the No. 1 jig will run about 4400 oz. and from the No. 2 jig, 3200 oz. Jig tails go to the stock pile. The fines from the trommel are put through a 12-mesh screen, and the oversize reground. This material, which only amounts to about six tons a day, is then fed to one Wilfley table, which makes about 30 lb. of a 3000-oz. concentrate every 24 hours.

RATIO OF CONCENTRATION EXTREMELY HIGH

This is the crudest sort of a concentrating operation, where a 15-oz. tailing is run to waste; but owing to the remarkably high grade of the ore produced at the Crown Reserve, the total recovery from this process is high. Assuming a total production of 8,000,000 oz. to date for the mine and that the stock pile contains 300,000 oz., it is evident that the recovery attained has been close to 95 per cent. The ratio of concentration in this crude operation is over 1:100. The high extraction is explained by the occurrence of exceptionally high-grade ore and the large percentage of silver that is picked from the run-of-mine, rather than by any excellence of the milling operations. The roll mills are practically only mechanical sorting plants in which the object is to obtain a high-grade shipping product.

CREDITABLE RESULTS ACHIEVED AT THE NORTHERN CUSTOMS CONCENTRATOR

Data on the operations of the Northern Customs concentrator, treating La Rose ore, for the period Sept. 18, 1909,



FLOW SHEET OF CONIAGAS MILL, COBALT, ONT.

to May 31, 1910, show what can be accomplished in a mill of this type. The mill treated 18,423 dry tons of ore averaging 25.58 oz. silver per ton. The mill tailings ran 3.68 oz., thus meaning a recovery of 79.12 per cent. The ratio of concentration was 29.3:1. Milling was accomplished at a cost of \$3.32 per ton of ore treated. The method of sampling employed in arriving at the recovery figures is unknown to me, so I do not vouch for these figures, but assume they are correct.

CONIAGAS MILL EMPLOYS CRUSHING, JIGGING AND TABLE CONCENTRATION

The further development of Cobalt metallurgical practice is illustrated in those mills where closer concentration is

from the "bull" jig is elevated and passes through the system to a Wilfley table. Jig concentrates run over 1000 oz. and probably 60 per cent. of the silver is recovered before stamping. The battery heads only assay from 14 to 18 oz. silver per ton.

The stamps in this mill weigh 1250 lb. and are dropped 7 to 7½ in. 100 times per min., using a 4-in. discharge. Water is fed in about the ratio of 10 tons of water to one ton of ore; 16-mesh screens are used and screen analysis of the battery pulp shows only a small percentage of the material on 20-mesh. The Callow-type settlers remove the excess water which contains only 15 per cent. slimes, assaying about 20 oz. silver per ton.

communication, writes that by making several minor changes in the flow sheet a marked reduction in the silver content of the tailings has been accomplished. The sands only run 3 to 4½ oz. silver per ton.

The feed to the first No. 3 Deister slime tables, made up of thickened overflow from the drag classifier in the upper part of the mill and from the 3-ft. Callow-type cones taking the battery discharge, will assay as high as 25 oz. per ton. Tailings from these tables joins the overflow from another drag classifier that treats the sand-table tailings, and gets a retreatment on a second series of Deister slimes after first being thickened in 8-ft. Callows. The feed to the second slime tables is 9- to 12-oz. material and a 1500-oz. concentrate is made.

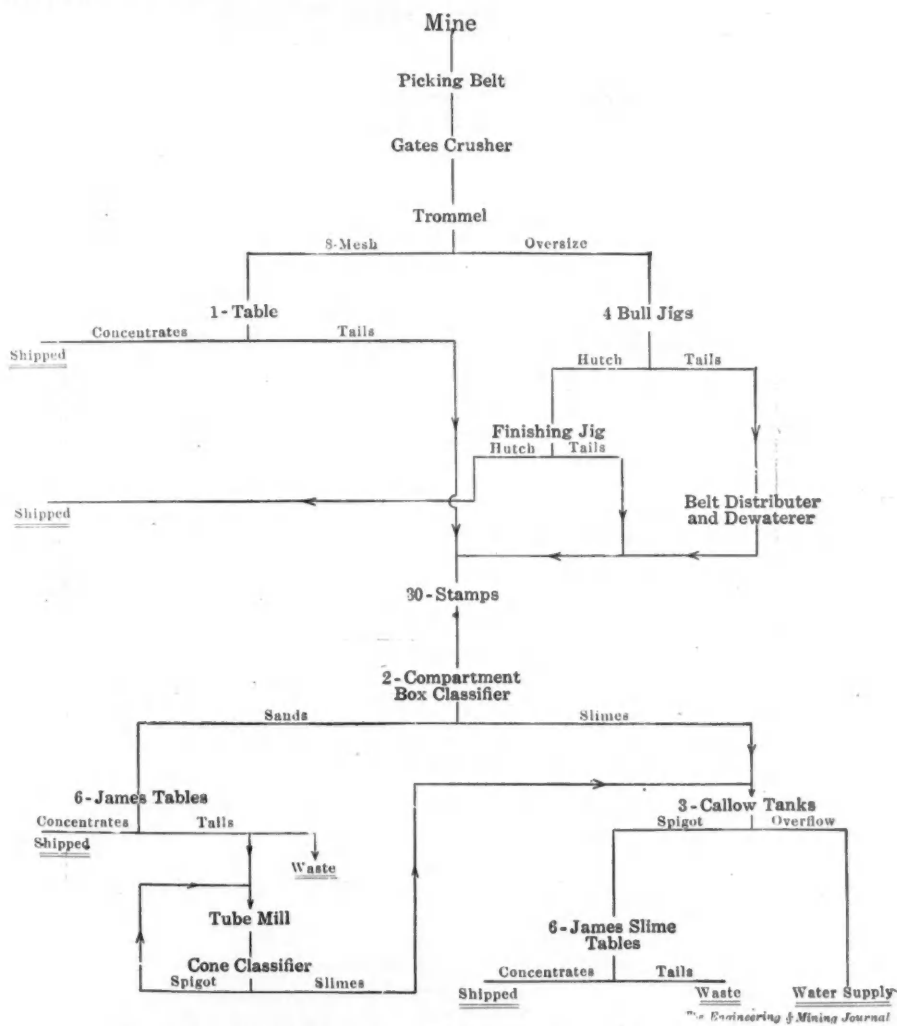
It is probable that all overflow from Callow tanks and tails from slime tables will be, at some time in the future, run over a canvas plant. At present the total extraction in the mine and mill, including sorting, picking out of high grade and concentrating, is close to 90 per cent. The mill probably makes a 75 per cent. extraction, although it is impossible to be sure of this figure, on account of the crude sampling methods that are employed.

POWER CONSUMPTION IN CONIAGAS MILL
6 H.P. PER STAMP

The motor equipment in this mill is as follows: One 100-h.p. motor (80 h.p. used) on each 30 stamps; one 100-h.p. motor (60 h.p. used) in the upper part of the mill for jigs, etc.; three 10-h.p. and one 5-h.p. motor on the tables; and a 3-h.p. motor on the Robbins distributor. This means that only 6 h.p. per stamp are used in the mill. The motors on the batteries are provided with silent chain drives.

PORTION OF SAND TAILINGS SLIMED IN
TRETHEWEY MILL

In the Trethewey mill, the general scheme of milling is similar to that in the Coniagas up to the point of table concentration. The sands from two-compartment box classifiers go to James tables; any desired proportion of the tailings from these tables is cut out for regrinding in a tube mill, the remainder being sent to the James slime tables. Classified pulp from the tube mill joins the overflow from the first box classifiers after the batteries and flows to Callow thickeners, the spigot product from which is concentrated on James slime tables. It is claimed that the regrinding materially increases the recovery, but it is a question in my mind if it does not cost at least as much as it is worth to recover this additional silver. The cost of recovering the silver from Cobalt ores is, in most cases, uncertain, owing to the nature of the ore and consequent difficulty of accurate sampling. As a result



FLOW SHEET OF TRETHEWEY CONCENTRATOR, COBALT, ONT.

employed. In this connection the Coniagas and Trethewey mills are interesting: The former as one where crushing, jigging and table concentration are employed; the latter on account of the additional fine grinding of the ore in a tube mill.

A complete flow sheet of the Coniagas plant is shown in an accompanying drawing. The mill heads at this plant average from 30 to 40 oz. per ton, and the ore picked above the jigs will average about 2600 oz. per ton. The hutch product

DEISTER CONCENTRATING TABLES USED

The primary tables on the sand-table floor make a 2000-oz. concentrate and 9 to 12 oz. tailings. As indicated on the flow sheet, the middlings from 11 No. 2 Deister and one Wilfley table are retreated on two extra Deisters. Tailings from both series of tables show about 4 to 5 per cent. slimes finer than 200 mesh, assaying 7 to 9 oz. silver. It should be stated, however, that F. D. Reid, mill superintendent, in a recent

there is continual discussion between those who advocate simple concentration and those who favor cyaniding of the tailings from concentrating devices.

CYANIDATION OF TABLE TAILINGS ADOPTED AT O'BRIEN MILL

In the O'Brien mill the ore is crushed in solution and slimed in Hardinge's pebble mills, after which it is concentrated to take out the metallics and finally given a cyanide treatment. Of the total recovery in the mill (preliminary picking is credited to the mine) 20 per cent. is made on the jigs, 30 on the tables and 50 by cyanidation.

The stamps in the O'Brien weigh 1250 lb. and are dropped 7½ in. 100 times per min. Crushing to 8 mesh they have a capacity of 3½ tons each, per 24 hours. Two 8-ft. Hardinge mills are used in sliming sands from a Dorr classifier and table tailings. These mills are run at 25 r.p.m. and give a product 85 per cent. of which will pass through a 200-mesh screen. Overflow from the Dorr classifier and the overflow from spitzlutte taking No. 2 Deister tailings go to a 30-ft. Dorr settler.

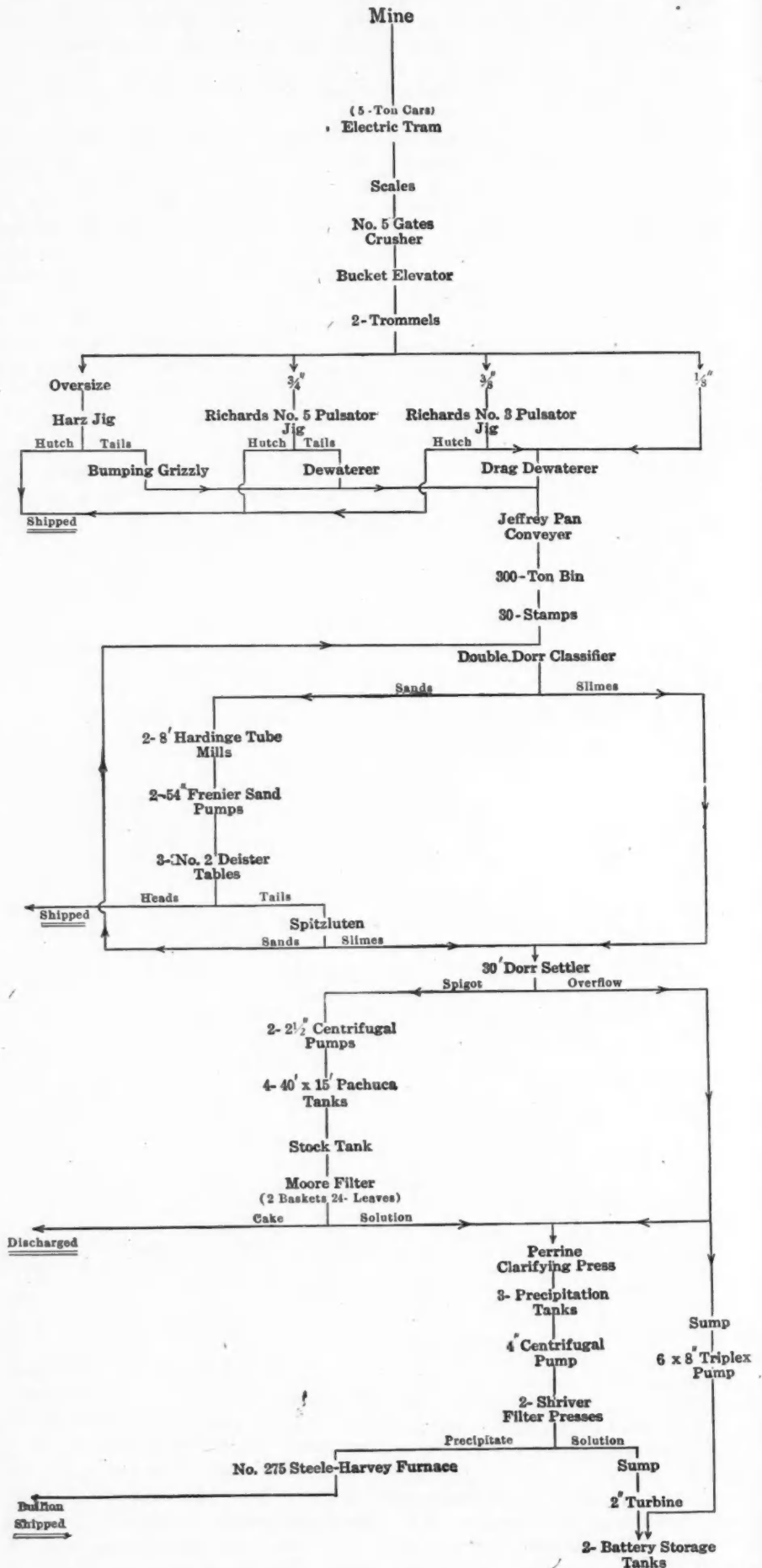
PACHUCA TANKS AND MOORE FILTERS USED

The Dorr settler has given excellent service. Practically any desired thickness of the pulp can be obtained and its installation has greatly improved the results obtained in this mill. The pulp from this tank has a specific gravity of approximately 1.35, or in this case between 30 and 35 per cent. solids. The cyanide solution is built up to 4-lb. strength in the Pachuca tanks, where 30 hours' agitation is given. To handle the pulp from the 30 stamps only one basket of 24 leaves is required in the Moore filters.

PRECIPITATION EFFECTED WITH ALUMINUM DUST

Solution from the Moore filters passes through a Perrin clarifying press and thence to three precipitation tanks, provided with agitating paddles. In these tanks aluminum dust instead of zinc dust is used to replace the silver, after a scheme worked out by Prof. S. F. Kirkpatrick, of Queen's University. This most interesting advance in cyanide practice will be described by D. C. Fessenden, mill superintendent, in a subsequent issue of the JOURNAL. Solution is drawn from the precipitation tanks and pumped through two Shriver precipitate presses. The precipitate is melted in a No. 275 Steele-Harvey furnace and the bullion shipped to London. Solution from the presses is returned to the battery storage tanks or used for wash water in connection with the Moore filters.

The O'Brien mill is equipped practically throughout with motors of the slipping type manufactured by the Swedish



O'BRIEN CONCENTRATOR AND CYANIDE-PLANT FLOW SHEET

melted, giving a product 940 to 950 parts pure silver. From 60 to 70 per cent. of the total recovery of the mill is effected in the amalgamation process.

TABLE TAILINGS ALL SLIMED AND CYANIDED

Tailings from the Deisters, where only a rough concentration is aimed at, pass to a Kirby classifier supplied with water under a 15-ft. head. The spigot product from this is again dewatered in 3-ft. Callow cones before going to the tube mills. Slimes from these mills and overs from the classifiers are pumped to Dorr settlers and the spigot from these, discharged as thick as it is possible to get it (usually 1.5 to 1.6 sp.gr.) so as to eliminate old solution, goes to three Trent agitators arranged in series. Here fresh solution is added, the pulp leaving at 1.4 sp.gr. These agitators have been fitted with decanting arms tapping at points 4 ft. from the bottom of the tanks; they connect with a 10x24-ft. settler. Solution can thus be quickly run out if it becomes necessary to empty an agitator. A 3½-lb. cyanide solution is built up in the agitators where 48 hours' treatment is given the pulp.

SPENT CYANIDE SOLUTION AERATED

Two racks of 34 leaves are used in the Moore filter equipment. The solutions for precipitation are first sent to the clarifying tank, thence to the precipitation tanks where the zinc dust is added by Merrill's method. The first wash joins

the overs from the Dorr settlers and is pumped to storage. A complete system of aeration is carried on throughout the mill, especially of the storage solutions which are continuously circulated through a series of perforated surfaces above the tanks. Solutions are kept up to 3½-lb. strength in the clarifying tank.

MOTOR AND PUMP EQUIPMENT IN FULL

The motor equipment at the Nova Scotia mill is as follows: Stamps, two 35 h.p., 550 volts, 850 r.p.m. back geared, belt-driven; tube mills, 60 h.p. 510 r.p.m.; a 20 h.p., 850 r.p.m. motor drives No. 1 agitator pump, lift pump and Nos. 1 and 2 Dorr settlers; No. 2 and No. 3 agitator pumps and No. 3 Dorr settler, 40 h.p., 850 r.p.m.; Aldrich triplex pump on precipitated solution tank and vacuum pumps, 25 h.p., 850 r.p.m.; Deisters, 5 h.p., 1130 r.p.m.; pan amalgamator and amalgamating barrel, 30 h.p., 900 r.p.m. The motor equipment for the entire mill figures 12.6 h.p. per stamp, which is a rather high figure.

The pumps in the plant are: Two 3-in. Morris centrifugals, one for elevating pulp from settler to agitator and one for No. 1 agitator; two 5-in. Price centrifugals, one for No. 2 and one for No. 3 agitator; one 3-in. Morris centrifugal for elevating the overflow solution from the drainage sump to agitators, one Aldrich 7x9-in. triplex for precipitate press; one 3-in. Buffalo centrifugal for pumping the unprecipitated solution to the storage

tank; and two 7x10-in. Buffalo vacuum pumps.

EXTRACTION RISES WITH GRADE OF ORE MILLED

The Nova Scotia mill was operated for quite a while on 12-oz. ore from the mine dump. With heads running from 10 to 15 oz., the extraction is only about 80 per cent. but it ranges above 90 per cent. when 40 to 50-oz. rock is being treated. Mill tailings average about 2.8 oz. silver per ton. Lime is used to the extent of 2½ lb. per ton of rock fed to the mill.

A complete sampling equipment consisting of a Snyder machine making a one-quarter cut, Blake crusher, Vezin sampler cutting 5 per cent. Cornish rolls, another Vezin machine cutting 5 per cent. and a sampler grinder is being added. The sampling equipment will provide a means of taking correct head samples and it will be possible to obtain some really accurate figures on extraction. The sampling system at most of the Cobalt mills is crude and most unsatisfactory.

SMALL OPERATING FORCE REQUIRED

The Nova Scotia mill is arranged so as to require a minimum of labor. A crew to operate the mill through the 24 hours consists of two battery men, one amalgamator, two crusher men, two filter-and-solution men, one laborer or "roustabout" and a sample boy. From two to four machinists are also employed. The company operates a well equipped machine shop where it does its own repair work.

Recent Developments at Jarbidge, Nevada

BY WINTHROP W. FISK*

There is greater activity at Jarbidge now than ever before. A mill is being built, two new roads are under construction and prospectors are opening many fine showings. The Pavlak company, which was the first to begin practical development of a mine, is the first to purchase and erect a mill. This company has contracted with Chalmers & Williams for a large cyanide plant, which is to be placed in operation as soon as possible.

The mill is to be built on the bank of the Jarbidge river and directly at the mouth of the adit. The ore will be dumped from the adit level into an ore bin, and after being crushed the pulp will be elevated to Dorr classifiers. The mill buildings will occupy nearly all of the available flat on the river bottom, while the solution tanks will be placed on a bench of the cliff 80 ft. above the mill floor. The mill was planned to handle

custom ore from other mines, but the company is opening up so much ore on its own ground that the probabilities are that it will not be able to treat any ore outside that from its own mine, and possibly that from the several leases on the Pavlak vein.

LEASING OPERATIONS

On the 4-M lease drifting operations from a winze on the 50-ft. level are yielding high-grade milling ore. At the Riddle-Corrigan lease the vein is opened by adits on two levels, and there is considerable ore in sight which assays from \$12 to \$16 per ton. On the Curley lease an adit has been driven about 80 ft. on the vein and the ore pans well. At the "Ham And" lease, on the Taft ledge, a vein parallel to the Pavlak about 400 ft. to the west of it and also on Pavlak ground, the lessees have an 80-ft. adit showing ore all the way. They are now starting a crosscut adit from the river

level to cut their orebody 65 ft. below the present adit and enable them to deliver their ore right on the wagon road for convenience in hauling to the mill.

The Amazon-Rainbow company has a 90-ft. adit on the Amazon ledge, and the ore encountered is steadily becoming better as the tunnel advances. It is expected that this adit will intersect the main Pavlak vein when in about 50 ft. further. The Good Luck mine has an adit in about 100 ft. and some high-grade ore has been found. On the North Star vein Clark & Fletcher have run a crosscut from their lower adit to a point under the winze which was sunk from the upper adit on a chute of rich ore, and are now upraising on the vein. When a connection is made it will provide good ventilation for the mine and will also open up considerable stopping ground.

James Duncan has bonded the Guess fraction, Buster Brown and Guess claims for \$50,000 to Mr. Featherstone and as-

*Mining engineer, Jarbidge, Nev.

sociates, who are laying in supplies and material for steady work this winter. Theodore Parks has purchased an interest in the Last Chance No. 1 and Last Chance No. 2 claims, and expects to start development work soon. The Sugar group of four claims has been bonded for \$50,000 to Jack Griffith, who represents Butte capitalists. The Free Fissure Gold Company has opened three veins on the east slope of Jumbo Peak and is finding large quantities of good ore and some high-grade rock.

Work in Jack Creek crater, three miles

southeast of Jarbidge, on the property of the Cœur d'Alene-Jarbidge Gold Mining Company, is progressing well and with good results. The property is favorably situated for cheap and quick development. The Elko county commissioners have undertaken to build a road into the camp from the south, connecting with the Deeth road at Charleston, which will provide an outlet to the Western Pacific railroad at Deeth. This will give the camp much cheaper freight rates and will greatly reduce the price of necessities. A large force of men are now at work push-

ing the road through so as to have it ready for winter travel. A new road has also been surveyed from Twin Falls, providing an easier grade besides being several miles shorter than the old road. It will be completed as soon as possible, in order that the heavier parts of the machinery for the Pavlak mill may be hauled over it without difficulty. The Elko Telephone Company has asked for bids to extend its line from Gold creek to Jarbidge, so it is possible that the camp may soon be connected by telephone with the outside world.

Transvaal Gold Production and Policies

LONDON CORRESPONDENCE

The following are the figures of production from the whole of the Transvaal for this year and for 1909:

	Year Ended Aug. 31, 1909.	Year Ended Aug. 31, 1910.
Tons of ore crushed...	21,033,857	21,837,783
Gold output, fin. oz. ...	7,360,915	7,361,372
Dwt. per ton crushed...	6.99	6.74

During the year ended Aug. 31, 1910, the salaries paid to all the white men employed on the Transvaal gold mines amounted to £7,500,000. African natives received £4,790,000, and the last of the Chinamen divided £61,000 among them.

The amount realized from the gold won was thus distributed: Working costs, 59.75 per cent.; dividends, 30.15 per cent.; profits tax, 3.11 per cent.; reserve fund, machinery renewals, capital expenditure, etc., 6.99 per cent.; total, 100 per cent. The working costs, amounting to nearly 60 per cent. of the value of the gold won, are classified as follows: White mens' remuneration, 34.5 per cent.; natives and Chinese, 21.6 per cent.; stores, 38.5 per cent.; sundries, 5.4 per cent.; total, 100 per cent.

OVERCOMPETITION TO GET LOW COSTS PER TON MILLED

It will be remembered that, owing to the competition between managers to show the lowest costs per ton milled, startling reductions in costs were made a couple of years ago. It is more than probable that the aim and object of a mine, namely to return the highest possible dividends to the shareholders, was more or less lost sight of in this competition, low costs per ton milled by no means necessitating maximum profits. A manager anxious to reduce his costs per ton had only to carry a stope 4 ft. wide when mining a 3-ft. reef, to reduce his mining costs per ton by about 25 per cent., though the extra foot of rock broken might contain no value whatever.

That a healthy reaction has set in is

shown by a rise in working costs for last August, as compared with August, 1909, of 23c. per ton, namely, from \$4.06 to \$4.29 per ton milled.

RISE IN COSTS ATTRIBUTED TO SHORTAGE OF LABOR

A shortage of native labor is the excuse generally made for the above increase in costs per ton. It is true that a few stamps were held up, and shortage of native labor was the reason given for so doing. The fact, however, that more rock was broken in August, 1910, than in August, 1909, proves that, though the native labor supply may not have kept up with the increased demand of the still-growing mining industry of the Rand, yet the total number in the field was greater in 1910 than in 1909. It is evident, therefore, that the increased cost per ton cannot be wholly attributed to the labor question, which is often a red herring drawn across the line to avoid the humiliating confession that maximum ultimate profit had been lost sight of.

Leslie Stephen, superintending engineer of the Consolidated Gold Fields, practically acknowledges in his annual report that the cost per ton has been brought too low. After pointing out that the policy of the Consolidated Gold Fields is to obtain the maximum profit from the mines under its management, he writes as follows:

REDUCING STOPPING WIDTHS BUT AVOIDING SELECTIVE MINING

"Consistent with this policy renewed efforts are being made to reduce stopping widths by leaving in place unprofitable reef and waste rock for the purpose of obtaining the greatest profit from each working place while, at the same time, avoiding selective mining. A pay-reef-width record system introduced on some of our mines, and followed in other mines of the Rand by a square-fathom

system of tabulating stoping results, provides a helpful means of determining to what extent it is possible to carry out this policy, and, at the same time, to what extent it may be profitable to attack low-grade areas, formerly left behind as unpayable, so as to add, wherever possible, to the stability and permanency of our mines. Continuous records and data of this description justify on economic grounds the increased cost per ton which has been brought about by mining from reduced stoping widths, and by the contingent reduction in tonnage mined by the same complement of labor. While the result of the foregoing will tend to increased profits from given areas, the inclusion in our mining operations during the year of a larger proportion than hitherto of the low-grade ore in sight, which under prevailing conditions can be dealt with advantageously, has resulted in reduced average grade and profit per ton, as compared with the previous year, but much of this lower-grade rock forms an addition to the ore reserves, and therefore prolongs the life of the mine."

RAND'S PROPORTION OF WORLD'S OUTPUT

The accompanying table shows the Transvaal's proportional contribution to the gold supply of the world.

RAND GOLD PRODUCTION COMPARED WITH THE WORLD'S.

Year.	World's Output.	Transvaal Output.	Per Cent. of Total.
1905...	378,411,754	101,225,558	26.8
1906...	405,060,969	119,609,373	29.5
1907...	416,101,396	133,182,167	32.0
1908...	443,355,856	145,593,985	32.9
1909...	459,486,282	150,299,329	32.7

The small falling off in 1909 can be attributed in great measure to the increased production of Russia, its percentage contribution in 1907, 1908 and 1909 was respectively 6.5, 7.1 and 8.2, other countries remaining stationary.

Role of Alumina in Copper Blast Furnace Slags

Vogt's Work Cited to Prove That It Acts as an Acid Only in Slags Rich in That Mineral and as a Base if Silica Is under 43 per Cent.

BY L. GARRETT SMITH*

In several issues¹ of the JOURNAL in 1908 there appeared some articles on alumina in copper blast-furnace slags, in which Charles F. Shelby and others endeavored to prove that all the alumina present acts as an acid, and only as an acid. On the other hand, C. A. Heberlein as a result of his experience with the silicious slags at the Magistral smeltery, Zacatecas, draws quite a different conclusion, believing that "alumina always behaves as a strong base, and becomes more active through the addition of silica, and at times through lime and silica combined, most likely forming a double silicate of lime and alumina."

VOGT'S WORK NOT WELL KNOWN

Referring to the scientific work performed to determine the rôle of alumina, it is necessary to insert a few preliminary remarks on the general character of slags as investigated by Prof. J. H. L. Vogt, whose excellent work² has been disregarded by engineers, even in Europe. This probably is because a considerable part of his writings are in Norwegian, and are supposed to be ultra theoretical and only connected with geology and mineralogy rather than metallurgy. Furthermore, as they are based on the laws of the modern science, physical chemistry, they are not understood.

The following applies only to slags formed during the absence of steam, carbonic acid and gaseous fluorine compounds which under normal conditions are given off long before the charge reaches the focus, and consequently before the formation temperature of the slag is attained. It is also necessary that the furnace run slowly enough to allow all the constituents of the charge sufficient time to enter into combination with each other. If driven too rapidly the resulting slag will carry with it, mechanically, uncombined particles of the charge, such as quartz and magnetite.

SLAGS ARE OF SIMPLER COMPOSITION THAN ROCKS

It is generally acknowledged that slags are solutions of compounds, chiefly silicates, which conform to the same laws that ordinary water and alloy solutions obey. Vogt has proved that, if formed under the conditions mentioned above,

these compounds are, contrary to expectation, limited to a comparatively small number and that their constitution is akin to the minerals formed in the porphyritic rocks. A large number of rocks are composed of three primary minerals; often there are only two.

There are two reasons why slags should be of simpler composition than rocks: (1) because they are not saturated with steam and other gasses, which, as De Beaumont, St. Claire Deville, Morozewicz and others have proved, tend to act as catalytic agents and consequently to form compounds which otherwise would not have been formed, and (2) because they are formed only at one pressure, namely atmospheric; different pressures exerted on the same molten mass are liable to cause the formation of different minerals; there are several instances among the rocks that prove this.

In fact, one can go still further and say that the constitution of the slag-forming substances, both in the molten and solid state, is dependent only on the chemical components of the slag, and not on the physical conditions attending the same; the fact that by cooling a glassy slag slowly its structure becomes crystalline is no exception to this rule. The cooling curves of slags are analogous to those of the alloys and ordinary solutions and are of a comparatively simple character. The only breaks occur at those temperatures when a constituent crystallizes out, thus proving (and this is of the utmost importance) that the same compounds which exist in the molten state crystallize out when the slag cools.

VOGT REASONS THAT ALUMINUM ACTS AS A BASE

I will now endeavor to explain with the help of Vogt's work a few of the facts that Shelby has put before us. He proves that in a number of copper blast-furnace slags, selected at random, the oxygen-ratio is almost 2:1, when alumina is reckoned as an acid. Vogt shows that in all slags under 43 per cent. silica, with a moderate amount of alumina and where the ratio $3(\text{Ca}, \text{R})\text{Al}_2$ (R may be Fe, Mg, Mn) is greater than one (which is the case with all the slags mentioned by Shelby), all the alumina will combine with part of the silica and other bases to form melilite.³

This compound has the general formula:

$x(\text{Ca}, \text{R})_4\text{Si}_2\text{O}_{10} \cdot y(\text{Ca}, \text{R})_3\text{Al}_2\text{Si}_2\text{O}_{10}$ that is, it is composed of mixed crystals of the two isomorphous substances, akermanite and gehlenite. The molecular relation⁴ between them tends to be $x = y$, but it is altered by the presence of other minerals, and also by the relation of Ca to R. An excess of $3(\text{Ca}, \text{R})$ to Al_2 is essential for the formation of melilite; if this is not the case either $(\text{Ca}, \text{R})\text{Al}_2\text{SiO}_6$ (augite), $\text{CaAl}_2\text{Si}_2\text{O}_8$ (anorthite), aluminates (spinel) or Al_2O_3 (corundum) may be formed.

After the bases CaO, RO, have satisfied their affinity for alumina and silica to form gehlenite $(3\text{Ca}, \text{RAl}_2)$, then,⁵ and not until then can part (or the whole) of the remaining alumina act as a real acid by forming an aluminate of lime or magnesia $(\text{Ca}, \text{Mg})\text{Al}_2\text{O}_4$, spinel. This mineral crystallizes out first until the relation $3\text{Ca}, \text{R} : \text{Al}_2$ is almost established, after which melilite, anorthite or augite crystals begin to form. Therefore, in order that alumina may act as a real acid, a large preponderance of this oxide over the rest of the bases is necessary, which, with slags rich in alumina, is never the case.

SYSTEMATIC RESEARCH INTO THE ROLE ZINC PLAYS IN SLAG DESIRED

The behavior of ZnO is one exception to this rule; an excess of about 5 per cent. ZnO will form ZnAl_2O_4 , zinc spinel, which solidifies at a comparatively high temperature and makes the slag difficult to manage. But I would point out that Vogt's work on the part that zinc plays in slags, has not by any means exhausted the subject, and our knowledge on this point can only be aided by systematic research in the laboratory. This would be of the greatest value to metallurgists, questions of this kind only too often turning up in practice.

Associated with one of the minerals mentioned, one, sometimes two, of the following are often present: augite, $(\text{Ca}, \text{R})\text{SiO}_3$; anorthite, $\text{CaAl}_2\text{Si}_2\text{O}_8$; magnetite, Fe_3O_4 ; olivine, $(\text{CaMg})_2\text{SiO}_4$; and FeSiO_3 ; and MgSiO_3 . With regard to the slags mentioned by Shelby, besides melilite, augite $(\text{Ca}, \text{R})\text{SiO}_3$ and FeSiO_3 will be the chief constituents, owing to the large preponderance of CaO and FeO. Then there will be lesser amounts of olivine, owing to the small

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¹ENG. AND MIN. JOURN., Vol. LXXXVI, pp. 270, 483, 730, 1111 and 1264.

²Studien über Schlacken, Silikatschmelzungen.

³These compounds will be called by their mineral names.

⁴Vogt, *loc. cit.*, p. 59.

⁵Vogt, *loc. cit.*, pp. 85-86.

percentage of MgO; also of anorthite and the alumina augite as the ratio 3Ca, R : Al₂ is greater than one; for the same reason there will be no spinel or corundum. Ferrites⁶ of the form RFe₂O₄ and xRO.yFe₂O₃ have been definitely established, but under normal conditions they only occur in basic slags rich in Fe₂O₃.

The accompanying table shows this in tabular form.

Primary Constituents.	Oxygen Ratio of Slags, Al ₂ O ₃ as an Acid.	
Melilite (x = y).....	1.87	: 1
Augite (Ca, R) SiO ₂	2	: 1
FeSiO ₃	2	: 1
Secondary Constituents.		
Augite (Ca, R) Al ₂ SiO ₆	5	: 1
Anorthite.....	7	: 1
Olivine.....	1	: 1

That is, the average must be somewhere near 2:1, which is just what Shelby showed in his article. In slags⁷ containing more than about 43 per cent. silica the alumina tends to form the slightly more silicious augite (Ca, R) Al₂SiO₆ + (Ca, R) SiO₂ instead of gehlenite, although akermanite, the one component of melilite, is also formed. This will be the case with slag No. 5 in Shelby's list, where the oxygen ratio is 2.41:1.

PRIMARY CONSIDERATION IS WITH WHAT SUBSTANCES DOES ALUMINA COMBINE

As the above oxygen ratios taken from Vogt's work agree with the analysis

idea that it is dissolved in the slags as ZnO, if we consider that the presence of substances like ZnSiO₃, Zn₂SiO₄ and ZnAl₂O₄ in slags has been proved. That alumina in the double alumina silicates should be considered as part of the acid constituent, seems to me unlikely, but a discussion on this question is off the point. The subject to be determined is not so much whether alumina is an acid or a base, but rather, as a basis for our calculations, with what substances we are to consider the alumina combined.

In the calculation of ore charges, the practical engineer wishes to know whether a slag of a certain composition, high in alumina, which it is desirable to make, will run well. A comparison with slags examined by Vogt, Akerman and others would be a difficult task, owing partly to the fact that this kind of work has hardly passed the first stage, and the data for these calculations are meager, partly because the literature on this subject is scattered and ultra theoretical.

METHODS SIMILAR TO VOGT'S SHOULD BE EMPLOYED TO TEST ALL SLAGS BEFORE RUNNING THEM

Before proving the usefulness of this slag by actually trying it in practice, and possibly causing much waste of time and money, I should recommend a few laboratory tests similar to those conducted by Vogt. The experiments should consist in

shall find a certain number of binary and ternary systems which we have no reasons for supposing to be more complicated than the present ones. By calculating the charge, one will have to aim at the eutectic mixture of these systems, so as to get as low a melting temperature as possible. Alloys, mattes and speisses have been and are being thoroughly investigated; in slags the mineral nature of this kind of work has kept metallurgists off this interesting field of study, but not until the slag solutions have been reduced to definite systems will order be brought in the present chaos.

Broken Hill South Silver Mining Company

The reports of the Broken Hill corporations are always looked for with interest, owing to the complexity of the ores treated. Unfortunately the report of this corporation is silent as to technical processes.

The work of the Broken Hill South Silver Mining Company was interrupted for two months in the first six of 1910, but for the other four, 7000 tons of ore per week were treated—a new record.

A dividend of 10 per cent. was paid for the half year, 5 per cent. depreciation written off, and over 8 per cent. of the

PRODUCTION DETAILS, BROKEN HILL SOUTH SILVER MINING COMPANY, JAN.—JULY, 1910.

PRODUCT.	NET WEIGHT. Tons.	PROPORTION	ASSAY VALUE.			METAL CONTENTS.			PROPORTION OF METAL CONTENTS.		
			Pb Per Cent.	Ag Ounces.	Zn Per Cent.	Pb Tons.	Ag Ounces.	Zn Tons.	Pb Per Cent.	Ag Per Cent.	Zn Per Cent.
Concentrates.....	20,735	15.6	72.0	21.5	5.3	14,912	445,369	1,098	73.9	52.2	6.4
Tailings—Zinc.....	58,915	44.3	4.2	3.7	18.5	2,457	217,754	10,889	12.2	25.5	63.8
Tailings—Quartz.....	36,170	27.2	2.3	2.3	8.3	851	84,169	3,020	4.2	9.9	17.7
Slimes.....	17,166	12.9	11.3	6.2	12.0	1,951	105,651	2,058	9.7	12.4	12.1
Totals.....	132,986	100.00	15.2	6.4	12.8	20,171	852,943	17,065	100.00	100.0	100.0

of copper blast-furnace slags taken from actual smelting, from all over the world, I would deduce that, if a slag rich in alumina is to work well, its components are represented roughly by the appended table, and that they satisfy the somewhat empirical oxygen ratio 2:1, as the table shows. Further, that in these cases alumina cannot possibly act as an acid, as the ratio 3Ca, R: Al₂ is always greater than one, double silicates of alumina and the other bases present being formed.

Slags rich in ZnO are apt to form an exception to this rule owing to the strong affinity of ZnO for alumina, the resulting zinc spinel being characterized by great stability. As indicated above, our knowledge on the general behavior of ZnO is not complete, yet I cannot entertain the

melting (1) the pure constituents of the proposed slag, well mixed, in a large crucible and (2) several other workable slags, of as similar composition to the required slag as possible. The physical properties of the latter should be compared to those of the proposed slag.

Research on eutectic mixtures will be of the greatest consequence to metallurgists; a judicious comparison of these to the proposed slag will reveal how, by varying certain of the constituents without altering the alumina, we shall get nearer to the eutectic mixture. In other words, we shall know how to make our slag of the lowest melting temperature possible under the circumstances.

The question as to the limit of alumina in slags offers a new field for further study, which cannot be answered at present. By varying the FeO, CaO, MgO, and SiO₂ contents, with high alumina, we

capitalization carried forward in undivided profits.

The tonnage treated was 132,986, which contained 20,171 tons lead, 17,065 zinc, and 852,943 oz. silver. A table is given, showing the work of the concentrating plant.

The corporation has over a million tons of old tailings available for sale to the zinc flotation companies, and would seem to be in a good financial position.

Working costs were: Mining, \$2.46; filling depleted stopes, 0.26; development, 0.24; concentration, 0.84; total, \$3.80.

The costs per ton of concentrates were \$24.63, so that the general showing is extremely favorable.

The Nitrate Propaganda Association gives the unmined nitrates of northern Chile at 245,827,000 tons, or a 50-years' supply at the current consumption.

⁶Metallurgie, 1910, No. 5 and following.

⁷Vogt, loc. cit., pp. 124-125.

Gas Power in High Altitudes

SPECIAL CORRESPONDENCE

While Peary, Cook and Shackleton were struggling with the mysteries of latitude, American energy and enterprise were successfully solving the problem of altitude in connection with the use of producer-gas power for mining purposes in the heart of the Andes of Bolivia. This was at the plant of the Compañía Minera y Agrícola Oploca de Bolivia, situated at Chocaya, 14,000 ft. above sea level, and about 90 miles southeast of Uyuni, Bolivia, the latter being the nearest railroad and telegraph station of the Antofagasta & Bolivia Railroad (the only one in Bolivia).

SHORT FUEL SUPPLY

The entire country is uninviting in aspect, devoid of timber and vegetation with the exception of a resinous plant called *tola* and occasional patches of a short bunch grass, which furnish the natives with the little fuel used in cooking and the llamas with food. There is also a peculiar resinous lichen, known as *yareta*, which makes an admirable fuel, running high in fixed and volatile carbon; but before it grows to sufficient size to justify gathering, it requires, it is said, not less than a century. Naturally it is now to be found only at points distant from mines.

The Oploca company, about three years ago, bought the holdings of the old Guadalupe Company, which from its silver mines at Tatasi had produced several million bolivianos profit. They were eventually closed by the purchaser as the lowered price of silver, combined with the yearly increased cost of fuel, made it impossible to operate at a profit, and the Oploca company turned its attention to the development of other properties included in its purchase, among them the property at Chocaya.

CHOCAYA MINE ORIGINALLY SILVER, NOW TIN

This was originally a silver property, or supposed to be, but the tin content of the ore was large and the silver content small, so the property has lain idle for years. Siete Suyas (seven veins), the mountain containing the orebodies, was partially explored with the result that the company decided upon the erection of a concentrating mill for the tin ores, leaving the silver out of the question except at such times as rich ore was struck which would pay to ship after sorting.

The majority of the machinery was purchased from the British works of Fraser & Chalmers, and while all of it was of the best, it was so installed that

much of it was entirely useless. One crusher was so large that it could not be hauled and two smaller ones were purchased in its place.

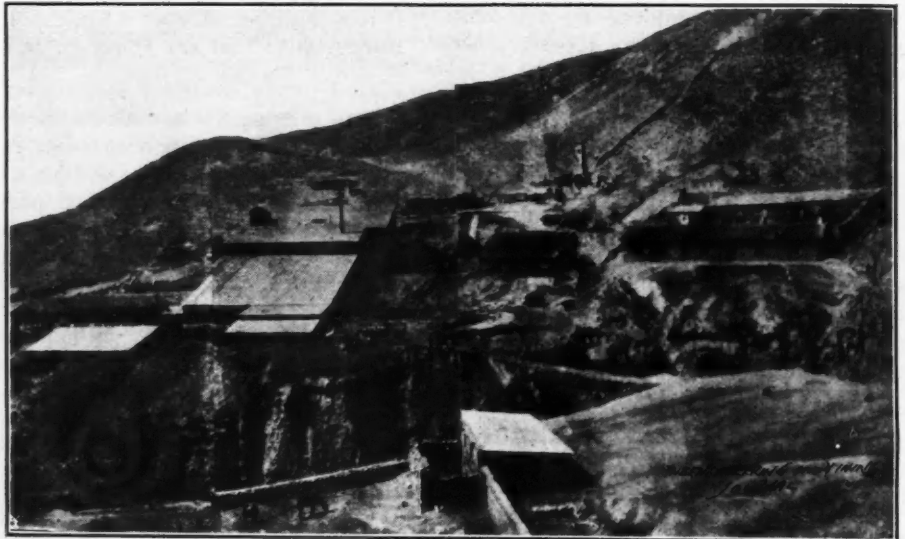
LONG WAGON HAUL

It should be remembered that all freight hauled in wagons costs from \$160 to \$200 per ton, and can only be hauled during the dry season of about eight months. There was included in the equipment an English semi-Corliss engine of 75 h.p. with a Root boiler, using the fuels above mentioned with a wood known as *churque*, a tree closely allied to the mesquite but larger.

From this *churque* an excellent char-

European manufacture, but were obliged to use anthracite coal which at Chocaya would cost \$150 per ton, and at these extreme altitudes the engines consume an average of 1.9 lb. coal per horsepower-hour, though I am unable to say whether this consumption is due to the altitude or to the small grate areas of the European producers.

I had an excellent opportunity of ascertaining the facts relative to the fuel consumption in both the plant of the Oploca company, and the plant of Aramyo, Framke y Cia., as I spent nearly nine months at Chocaya while installing the Oploca gas-power plant and making some changes in the concentrat-



TIN PLANT OF THE OPLOCA COMPANY AT CHOCAYA, BOLIVIA

coal can be obtained, and it is this fuel which proved to be the salvation of the company financially. It can be obtained in good quantities at altitudes of about 10,000 ft. and grows plentifully at the ranches owned by this company, situated at Oploca, about sixty miles northeast of Chocaya. As charcoal it was, of course, useless under the boiler, and was high in price when hauled to the mine as wood.

FUEL COST ONE-HALF OF OPERATING EXPENSE

When using the steam plant, owing to the mill not being entirely completed, not more than 30 h.p. was actually used. The fuel bill with the closest economy in the way of firing, etc., made up nearly one-half of the gross operating expenses of the company at this property, averaging \$2410 per month.

Several other tin properties, notably those of Aramyo, Framka y Cia., were operating with producer-gas engines of

ing mill, all of which was done without suspending operations over three days.

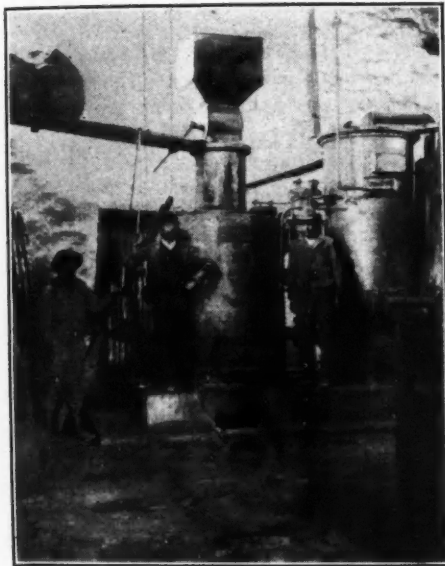
GAS ENGINES BUILT FOR SEA-LEVEL WORKING

The Oploca company ascertained that it could use charcoal successfully in the producers built by the Weber Gas Engine Company of Kansas City (now the Sheffield Gas Power Company), and purchased two 65-h.p. engines and producers with their respective air-starting plants. Unfortunately when the order was placed, nothing was said about the altitude at which these plants were to be run and they were equipped for sea-level operation, as their destination was given the manufacturers as Antofagasta, Chile.

In addition to this misfortune, a mechanic was sent to erect the plant, who while he followed closely the plans and made an excellent installation, had never seen or operated a gas engine. With the compressor furnished for sea-

level for the air starter, not more than 40 lb. pressure could be obtained, so that the steam engine was used as an auxiliary. About this time, a native mechanic named Ramon Serpa was appointed as master mechanic, as he had had some experience with other gas-power plants for Aramyo, Framke y Cia., and he succeeded with the help of the steam engine in starting and running the plant spasmodically. Instructions were asked for from Kansas City, which were sent, but before they had arrived the board of directors in Santiago, Chile, cabled to the Sheffield Gas Power Company to send an engineer to help them out of their difficulties.

On my arrival after the most tedious and disagreeable trip I ever made on mule-back, I was much surprised to be saluted with the steady "chug-chug" of the engine, running as smoothly as possible, so it was plain that the greater difficulties had been overcome. It developed that the mechanic Serpa had



GAS PRODUCER, CHOCAYA, BOLIVIA

learned to handle the producer satisfactorily, and had the engine in perfect order, but was unable to get its full power from it owing to lack of compression and improper setting of the time of ignition.

ENGINE WORKING AT 75 PER CENT. OF SEA-LEVEL RATING

Within a few days' time we had the engine tuned up so that it would pull 49 h.p. and there is still power to spare in it. As it is only rated at 65 h.p. sea level, there are two conclusions: either that it is underrated at sea level or that a splendid duty is being obtained. After the installation of a larger auxiliary kerosene engine and 5x7 single-acting compressor, we were able to get up 125 lb. pressure in the two large air receivers in from 15 to 20 minutes, and for June made this record: Total hours possible, 720; total hours of work, 654; total

charcoal used, 34,200 lb.; waste charcoal, 1320 lb.; clean charcoal consumed, 32,880 lb.; horsepower-hours consumed by different machines, 17,159; charcoal consumed per horsepower-hour, 1.9 pounds. In other words the total amount of charcoal used at the regular cost of \$0.67 per 100 lb. made a cost of \$228 for the month as against an average former cost of \$2410. Rather a nice dividend by itself.

Pig Iron Production for 100 Years

The accompanying table, which is of much interest, is compiled from the records of the American Iron and Steel Association. It shows, in long tons, the production of pig iron in the United States in the past 100 years. Prior to 1854 the statistics given were compiled by various Government and other statistical agencies. For 1854 and all succeeding years the statistics have been gathered by the American Iron and Steel Association. The statistics for 1810, 1840 and 1850 are for census years. The figures for 1820 and 1830 are estimates made by early statisticians. Census statistics for those years are wanting.

PIG IRON PRODUCTION FOR 100 YEARS.

1810	53,908	1875	2,023,733
1820	20,000	1876	1,868,961
1828	130,000	1877	2,066,594
1829	142,000	1878	2,301,215
1830	165,000	1879	2,741,853
1831	191,000	1880	3,835,191
1832	200,000	1881	4,144,254
1840	286,903	1882	4,623,323
1842	215,000	1883	4,595,510
1846	765,000	1884	4,097,868
1847	800,000	1885	4,044,526
1848	800,000	1886	5,683,329
1849	650,000	1887	6,417,148
1850	563,755	1888	6,489,738
1852	500,000	1889	7,603,642
1854	657,337	1890	9,202,703
1855	700,159	1891	8,279,870
1856	788,515	1892	9,157,000
1857	712,640	1893	7,124,502
1858	629,548	1894	6,657,388
1859	750,650	1895	9,446,308
1860	821,223	1896	8,623,127
1861	653,164	1897	9,652,680
1862	703,270	1898	11,773,934
1863	846,075	1899	13,020,703
1864	1,014,282	1900	13,789,242
1865	831,770	1901	15,878,354
1866	1,205,663	1902	17,821,307
1867	1,305,023	1903	18,009,252
1868	1,431,250	1904	16,497,033
1869	1,711,287	1905	22,992,380
1870	1,665,179	1906	25,307,191
1871	1,706,793	1907	25,781,361
1872	2,548,713	1908	15,936,018
1873	2,560,963	1909	25,795,471
1874	2,401,262		

Up to 1854, the reports are irregular, some years being omitted; from that year on every year is included. Growth for many years was slow; in 1847 the yearly total reached 800,000 tons, but it was 17 years later, in 1864, when 1,000,000 tons were reported. In 1872 the 2,000,000-ton level was passed, and by 1886 a production of 5,000,000 tons was reached. In 1898, for the first time, the make was over 10,000,000 tons, and seven years later, in 1905, it exceeded 20,000,000 tons. The table shows many sharp fluctuations from year to year; the most noticeable being the abrupt drop

in 1908, and the equally sharp recovery in 1909. The difference between 1907 and 1908 was greater than the entire production in any year prior to 1898, only 10 years previous.

Operations of the Austrian Potash Syndicate

The Galician potash field, at Kalusz, is to be worked jointly by the Austrian government and a syndicate of Austrian capitalists. So far an area of only 1148 by 1800 ft. has been worked, in which four shafts have been put down, none, however, to a greater depth than 920 ft. According to engineers' estimates, a supply of 33,000,000 lb. of potash salts per annum could be obtained from the existing shafts for 18 years, but it is the intention to put down additional and deeper shafts.

The Kalusz field, according to the *Daily Consular and Trade Reports*, has produced kainite and sylvite chiefly, the kainite carrying 12 to 15 per cent. of potash. The output in 1908 amounted to 24,840,000 lb.; the 1909 statistics are not yet available. Austrian imports of potassium chloride from Germany have increased from 8,800,000 lb. in 1902, to 154,000,000 in 1909.

Owing to the feature of the law of Austria, which forbids the manufacture of mineral salts by private corporations, the Kalusz field is to be worked under the form of a lease, the syndicate delivering the salt to the government at a fixed price. The government will erect and operate a factory at Kalusz for its preparation for market. There are many features of the proposed joint working of the government and the syndicate which are still to be determined, viz., contract price for delivery of salt by the syndicate, terms of lease of additional territory, terms for syndicate participation in manufacture, etc. Offers from foreign countries to furnish capital and participate in the syndicate's operations have been received and rejected. It is the firm intention of the interested parties to maintain the enterprise as a purely Austrian undertaking. Herein should lie the greatest advantage to the American purchasers, namely, a large supply from works independent of the German monopoly.

The progressive spirit of Mexico is shown by the attention devoted to wireless telegraphy. As early as 1903 the wireless land stations erected at Guaymas, Sonora, and at Santa Rosalia, Baja California, had been successful in establishing communication with steamers, either outgoing or incoming, and in 1909 the Government announced the establishment of additional wireless stations at Payo Obispo and Xcalac, in Quintana Roo Territory, bringing the number of such stations in the Republic up to six.

Revised Flow Sheet of Utah Copper Mill

BY CLAUDE T. RICE

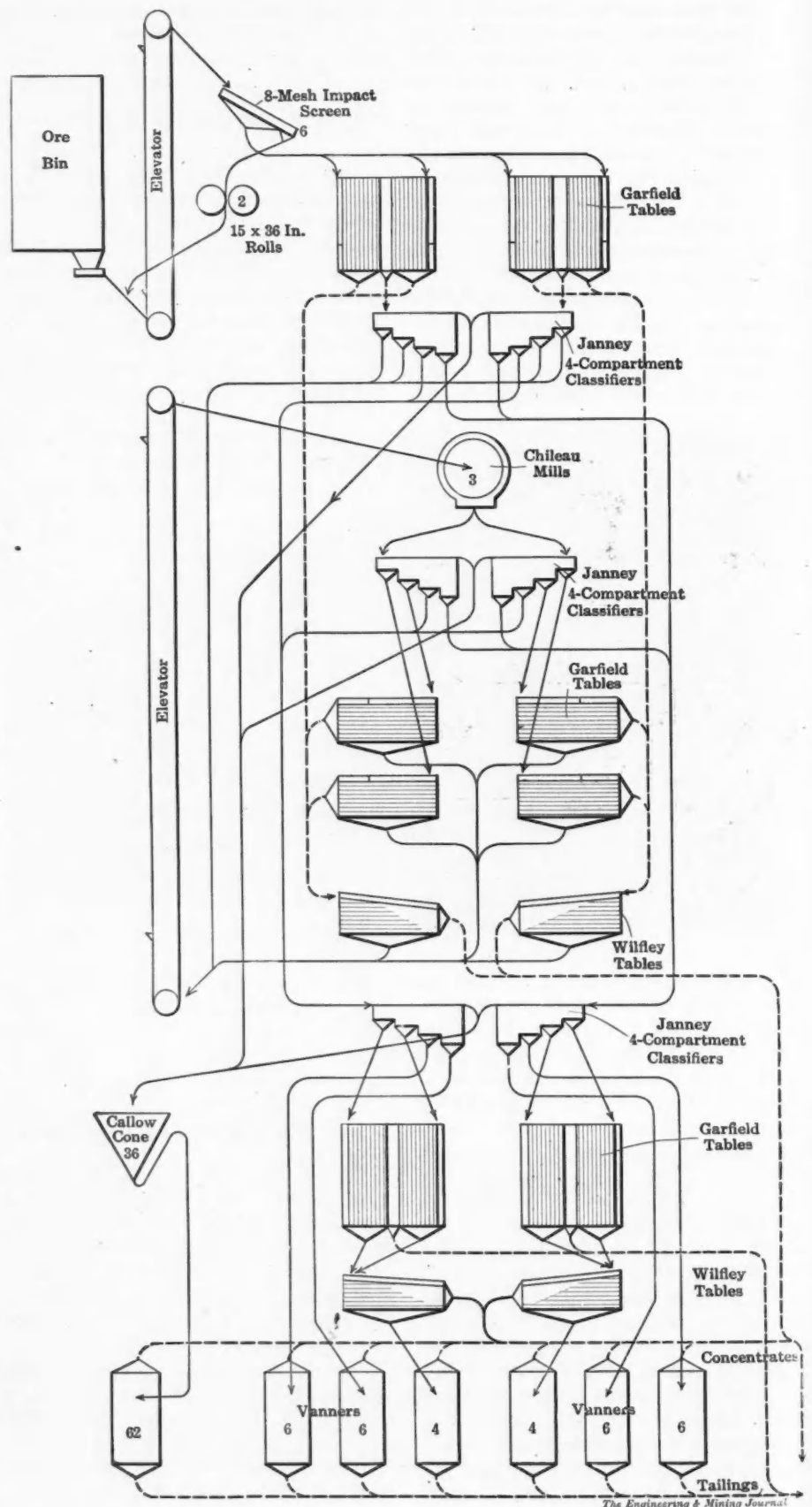
The management of Utah Copper Company made a decided move for the better when early in 1910 it radically changed the flow sheet of the mill. Formerly all the pulp had gone to chilean mills to be ground until it would pass a No. 18 rolled-slot screen. This resulted in a great deal of the sulphide minerals being unnecessarily reduced to impalpable slimes. Not only was this fine grinding bad practice because of the excessive amount of slimes formed, but also on account of the reduction of capacity that it caused.

On account of the large proportion of slimes in the feed going to the tables it is doubtful whether the mill, as formerly arranged and treating a head averaging 1.6 per cent. copper, ever maintained an extraction greater than 64 per cent for a whole month; most of the time the extraction was not more than 60 per cent. Of course, in the early days of the Coperton plant when the ore was coming mainly from the underground workings, the ore milled averaged over 2.25 per cent. copper, and a saving as high as 70 per cent. was effected. Recently an extraction as high as 67 per cent. has been made on a head averaging about 1.55 per cent. copper.

The accompanying flow sheet is not so complete as it might be, for there is some doubt as to the size of the screens used on the impact screens and also on the chilean mills. Otherwise it is an accurate representation. The flow sheet indicates a notable advance over the company's former practice and in some respects the treatment outlined is quite a little in advance of general milling ideas.

ALL-SLIMING AND CLOSE CLASSIFICATION ABOLISHED

The most striking thing that the reader will notice upon referring to the flow sheet is that the company has recognized the futility of grinding the sulphides to a powder before trying to save them. Therefore all the pulp is passed over concentrating tables before it goes to the chilean mills, and a notable portion of the chalcocite is recovered before it is slimed. Moreover, the company has adopted the idea, first used on a large scale in the West at the Ohio Copper mill, but long in general use in the Michigan copper country, of not trying to make a finished concentrate at first but, instead, making a dirty head and as clean a tailings product on the first tables as is possible and later cleaning the first concentrates on other tables. This is the "roughing" principle.



REVISED FLOW SHEET FOR UTAH COPPER MILL

According to this flow sheet close sizing is not resorted to. This is in line with what many millmen in the West have been noticing, i. e., that in many cases a better saving is made upon an unclassified head than upon the same pulp when it is closely classified and the different sizes treated on different groups of tables. The coarse concentrates seem to cover up the finer sulphides as they lie in the riffles on the tables and protect them from being washed away by the strong water currents. No doubt on a complex ore close sizing is necessary, but on a simple ore it has been proved in several instances that this is not the case. For example, in one instance, a better saving was made on a pulp that was treated without any classification than when (with the same tables, the same feed and the same men tending the tables) the feed was split on a 12-mesh screen and the oversize sent to one group of tables and the undersize to another. In the first case the extraction was 48 per cent., in the second only 41 per cent. In another instance the pulp was split on a 40-mesh screen and the oversize treated on one set of tables and the undersize sent to another set. This gave a better extraction than when the pulp was sent to a hydraulic classifier and each of the four sizes obtained was treated on a separate group of tables. In still another case it has been found that a better extraction is made when the slimes go to the sand tables before going to the slimes tables than when the slimes are sent direct to the latter.

The roughing table used at the Utah Copper mill is the Garfield table devised by members of the Utah Copper staff. It is simply a large rectangular table with riffles extending entirely across the surface so that the concentrates are discharged off the end of the table. The riffles are $\frac{3}{4}$ in. deep at the head end and $\frac{3}{8}$ in. at the discharge end. The head motion is a Wilfley motion. The tendency of this riffle is to raise the concentrates as they approach the discharge end, so that the silica can be washed off of them. Of course these tables give a dirty concentrate which requires cleaning. This is done on Wilfley tables.

CHILEAN MILL PULP RUN IN CLOSED CIRCUIT

The tailings after this rough concentration are sent to a four-compartment classifier. The first two compartments send their pulp to a bucket elevator which returns it to the chilean mills, while the pulp from the third and the fourth compartments is so fine that it requires no further crushing, and so is shunted past the chileans. The pulp from the chilean mills is sent to a second four-compartment classifier. The first two sizes from this classifier are taken out and, after concentration on a set of Gar-

field tables, the concentrates from which are cleaned on Wilfley tables, are returned again to the chilean mills. This forms a closed circuit, thought by some to be quite bad, but by means of the hydraulic classifiers the system is kept in equilibrium. On the second return to the chilean mills the chances are that the particles will be ground finely enough so that they will go to the third or the fourth spigot, and so the tendency to build up a coarse product on account of the closed circuit is counteracted to a considerable extent.

PRIMARY AND SECONDARY TABLES MAKE NO TAILINGS

The first two groups of Garfield tables and the Wilfley tables treating the concentrates from them do not make tailings, and it is not until the pulp has passed through a third or a fourth spigot of one of the sets of classifiers that it is fine enough for the tables treating it to make a true tailings product. These last Garfield tables make tailings. This seems a bad point in the practice, although it is foolish to criticize when one does not know the grade of the tailings that the tables are making. But generally it is not good practice to make tailings on such a crude table as is this Garfield roughing table. Probably, though, on these tables the middlings are thrown with the concentrates, and the real tailings separation is made upon the Wilfley tables.

The tailings from the Wilfley tables of the finishing group go to vanners of the Johnston suspended type, as does the overflow from the different classifiers after being dewatered. In fact, the vanners still do a large proportion of the concentration on account of the great sliming effect of the chilean mills on this ore, no matter how coarse the screen used on the mills. Still the shunting past the chilean mills of the portion of the pulp that is fine enough for final concentration and the use of coarser screens on the mills themselves has resulted in less sliming. As a result of working out a scheme for getting a tube-mill product from Bingham porphyry ore, coarse enough for table concentration, the Utah Copper Company has been able to return to the use of concentrating tables. The flow sheet also witnesses an appreciation of the fact that, although there are portions of the material passing a Wilfley table that can be saved on a vanner, it is cheaper to catch as much of the sulphides as possible on Wilfley or similar tables as they are less expensive to operate than are vanners.

The numbers on the flow sheet show how many of each kind of machine there are in a unit of the mill. For instance, there are six impact screens in a unit, served by two sets of rolls that feed to one elevator. The six screens feed three

chilean mills, etc., to 62 vanners, in each of the 12 units in the mill. The capacity of these units is being crowded considerably at the Utah Copper mill, but at the Ray Consolidated and the Chino mills it is the plan to treat 1000 tons per day in each of the units, which are in every respect similar to the unit represented by the accompanying flow sheet.

Alaska Coal Lands

In reporting upon the investigation of Secretary of the Interior Richard A. Ballinger, the majority of the so-called Ballinger Investigating Committee filed a report under date of Dec. 10, in which incidentally judgment is expressed with reference to the now famous "Cunningham claims," in Alaska, and the general question of Alaskan coal development. The committee says:

"The conditions, . . . while adequately safeguarding the Government ownership of Alaska coal lands, are a serious hindrance to the proper and desirable development of the Territory and unjust to residents of Alaska and to such worthy citizens of the United States as may seek there a field for honest and legitimate enterprise. The resources of Alaska cannot be made generally available for the benefit of mankind without the use of coal. Unable to buy or obtain coal from Government lands, the people there are now obtaining coal from distant States and foreign countries at prices ranging from \$12 to \$24 per ton. It is not sensible to require the importation of coal at such enormous expense while these vast coalfields are at hand. Such a course must end some time if the coal of Alaska is ever to be of value to anyone.

"Your committee believes that it would be the height of unwisdom to permit these coalfields to be monopolized or gathered into the private ownership of a few for speculative purposes. As they increase in value the increment should inure to the benefit of all the people. To bring about this result, and at the same time put an end to the unreasonable condition now existing, your committee recommends that the Government refuse to sell these lands, but that retaining their ownership, it shall grant leases at fair royalties for periods limited, but long enough, and covering areas large enough to justify the necessary investments upon sound business principles, and thus secure the opening and operation of sufficient mines to meet the necessities of Alaskan consumption; afford relief from the present outrageous prices paid by consumers, and at the same time afford some revenue to the Government. We recommend legislation to that end, and that, pending such legislation, the existing withdrawal from entry of the Alaska coal lands be continued."

Some French Experiments on Coal Dust

Results of an Exhaustive Series of Tests to Determine the Underground Conditions Favorable to the Production of a Coal Dust Explosion

BY HENRY BRIGGS*

J. Taffanel, the director of the experimental station at Lievin, France, has described an exhaustive series of tests, conducted between June, 1908, and April, 1909, principally in the main gallery, which at that time was 65 m.¹ long. The conditions approximated as closely as possible those obtaining in a dusty colliery, and were chiefly for the purpose of ascertaining the underground circumstances favorable and unfavorable to the production of coal-dust explosions.

FACTORS BEARING ON COAL DUST PROBLEM

The following is a digest of the discussion of results which forms the concluding section of the report:

Apart from all experimenting, it is postulated that the factors which bear on the coal dust problem are (a) The proportion of volatile matter contained in a dust, and its chemical composition, (b) its purity, (c) its fineness, (d) the quantity of dust affected, (e) the dimensions and form of the gallery in which an explosion takes place, (f) the chemical and physical composition of the air in the gallery, (g) the degree of dampness of the dust, and of the walls of the gallery, and (h) the nature, intensity and other characteristics of the initial inflammation which causes the explosion. These factors are discussed in detail in order to bring out their relative importance as revealed by the experiments, thus:

THE INFLUENCE OF THE FORM OF GALLERY

The full importance of the form of gallery, as a factor, could not be shown by the experiments owing to the fact that the same gallery had perforce to be used for all the tests. As a result it could not be stated whether the results would be the same in another gallery differing from that used in shape and exposed internal surface, in the character of the walls, and in having twists and branches. Experimental galleries in other countries are not of the same dimensions as that at Liévin; the cross-section is greater at Altofts (England), and smaller at Gelsenkirchen (Austria), and Frameries (Belgium). The desirability of performing compara-

tive tests in these different galleries, using the same dust and keeping other conditions the same, is pointed out. In order to draw a comparison with the results obtained in 1890 by Mr. Simon, who experimented in a metal tube one meter in diameter, dust prepared in the same way as that employed by Mr. Simon was used, and it is concluded that a small-sized gallery appears to be unfavorable to the production of a dust explosion. To some extent this is a logical conclusion, as the cooling action of the walls will be more in evidence in a smaller gallery; yet the deduction is not considered as finally established, because other conditions obtaining in Mr. Simon's experiments could not be attained. It is, however, pointed out that in several colliery explosions the flame traversed the larger roadways in preference.

Though it seems probable that the propagation of an explosion is generally facilitated when the sectional area of the road is large, it must be borne in mind that in certain circumstances the reverse may be true. In passing from its source, the ignition at first extends in all three dimensions, but once the flame fills the roadway, it can travel only in one dimension. The chance of extinction is greater in the first than in the second stage, and the first period is lengthened the more spacious the roadway; furthermore, the initial disturbance has less effect in raising dust in a large gallery, and if the dust is only imperfectly raised the propulsion of the flame in the direction of the road will be less violent, and will be less capable of lifting more dust in front of it, and hence the flame will have a better chance of dying out. It is concluded, in short, that a coal-dust explosion is less easily originated in a roadway of large area than in a smaller one, but once it is well started it is carried forward with greater ease. Further experiments will be needed in this connection, however, before this conclusion can be considered thoroughly proved.

The influence of twists and bends in the gallery, and several other factors such as irregularity of the walls (which offer some resistance to the rapid passage of a large volume of gas, and change the course of eddies), are questions that are to be taken up subsequently with the gallery lengthened and provided with branches. It is then hoped to settle whether the conditions

of production of a dust explosion differ when the initial detonation occurs at the end of a heading, in a roadway traversed by a rapid current of air, and when the air is stagnant. Explosions are doubtless less frequently originated in an open roadway than in a *cul-de-sac* where firedamp has a better chance of collecting, and where the shots are "tighter" and more apt to blow-out; but it will be necessary to study the former case, *inter alia*, as such ignitions have occurred in practice.

THE INFLUENCE OF ATMOSPHERIC CONDITIONS

The temperature and the hygrometric state of the air, and the barometric pressure have either brought about only some very slight systematic differences in the results of the experiments, or have had no visible influence. The effects of changes in temperature and pressure of the air are both intangible, and it is a probable consequence that the increase of pressure resulting from the depth of mine workings will have no very sensible influence. Only the humidity of the air appears to have had an effect appreciable within the degree of precision of the experiments; it being found that explosions have a little less life in damp than in dry atmospheres. This factor is, however, of small importance and easily masked by other secondary influences, such as the unavoidable discrepancies in the fineness and purity of the dust.

The well-established fact that explosions more frequently traverse the intakes than the returns is sometimes expressed by saying that in dust explosions the flame "rushes toward fresh air." Now the air in returns only differs from that in intakes in having a higher temperature, often an increased humidity, a slight reduction in the oxygen percentage, and a slight increase in carbon dioxide. The increase in humidity will have no notable influence in the propagation of a dust explosion, and the variation in composition of the air is so small that it appears doubtful whether it can have any appreciable effect; this (with slight reservations on the last point) the results of the experiments go to show that the atmosphere of a return is practically as favorable a medium for carrying a dust explosion as that of an intake. Since it is evident that the quality of the air has little to do with the comparative immunity of re-

NOTE—Abstract of a bulletin entitled, "Troisième Série d'Essais sur les Inflammations de Poussières: Production des Coups de Poussières," April, 1910.

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¹One meter = 1.094 yd.; 1 gram = 0.035 oz.

turns from dust explosions, the question may now be asked as to whether the direction of the air-current before the explosion has any effect. When an explosion of dust is witnessed in the test-gallery under favorable conditions, using fine, pure dust, rich in volatile constituents, it becomes very evident that the blasts of air arising immediately on the ignition of the dust, and which not only accompany but also precede the flame, have a velocity so vastly superior to that of a normal current of air traversing a mine roadway that the original direction of the latter must be a matter of indifference. If the point has any bearing at all, it can only be of importance at the origin of the ignition, where the air movements are less violent than when the explosion has got thoroughly under way; for example, if an explosion should originate in a short entry turning off at right angles from an airway, the air current passing in the latter may have some influence on the respective rates at which the ignition is carried forward on the two sides of the entry. In such a case, it would seem at first sight that the inflammation would be facilitated in its passage along the airway in the direction coincident with that of the normal current.

It will not, however, be possible to speak authoritatively on this point until the gallery has been provided with branches and further experiments have been conducted in it, for it might happen that the actual effect is just the reverse of that indicated, owing to the fact that an explosion-wave, opposed in direction to the flow of the air-current would probably cause considerable swirling and eddying, which would facilitate the raising of dust. All that can be said at present in this connection, then, is that the direction of the normal air current has no tangible influence on the propagation of a violent dust explosion, but may possibly have some bearing on the direction which the explosion takes in the first instance; or it may affect the development of a slow ignition produced under less favorable conditions. The results of the experiments render it possible to assign another reason to the freedom of returns from explosions, through the fact that they are generally narrower than intakes. Narrow galleries act in the same way as partial obstructions, which have been shown by recent experiments to exert a great modifying influence; they offer more resistance than the wider intakes to the passage of air-blasts, and reduce at the same time their speed and their power of raising dust. Again, in most mines, returns are less favorable to dust explosions either through the simple fact that coal is no longer trammed along them, or because the rubbish is all trammed out that way,

and that repairs are constantly producing stone dust. As a rule whatever carbonaceous dust there may be in returns is exposed for a longer time than that in intakes to atmospheric agencies which alter its composition and perhaps diminish its aptitude to carry an explosion. This latter question has been discussed in connection with the Monongah and Darr disasters, and it is intended to study it subsequently at Lievin.

THE INFLUENCE OF THE INITIAL CAUSE OF THE EXPLOSION

Of all the determining causes of a dust explosion those appertaining to the mode of ignition are among the most decisive.

In order to fire an explosive mixture of gases, all that is necessary is to bring a portion of the mixture to the temperature of ignition; the firing of dust, however, is more difficult, because the inflammable mixture of air and dust is not usually formed in advance. Under normal conditions the air of mines only holds in effective suspension a fraction of a gram, and exceptionally a few grams, of dust per cubic meter. Such a cloud is not dense enough to be inflammable.

Occasionally a quantity of dust may be thrown into the air in excess of the limit of inflammability through some accidental cause, and the question may then be asked as to whether, in such circumstances, the naked flame of a lamp is sufficient to produce an ignition, or whether it is necessary to have a source of heat of greater volume or greater intensity. Inquiry may also be made if compression is necessary, too, at the initiation of an explosion—this theory having been sometimes advocated. In elucidation of these points experiments were conducted in the following way: At one or two meters from a naked lamp-flame was placed a heap of fine, pure, Lievin dust containing 30 per cent. of volatile hydrocarbons; a strong jet of air, conveyed by a branch pipe from a compressed air main, was then caused to play on the heap, causing a voluminous cloud of dust to pass over the lamp and to extend many meters beyond. When the cloud was sufficiently dense, an ignition occurred which traveled to the boundaries of the cloud. The same result was also attained with an arc-lamp, the one used in the tests absorbing 20 amp. at 40 to 50 volts. In another experiment a cloud was continually formed by blowing the same kind of dust from the mouth of a hollow cone—the orifice being 65 cm. across—by means of a special ejector. The cloud was then ignited by the aid of a flaming rag previously soaked in petrol, and, by regulating the ejector properly, it was found that the burning rag could be withdrawn while the dust cloud con-

tinued to burn from the mouth of the cone in the same way that a mixture of coal-gas and air burns on a Bunsen burner.

EXPLOSIONS ATTRIBUTED TO IGNITION OF DUST BY A NAKED FLAME

Experience has shown that inflammations of a similar character to these might occur in practice. There have been several cases of dust having fired at an Argand or other form of open light near coal-chutes in screening sheds, while at the Middleton mine, England, on Sept. 2, 1907, a cloud of dust raised by a rake of full trams traveling outbye in a very dusty intake, was ignited under the eyes of an official by a burning "snuff" from the wick of a lamp being flicked onto the floor. Again, certain localized dust explosions have been attributed to the ignition by a naked flame or an arc-lamp of the cloud of dust raised by a runaway rake of trams on a dusty incline. This same initial cause has been reported on in connection with the generalized explosion at Monongah, West Virginia.

Though the probability of a dust explosion arising by the above process is certainly not *nil*—both experience and experiment testifying to that—it is very slight. The tests showed that dust clouds had to be quite thick and opaque before they could be ignited at a naked flame or electric arc; hence it is concluded that clouds of an inflammable density, produced in the ordinary working of a mine, are of rare occurrence. Moreover, save in exceptional circumstances such as those which obtained at Monongah, the volume of such a cloud can only be a few cubic meters at the most. It is further to be noted that the initial speed of the flame in a cloud that is not caused to eddy violently is very small; also that the air-blasts resulting from the production of quantities of warm gases in a limited space only attain the speed and violence essential to the lifting of more dust and to the generalization of the explosion when the original ignition has been able to feed on a large volume of inflammable mixture—and such a volume is not generally present in the circumstances now being discussed.

A coal-dust explosion is produced much more easily through the detonation of an explosive, or through the firing of a sufficient amount of firedamp. Such an occurrence gives rise to a much larger dust cloud in the first instance, and creates besides, violent eddies in the cloud which accelerate the speed of propagation of the flame to a singular extent. To the effect of the eddies must be added that due to the accelerative influence of the initial ignition. It follows from the fact of the specific gravity of the dust particles being so greatly

superior to that of air, that they will be given a velocity different to that of the air surrounding them; this will increase the speed of ignition since the more rapidly a combustible body moves through the air the quicker it will burn. These facts permit us to comprehend with what facility a dust explosion may be caused by firing an explosive or a quantity of firedamp.

EXPLOSIONS RESULTING FROM SHOT FIRING

Dealing first with explosions resulting from shot firing, it is to be noted that the shot needs to produce two effects, namely, the raising of a cloud of dust, and its ignition. If the drill-hole is properly charged and fired, all the available energy of the charge is converted into useful work, and is applied in breaking ground. The broken rock will be thrown forward with a velocity which will be inversely proportional to the total weight shifted; hence, with a good shot, this velocity must be small, and as a result the air of the place will not be much shaken and the dust will only be slightly lifted; in addition, very little, if any, exterior flame will accompany the shot, and even if a little should make an appearance it will be so intermingled with rock fragments as to reduce the chances of a dust-ignition to a minimum.

If, on the other hand, the shot should blow-out, or—to state the extreme case—if it should be fired in a cannon without stemming, all the available mechanical energy of the charge is employed in putting in motion the air of the gallery; and, since the specific gravity of air is small, the accelerations and velocities so induced will be very large; at the same time there will be considerable projection of flame. Hence these conditions will be as favorable as possible to the lifting of dust and to its immediate ignition. In these favorable circumstances, the experiments have shown that explosives differ in regard to their power of lifting and of firing dust. It was shown that black powder, which is sometimes considered to be the most dangerous explosive, is indeed, by virtue of its persistent and bulky flame, the best capable of firing dust which has been previously raised in a cloud. But if the dust simply lies on the floor, as is usually the case in mines, different results were obtained, black powder, because of its comparative slow ignition, causing less violent disturbances in the air and hence acting less powerfully in lifting dust than an equal weight of high explosive. For instance, using a cannon of 55 cm. bore placed 60 cm. above a dusty floor, ready ignitions were produced with a charge of 160 grams of blasting-gelatin, but the dust was fired only exceptionally under the same conditions with charges of powder up to 500 grams. High ex-

plosives—and most of the French safety explosives fall into this class—raise dust easily, but fire it with difficulty, the flame being too short in length and brief in period of time; hence, by the time the dust is raised to the vicinity of the axis of the cannon, the gases passing from the latter will have cooled to some extent. To render the dust capable of coming into contact with the gases before they cool too far, the cannon was placed nearer the dust, and it was found that by reducing the height of the axis of the cannon from 60 to 30 cm., the minimum charge of *grisoutine*² necessary to explode the dust fell from over 1000 down to 500 grams.

GELATIN IS MOST CAPABLE OF PRODUCING DUST EXPLOSION

Of all those explosives that were tried, gelatin seemed most capable of producing a dust explosion. Under the conditions that obtained in the test gallery, the high shattering power of this explosive, together with the high temperature and large volume of the flame, being effects favorable to the ready lifting and firing of the dust. A further effect of the shattering action is to create an extreme agitation in the air of the gallery, which adds considerably to the speed at which a dust explosion is propagated during its first phase; it is also possible that the pressure of the wave of detonation has an accelerative influence. The combination of these various effects renders gelatin the readiest and most certain means of producing dust explosions at the disposal of the experimenter.

It is not considered, however, that it necessarily follows that gelatin is the most dangerous explosive in the mine. The probability of the occurrence of an explosion underground is actually the product of three factors, namely: (a) The probability of an ignition taking place when a dangerous circumstance occurs, such as a blown-out shot; (b) the probability of occurrence of such a condition—for example, the proportion of blown-out shots in the total number fired; and (c) the frequency of shot-firing, which may be measured as the number of shots fired per ton of coal gotten, or per meter of advance of the face. In the case of gelatin, though the first of these factors has been stated to be more important, the second and third are less important than with any other explosive; and it is the combination of the three that measures the probability of an explosion arising with the explosive.

Having dealt with shots properly charged and fired, and with those that blow-out, it was necessary to experiment with charges set off outside shot holes among dust in order to be able to pre-

sent a full statement of the case. Several trials conducted with safety explosives seemed to indicate that ignition in such circumstances is not easy; instead of the dust coming under the influence of the eddies caused by the jet of hot gases issuing from a cannon or blown out shot, the dust is scattered on all sides a great distance from the flame.

ADDITION OF FIREDAMP REDUCES LIKELIHOOD OF EXPLOSION

Another interesting question touched on in the trials was that of the inflammation of dust by a preliminary explosion of firedamp. When the conditions were favorable, it was found that by firing only 100 grams of black powder into 8 cu.m. of a mixture of firedamp and air, a vigorous blast of air and wave of compression were produced, easily giving rise to a dust explosion. When gas was fired by a charge of gelatin, voluminous flames were seen to issue from the mouth of the gallery, while, judging from the great pressures attained, and from the noise and dynamical effects of the ignition, it appeared that the addition of firedamp intensified the violence of the explosion; it was not, however, found that the speed of the explosion was sensibly increased. It was also demonstrated that when conditions are not so favorable to a dust explosion, the addition of firedamp to a gelatin charge actually reduces the likelihood of explosion, and it is proposed to explain this paradoxical effect through the deadening influence of the large quantities of carbon dioxide and watery vapor thrown into the atmosphere by the ignition of the firedamp. In experiments of the scale of those in the test gallery it would seem that firedamp does not form the surest priming for a dust explosion, and it was thought better to eliminate it entirely when studying the rationale of dust explosions, merely employing gelatin fired unstemmed from a cannon as the mode of ignition.

Dealing with the magnitude of dust explosions caused by firing unstemmed shots, it was found that when conditions are favorable to a dust ignition, any charge of a weight in excess of a certain minimum will always produce an explosion, but the minimum weight may be doubled or trebled without causing any sensible difference in the results. On the other hand, if conditions are less favorable to the propagation of the flame, the smallest charge necessary to fire the dust is greater than the minimum just mentioned.

These two facts are explained as follows: An increase in the charge intensifies the eddies and accelerations which accompany the wave of detonation, and also augments the volume of the dust cloud raised. The former effect is limited to a zone immediately about the shot-hole, for the detonation wave, trav-

²A French safety explosive, having ammonium nitrate and nitroglycerin as active bases.

eling with a velocity at least equal to that of sound, will outpace the flame, and must then cease to have a direct effect on the speed of propagation; accordingly, under conditions favoring a dust ignition, any charge over and above the minimum weight will not materially affect the initial speed of the explosion. The principal effect of such an excess, then, is to extend the zone in which the dust is raised by the wave of detonation immediately the shot is fired; but this can have no influence on the pace of the explosion when conditions are favorable to a dust ignition, as in such circumstances the ignition is vigorous enough from its start to keep itself amply fed with dust raised by the propulsion of the products of combustion along the gallery, even with the minimum charge; a sufficient supply of dust being therefore insured, it is a matter of indifference if the cloud happens to have been formed slightly earlier by the wave of detonation.

On the other hand, if the conditions are such that a dust ignition can only be produced with difficulty, the initial combustion of dust round about the shot hole may be so slow as to be incapable of causing, *per se*, a good propulsion of gas and a good lifting of the dust in front of the flame. In such a case an increase in the charge, adding to the violence of the wave of detonation, will have the effect of raising a larger initial cloud of dust, which, on being consumed, will give rise to a greater expansive propulsion of air. In other words, as the charge is gradually increased in these unfavorable conditions, the speed of the air blast is augmented little by little, and the dust is raised more and more completely in front of the flame. Thus it happens, that while the initial detonation simply plays the part of a priming when conditions are favorable to a good ignition, yet in unfavorable circumstances, the pace of a dust explosion in a length approximating to that of the 65-m. test gallery depends on the magnitude of the initial detonation, which therefore decides whether an ignition will terminate as a generalized explosion or by dying out. It is considered possible, that, by using charges in excess of those employed in the tests, the limit of the conditions permitting an explosion to take place could be extended, inasmuch as the heavier charge would lengthen the preliminary period during which the progression of the flame is aided by the initial raising of dust.

THE INFLUENCE OF THE QUANTITY OF DUST

Whether underground conditions in respect of coal dust may be considered dangerous or not will depend on the quantity, the purity, the chemical composition, and the degree of dampness of the dust. Methodical investigations were

undertaken to determine the influence of each of these independent variables, and the results of the tests may be stated as follows:

An important first point in regard to the quantity of dust is the great distance between the upper and lower explosive limits. If the combustion of the carbon of the dust were solely considered, it would perhaps be thought that a dust cloud would carry an explosion only when its density lay between narrow limits, neither being far removed from that of 112 grams of dust per cubic meter³, since in clouds of lesser density there is an insufficiency of combustible material, and in those of greater density the excess of it would result in the formation of carbon monoxide and a reduction in the temperature of combustion. The theoretical temperatures of combustion respectively, of 112 and 225 grams of carbon per cubic meter of air, with the formation of carbon dioxide in the first case and carbon monoxide in the second, are about 2030 deg. C., and 1300 deg. Centigrade.

VOLATILE CONSTITUENTS OF THE DUST PLAY AN IMPORTANT PART

The experiments conducted at Liévin have amply shown, however, that this conclusion is incorrect. They have proved that the volatile constituents of the dust play a most important part in the combustion, and further, that in order to express the quantity of heat generated, the combustion of the hydrogen has to be taken into account, this element having an importance much greater than would at first seem from the ultimate analysis of the coal. It is therefore concluded that the cooling effect brought about by the formation of carbon monoxide has less proportionate effect than might be expected. Moreover, a consideration of the results attained by analyzing the products of combustion taken (a) from close behind the face of the flame, and (b) from some distance behind the flame, reveals that the dioxide and not the monoxide of carbon is the gas chiefly formed at the front of the flame even when an excess of dust is present; also that a second reaction setting in behind the face of the flame converts a large proportion of the dioxide originally formed into the monoxide, and that this second reaction requires an appreciable time in its performance. As the face of the flame is the active region so far as the propagation of the explosion is concerned, it is evident that an excess of dust diminishes the quantity of heat generated in that region to a much lesser degree than one had supposed.

There cannot be any doubt, nevertheless, that there exists for dust, as for in-

³One ounce of dust per cubic yard is very nearly equivalent to 37 grams per meter.

flammable gas, a lower and an upper explosive limit. For gas these limits depend on the temperature of the source of ignition, and correspond to the mixtures whose temperature of combustion is equal to that of the igniting source. For dust, however, the law is less simple, for, unlike gas, the temperature of combustion cannot be deduced directly from the composition of the mixture, owing to various conditions (some independent of the amount of dust in suspension), modifying the reactions which take place and the influence of the bodies participating in the combustion. Nor can the evolution of heat be calculated with certainty, as one is ignorant of the extent to which the residual solid particles, by taking up heat, interact as cooling media, and so affect the propagation of the inflammation. These phenomena are exceedingly complex, and it is intended to report on them subsequently, after they have been specially studied.

All that can be definitely advanced at present in this connection is that various causes combine to permit of the inflammation of clouds overcharged with dust. It is also to be noted that the evolution of the volatile constituents, which take a very active part in the combustion, is facilitated by the increased area of exposed surface in these overcharged clouds, and furthermore, such a cloud will hold a greater number of excessively fine particles, which are evidently the most inflammable. Apart from the cooling action due to the formation of carbon monoxide—which already has been stated not to be of great moment—and that due to the residual solid matter, a further retarding influence in an overcharged cloud will be due to the excess of dust acting as a black screen and preventing to some extent the transference of heat from the face of the flame to the unburnt mixture.

The experiments have shown that the upper explosive limit is very high for fine, pure dust, rich in volatile matter; and it was not reached even with a dust-charge of 1650 grams per cubic meter of the gallery, which is 15 times the charge of 112 grams of carbon per cubic meter of air theoretically corresponding to complete combustion. It must be remembered, however, that especially with heavy overcharges, the dust is only lifted imperfectly, and in consequence the weight of dust actually in suspension in the test just referred to, did not reach the amount of 1650 grams. Though this quantity fell short of the upper explosive limit, it was in excess of the amount that gave the maximum rate of explosion, which was attained for fine, pure Liévin dust between the dust-charges of 337 and 610 grams per cubic meter of air—these amounts being almost entirely thrown into suspension during the passage of the flame.

WITH LESS INFAMMABLE DUST

When less inflammable dust is used, the limits necessarily converge, and there is then some chance of the upper limit falling; it would seem from the following cases that it has been approached:

Coarse pure dust from Liévin, with 30 per cent. volatile hydrocarbons, has transmitted an inflammation at the very high charge of 1300 grams of dust. Dust from Noeux, containing 24 per cent. volatile matter, propagated flame, though at a very reduced speed, with the large dust-charge of 900 grams. Dust with only 15 per cent. volatile matter, which never could be made to explode, nevertheless gave rise to a longer flame with charges from 112 to 450 grams than with orders in excess of, or lesser than, these amounts.

Under the conditions obtaining in the tests, the lower explosive limit for fine Liévin dust strewn on the floor of the gallery appeared to be in the neighborhood of 112 grams per cubic meter. This is a higher figure than was obtained in previous tests in which the dust had been flung into the air prior to firing the shot into it, and it therefore becomes apparent that the rate at which the dust is lifted must be taken into account. The coarser dusts are more difficult to lift and are probably less inflammable than the finer ones, and their lower limit of inflammability was determined as 225 grams or thereabouts. It was found that difficulties arose in determining the precise lower limit for fine dust containing 24 per cent. volatile matter. The charges that fired least readily lay between 225 and 337 grams per cubic meter; but it is not possible at the present state of knowledge to say if this irregularity in behavior is merely a chance result, or one of the consequences of the complexity of the laws governing the combustion of dust.

CONCLUSIONS

From these considerations and results the following conclusions are deduced:

In testing whether a dust is dangerous, different charges of dust must be used in the trials, and experiments must be made with quantities greatly in excess of the theoretical charge of 112 grams per cubic meter of air, for, as an actual fact, charges of some of the less inflammable dusts in the neighborhood of 500 grams gave the longest flames or the easiest ignitions. Inasmuch as the upper explosive limit has been shown to be difficult to reach, an excess of dust cannot be counted on, in practice, to stop an explosion; and it is to be noted that if the flame encounters clouds of too great a density, the resulting reduction in speed diminishes the lifting effect; hence the cloud loses density, and there is therefore something in the nature of an automatic adjustment continually tak-

ing place as the flame traverses a gallery in which an excess of dust is present.

Again, the lower limits of inflammability are generally so low that there will be sufficient dust in most parts of a dusty mine to give rise to an explosion. A gallery 2 m. high and 2 m. broad has an area of 4 sq.m. and a perimeter of 8 m.; with a dust charge of 112 grams per cubic meter, which corresponds to the lower limit of some dusts, there will be 450 grams per running meter and 56 grams per square meter of wall area, assuming the dust to be deposited evenly. Taking the apparent specific gravity of dust as 0.5, the thickness of the dust-layer in the case under consideration will be about one-tenth of a millimeter (0.112 mm., to be exact); such a thickness is habitually considered small by practical men. The mean dust-charge and the greatest dust-charge of the experiments, namely, 450 and 900 grams per cubic meter, if allowed to settle uniformly on the walls, roof and floor of the above gallery, respectively correspond to layers 0.45 and 0.90 mm. in thickness, which are by no means rarely met with in dusty mines.

Hence it follows that it is impossible to guarantee that a roadway is immune from a dust explosion because there happens to be only a thin deposit of dust on the floor and walls; and again, that little dependence can be placed on the operation of removing dust as a preventative measure if that precaution is the only one applied. This last conclusion does not hold, however, if the dust is removed by means of a jet or strong spray of water under pressure.

SPRINKLING AS A PREVENTATIVE MEASURE

With regard to sprinkling, it is evident that if sufficient water is used to convert the dust into a fluid mud, it becomes impossible to fire it. If water is added little by little to 10 grams of very fine dust, it is seen at first that the water assumes the form of globules surrounded by a dusty skin and does not wet the mass; on thorough mixing, however, it is incorporated, and when three or four cubic centimeters are added, the dust no longer appears in a finely divided state, but tends to agglomerate; the agglomeration is not complete until the weight of water is at least equal to that of the dust. On adding a further 50 per cent. of water, pasty mud is formed, which becomes fluid when the weight of water is double that of the dust. In this latter condition there is no need of tests to show that the mass is noninflammable. In practice, the mixing of dust and water is very imperfect; after a dusty area has been sprinkled it will be found that the dust is scarcely wetted; because the sprinkling is not evenly done, a part of the area will escape wetting, while some

of the dust will float on the water. Inquiry had therefore to be made as to whether such an operation will be efficacious even when a large excess of water is used, and experiments were made to determine the efficiency of sprinkling.

When water was used in adequate quantity, it was found to be sufficient to impede the lifting of dust in front of a shot-hole. In cases where an initial ignition of dust was produced, a weight of water equal to that of the dust was found capable of preventing an explosion spreading, providing the dust did not exceed 450 grams per cubic meter of the gallery. The nearer the wetted area was to the shot the more efficaciously it acted in preventing an ignition of dust. It is not to be doubted that water acts beneficially in cooling the flame as well as in interfering with the formation of a dust-cloud, and this double influence is stronger when the lifting action of the shot is weaker, and when the temperature of the flame happens to be low. More water is needed to prevent a strong detonation producing an initial ignition than to stop such an inflammation developing into a generalized explosion; it is also true that a much greater proportion of water is required to stop a dust explosion that has got thoroughly under way. In this connection it is intended to publish, at a later date, a separate account of trials of wet zones conducted in the 230-m. test-gallery.

Though the experiments described above have shown that sprinkling can effectively prevent a dust explosion arising without any excessive quantity of water being necessary, yet in practice evaporation will render sprinkling nugatory unless it is performed immediately before the occurrence of the initial cause of inflammation. This is possible for a shot, but not for an explosion of fire-damp unless the whole of the dust is wetted at frequent intervals.


COLLIERY NOTES

The Dominion Government has appropriated \$75,000 to cover the cost of the investigation now being carried on by the Mines Branch, Ottawa, into the economical value of Canadian peat bogs. This is an increase of \$25,000 over last year's appropriation.

In the Oak Creek district of the Yampa coalfield, the Routt County Fuel Company is producing 500 tons per day of a fine, hard, bright bituminous coal. The McKinlay mine, on the same seam—to which a spur is being built to connect with the Moffat road is installing machinery, and the expectation is to output 500 tons per day by the first of the year. The strike of the miners of the Oak Hills Coal Company, which lasted all summer, is said to be ended.

i PERSONAL i

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

C. W. Goodale has returned to Butte.

Frank Dean, of Chicago, was recently at Tombstone, Ariz., on professional business.

W. A. Wallace recently spent a week at Tombstone, Ariz., and went thence to Mexico.

Charles W. Mitchell has resigned his position as general superintendent of the Dominion Steel works.

J. Parke Channing expects to leave for the Southwest on Dec. 27. He recently returned from Lake Superior.

A. J. Beaudette, mining engineer for the Grand Trunk Pacific Railway, has established his office at Winnipeg, Manitoba.

Ernest Levy, of Rosslund, B. C., manager of Le Roi No. 2, Ltd., and the Van Roi Mining Company, has been at Spokane and Seattle.

Henry M. Waite, vice-president of the Clinchfield Coal Company of Virginia, has been visiting Birmingham, Ala., his former residence.

James M. Hyde, of Palo Alto, Cal., representing the Minerals Separation Company, of London, is on his way from Mexico to London.

Prof. H. S. Munroe, for whom 1911 will be his sabbatical year, is planning to go abroad, expecting to sail from New York on Feb. 4 next.

H. J. Booth, A. C. Narnsdale and E. A. Drake, of Boston are inspecting mining properties in which they are interested in the Port Arthur, Ont., district.

George H. Aylard, of New Denver, B. C., manager of the Standard silver-lead mine near Silverton, Slocan lake, was in Spokane, Wash., early in December.

Francis C. Bowman, who conducted the examination of the Sunnyside mine has returned to inspect the new orebodies struck in Terry tunnel since the same was completed.

Samuel Bilsky, of Ottawa, and John Black, of Montreal, are associated in an extensive purchase of sandstone quarries in the Ottawa district and near Montreal.

Carl O. Lindberg, mining engineer for Spurr & Cox, of New York, is acting as superintendent of the Santa Gertrudis mine at Pachuca, Mexico. This is the new Camp Bird property.

Robert W. Hollis has been appointed manager of the Silver Ledge mine. Mr. Hollis has been trustee of this property for many years and is well acquainted with its orebodies and its needs.

Walter Harvey Weed is still in Butte, Mont., examining the Butte-Ballaklava

mine and will probably be the chief witness for this company in the law suit pending with the Amalgamated.

Joseph M. Bourke has been appointed by the Temiskaming & Northern Ontario Railway Commission to take charge of the construction of the branch of that railway from the main line near Kelso to Porcupine.

A. N. C. Treadgold, head of a placer gold mining company which is preparing for extensive hydraulicking operations in the Yukon, left Dawson Nov. 24 by special stage for the Coast, on his way to New York.

Frank H. Probert recently returned to Los Angeles, Cal., from a professional visit to the Superior & Boston mines, at Globe, Ariz., and left again Dec. 9 to make a thorough examination of the Ray Central mine, at Ray, Arizona.

Wesley Harris, district superintendent of the Vandalia Coal Mining Company, has resigned to accept a similar position with the Chicago & Indianapolis Coal Mining Company, operating Shirley Hill mine No. 1, near Linton, Indiana.

F. J. Tone, works manager of the Carborundum Company, Niagara Falls, N. Y., has lately been suffering from a serious illness. He is now on the road to recovery, and is going away, on a leave of absence in order to complete convalescence.

Dr. Herbert Gray Torrey, for 37 years chief assayer at the United States assay office in New York, has opened an office as assayer and metallurgist at 99 John street, New York. He has associated with him Charles Taylor, the firm name being H. G. Torrey & Co.

John F. Meagher, late superintendent of the Whitworth division of the Tennessee Coal, Iron and Railroad Company, has been appointed superintendent of the Mulga mines of the Birmingham Coal and Iron Company, at Mulga, Ala. Thomas G. Fear, succeeds Mr. Meagher at Whitwell.

C. S. Herzig and W. Murdoch Wiley have resigned as president and vice-president, respectively, of the Constant-Herzig Company. C. S. Herzig has taken over the mining contracts and will continue the business heretofore carried on by the mining department of the company.

Charles T. Fairbairn, of Pittsburg, late general manager of iron mines for the Republic Iron and Steel Company, has been appointed manager of the Southern division of that company, with headquarters at Birmingham, Ala. He succeeds W. A. Greene, who will become controller of the Texas Company Jan. 1 next.

W. R. Ingalls, editor of the JOURNAL, has retired from the editorship of "The Mineral Industry," publication of which will be continued by the McGraw-Hill

Book Company. Albert H. Fay has resigned from the editorial staff of the JOURNAL to become editor of "The Mineral Industry." Frederick W. Horton, who has been assistant editor of "The Mineral Industry" has accepted a position with the U. S. Bureau of Mines.

+ OBITUARY +

Henry C. Davis died in New York, Dec. 15, aged 61 years. He organized the Tacoma Smelting and Refining Company some years ago. For several years past he had been a broker in New York.

Sanford C. Prunty died at Guadalajara, Mexico, Dec. 12, aged 32 years. He was born in Kansas, and went to Mexico 13 years ago. He was for some years connected with the smelting works at San Luis Potosi, and recently started an office as mining engineer and assayer at Guadalajara. He left wife and one son.

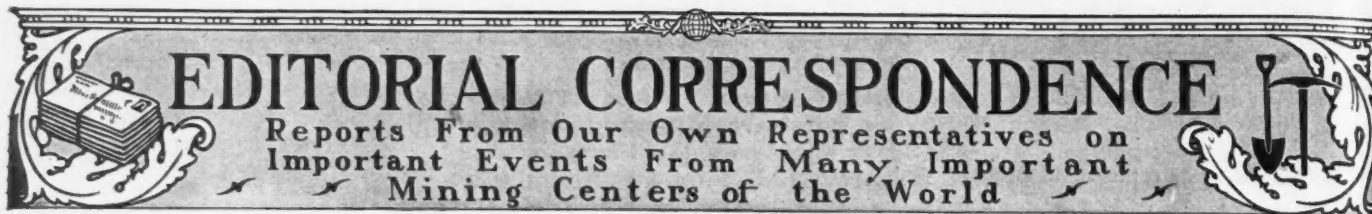
Wallace T. Foote, Jr., of Port Henry, N. Y., died in New York, Dec. 17, aged 46 years. He was born at Port Henry and graduated from Columbia University. After practising law a few years, he turned his attention to the iron business. He was a director of Witherbee, Sherman & Co., president of the McIntyre Iron Company and the Tahawus Iron Ore Company. He served four years in Congress from the Essex district.

Stewart Watt, vice-president and superintendent of the Watt Mining Car Wheel Company, died at his residence at Barnesville, Ohio, on Dec. 10, at the age of 64. He was ill but a few days of bronchial pneumonia. Mr. Watt was, with his brother who died several years ago, the joint inventor of the first self-oiling mine car wheel, and for the last 35 years had been actively engaged in the manufacture of mine car wheels. He first operated a foundry in 1863. He was born in 1846 in Noble county, Ohio.

Walter L. Pierce, who for 32 years had been connected with the Lidgerwood Manufacturing Company and for 29 years its secretary and general manager, died suddenly of heart failure at his winter home in the Hotel St. Andrews, New York City, Dec. 10. He was a son of John F. Pierce and was born at Dorchester, Mass., in 1855. His parents survive him and he leaves a widow, Jane Hutchins, an only son, Walter L. S. Pierce, a brother and a sister. Mr. Pierce's death was entirely unexpected and was a great shock to his family and associates. He had suffered for several years with nervous troubles but by devoting much of his time to out-of-door pursuits he had apparently recovered.

SOCIETIES and TECHNICAL SCHOOLS

Mining and Metallurgical Society—The New York Section held its regular monthly meeting, Dec. 15, at the Engineers' Club.



EDITORIAL CORRESPONDENCE

Reports From Our Own Representatives on
Important Events From Many Important
Mining Centers of the World

San Francisco

Dec. 16—The suit instituted by the Federal Government against the Southern Pacific Railroad Company, attacking the title of the railroad to oil lands in McKittrick district, Kern county, is based on the allegation that the railroad company patented the land with the full knowledge that they were mineral-bearing. It is understood that this is only one of many similar suits to be commenced for oil lands in Kern, Kings and Fresno counties. The complaint admits that the Government officials were negligent in granting the patents.

In the land grants to the railroad, mineral lands were explicitly excluded, but it is notorious that the railroad companies have been patenting such lands for years. The wonder is that the railroad companies have been able to stave off for so many years the reacquirement of the mineral lands in their grants. Not only in the oil belt have "mineral" lands been taken up as "agricultural," but throughout the gold belt of California and adjoining States. Fifteen years ago an effort was made by the California Miner's Association to bring this matter to the attention of the Government and suits were brought but they were never tried, because of lack of funds. Miners and others knew the lands sought to be mineral, but they did not want personally the expense and trouble of making a contest and there was no official whose duty it was to personally examine the lands as to the mineral character. The Miners' Association tried to have examinations made but could get no hearing in Congress.

The railroads made the contention when mineral was found that the lands were supposed to be nonmineral when the grants were made and that subsequent discovery did not change the matter. They have been able for years to carry this "bluff" through successfully. If the Government can make the railroad companies make restitution of lands taken up under false characterization, it also has the power to take patented lands back from individuals who have located as "agricultural" lands in the mineral belt. Hundreds of ranches have been located and patented in mineral districts where there were active mines. These were subsequently sold to mining companies.

The domain of the prospector has been wrongly narrowed for these reasons and instances are notorious in most of the mining counties of the State. The mining community until of late has been

mainly composed of gold miners only, but now that the oil men have taken a hand with strong organizations, they may be able to bring the railroads to task, especially as the Government has taken the initiative in this case.

The Neocene Mining Company is working on a gravel channel which it claims passes under the old mining town of Scales, in Sierra county. It now wants to work that part of the channel under the town, but the residents do not want to move their houses without compensation. The mining company has a patent on the land.

Denver

Dec. 19—"Carbonate of Zinc" continues to be the Leadville "war cry," and to furnish the principal topic for conversation among mining men and for articles by the technical and daily press, the latter rhapsodical and optimistically prophetic to the last degree. One of the latter goes so far as to predict that though the output in Leadville is now close to 4000 tons per month that in three months more it will have reached 25,000 tons per month, the returns thus far indicating an average of about 20 per cent. of zinc in the ore. At the close of the year when the leases expire, it is said that the large companies will decline to renew them, preferring to work their zinc "bonanzas" on company account. This, of course, will happen, as the "tributers" hardly ever get a lease until the company has failed to work the mine or ground at a profit. But the lessee has a slight advantage, inasmuch as he pays no salaries nor office expenses, does no development ahead of extraction, has no outlay and risk except for his "grub" and supplies, and no deterioration of plant except the wear and tear of clothes and muscles. But he has to give up, say one-fifth or one-fourth of his profits to the company owning the mine. So the lessee's life is not "all beer and skittles."

But it is astonishing how the demand for a metal creates it—to read the papers of the State you would think the whole of the mines had turned into zinc. This is in some part true, though, for under the old régime when zinc was penalized, its occurrence in a mine was kept dark, whereas now under the changed conditions it is naturally loudly heralded.

The North American Smelter and Mines Company, owning the independent pyritic smeltery at Golden, which has been running continuously since last July, to insure an ore supply has purchased the

control of the Santiago mine in the East Argentine district above Georgetown. An exhaustive sampling of this mine has been lately completed, and as a result it is stated that the ore averaged \$24.59 per ton in gold, silver and copper, the latter being about 5 per cent. The smeltery has a five-year contract on the output of the Santiago group, and it is said that during September and October it received 1500 tons of ore from the Donaldson and Magalina mines. The matte is shipped to the American Smelting and Refining Company at Denver. The Argentine Central Railroad runs past the portal of the Waldorf Mines Company tunnel, of which E. J. Wilcox is manager, and connection will be made, by a lateral from this tunnel, with the Santiago shaft 500 ft. below the present shaft bottom and the ore will then come direct from the mine to the smeltery by rail.

Salt Lake City

Dec. 20—Articles of the Utah & Grand Cañon Railroad were filed Dec. 5. The line is projected from Lund, Iron county, to St. George, Washington county, 85 miles, and from Marysvale, Piute county, to Panguitch, Garfield county, 55 miles. The company has been investigating the resources of southern Utah and northern Arizona for two years, and considers it advisable to extend a road into this territory. Surveys have been made from Marysvale on the Denver & Rio Grande to the Grand cañon, and from Lund on the Salt Lake route through St. George to Searchlight, Nev., where connections can be made with the Santa Fé. The proposed road will pass near the Silver Reef, Grand Gulch and Bunker Hill districts, also in the neighborhood of the Virgin oilfields and through the Kaibab National forest reserve. Frank A. Dudley is president.

The first work of surveying public lands in the southern part of the State under the new system of direct supervision by the Surveyor General, has been completed. A double surveying party made surveys of 10 full and 3 fractional townships, which exceeds any previous record of the office for the same length of time in the field. Work has been discontinued until early spring. The Surveyor General states that there has been a saving of at least 33½ per cent. compared to expenditures under the old contract system.

The sixth reverberatory furnace at the Garfield plant has had the bottom smelted

in, and will be ready to receive ore before Jan. 1. When this furnace is in use, fires will be drawn from reverberatory furnace No. 5, which will be put in repair. This furnace has been in steady operation for some time, and the walls are badly eaten out and need strengthening. For the present, five furnaces will be kept in use, while one furnace is shut down for repairs, as is the case with the blast furnaces, of which three out of four are operated. A new Pierce & Smith basic-lined converter is nearly completed.

Indianapolis

Dec. 19—The mine workers of Indiana have indorsed the proposed compensation law providing for a tax of 1 per cent. upon the output of Indiana mines to be collected by the State and to be apportioned by the State in the event of loss of life or limb by accident in a mine. Another proposed law urged by the miners is a qualification act, providing that every man who enters a mine to work must be examined and prove himself capable of doing the work before he is employed. The necessity of the enactment of a law which will provide adequate means of escape from coal mines in the event of fire is another measure that is being emphasized by the miners of this district.

Steps have been taken to organize first-aid classes in the mines in Vermillion county. At a meeting held at Clinton Glen Martin was elected president and H. M. Furguson vice-president. A committee was appointed to secure a permanent meeting place. The purpose is to ask for the return of the Government rescue car which recently visited Clinton.

The Southern Indiana Railroad Company has entered the Clinton coalfield and coal is being shipped from Crown Hill mine No. 5 of the Clinton Coal Company, over a recently built switch from the Southern road which leaves the main line at West St. Bernice. The Clinton company is sinking a sixth mine which is also on the Southern Indiana. All other Clinton mines are on the Chicago & Eastern Illinois.

With the opening of the Grand View extension of the Evansville railway in Spencer county a new coalfield will be developed. The block coal which abounds in the hills near Grandview, is of excellent quality, but for lack of transportation only limited mining operations have been carried on.

The finding of oil on the Barr farm near Selven, Warrick county, a territory which had practically been abandoned by oil prospectors after a number of "wild cat" wells had been drilled without any prospect of oil, has caused excitement. It seems it is necessary to drill about 100 ft. deeper and an oil pool will be reached. Old leases are being renewed and new ones made and the work of drilling down the abandoned wells will be

rushed. None of the old wells have been put down more than 1000 ft., while the Barr well shows that there is oil to be had by drilling deeper.

Globe, Ariz.

Dec. 19—The beginning of production at the Miami concentrator, the initial treatment plant for the low-grade ores in the Miami district, is being awaited with interest. The pumping station at Burch is completed, but there is 9000 ft. of pipe to be laid and connected up to the concentrator before the plant can be put in operation. The cooling tower, west of the power house on the flat to the north of the Miami townsite, is assuming shape. In the concentrator building proper the crushing machinery, as well as the Deister slime and sand tables and the electric motors to operate the same, are all in position. The tanks for the handling of the concentrates have been finished; they consist of six tanks with a capacity of 250 tons each, making a total of 1500 tons. Work has been started on the tramway that will haul supplies from the railroad in the town of Miami to the concentrator, and the various other places situated on the hill.

In the underground workings 80 men are getting everything in readiness so that there will be no delay when the concentrator is started. In the main drifts the timbers are being strengthened and all arrangements made for the stringing of the trolley wires for the electric system that will be used for the hauling of ore to the mammoth bins at the bottom of the main shaft. The work on the raises under the ore "rooms" on the 370-ft. level is being carried on and the installation of the ore chutes in these raises has begun. Down these chutes the ore will pass to the 420-ft. level, where the main haulage system is installed. The three churn drills in the northwestern part of the Miami ground are determining the extent of the orebody in that direction, working a 12-hour shift each and sinking at an average of 35 ft. a shift for each drill.

The first section of the mill will probably go into operation soon after the middle of January.

Cobalt

Dec. 19—During January, eight Cobalt companies will disburse to their shareholders, dividends aggregating practically a million dollars.

The increasing importance of Porcupine has led the Temiskaming & Northern Ontario to put on a special daily train that will connect with the Montreal train at North Bay and arrive at Kelso in the morning in time to make connections with the stage. The telephone line is now completed and working, and a daily mail service has been inaugurated. The sleigh road from

Kelso is in fairly good shape and a number of teams are hauling freight and supplies, but another foot of snow is needed, however, before heavy machinery can be handled to advantage. The Temiskaming & Northern Ontario has decided to purchase the supplies and equipment of E. A. Wallberg, whose charter to build a road into the district was canceled.

Toronto

Dec. 19—The Ontario government has declared several thousand acres of mining lands in the Thunder Bay district forfeited for non-payment of taxes. A large number of patented mining claims are now thrown open for staking.

On Dec. 13 a deputation representing the Canadian Mining Institute waited on Sir Wilfred Laurier and other members of the Canadian Government, at Ottawa, with the request that the recommendation adopted by the Mines Committee of the House of Commons that all mining laws and regulations should be codified and steps taken to secure uniformity of legislation on mining by the provinces, should be acted upon. The Government agreed that a general act should be drawn up and presented to Parliament codifying existing Federal legislation and that whatever further action was possible to effect uniformity of legislation throughout Canada would be taken. The latter undertaking, however, will necessarily be a difficult and tedious one, as each province frames its own legislation as regards lands belonging to the province and their mining regulations differ considerably.

Advance extracts from the annual report of the Mines Branch of the Canadian Department of Mines give the revised figures for iron and coal production for 1909, according to which the total production of iron ore in Canada last year was 268,043 tons, valued at \$659,316, about 30,000 tons more than the output of the previous year. The total production of pig iron was 757,162 tons, valued at \$9,581,864, being an increase of 126,327 tons or 20 per cent. The production of steel ingots and castings was 754,719 tons, valued at \$14,359,800 an increase of 165,956 tons or 28 per cent. Canada stands eighth in the list of pig-iron producing countries. The total coal production was 10,501,475 tons valued at \$24,781,236; a falling off of 384,836 tons as compared with 1908, due to strikes at Sydney and Springfield, N. S.

There is a revival of interest in the Cripple Creek gold area, about 45 miles south of Porcupine, where gold was discovered last summer and a number of claims taken up. The excitement soon died away and only a few who took part in the rush remained. Some work has since been done and reports of high assays of the output are attracting a number of prospectors from Porcupine and other points.

THE MINING NEWS

Reports of New Enterprises, New Machinery, Installations, Development Work and Property Transfers The Current History of Mining

Alaska

Gold discoveries rivaling in richness those of some of the best claims in the Fairbanks district have recently been made on the third-tier claims on Gold stream. The discoveries have been made on ground that has been considered worthless. One claim on Gold stream, eight below on the third tier, was recently sold for \$125,000. This same claim was sold two years ago by Murdock Morrison for \$75. Exceptionally rich dirt has been located on the claim.

The Northern Commercial Company will run a steamship from Seattle to the Kuskokwin next summer. The company is preparing to handle freight on the early boats down the Yukon and will give a through bill of lading for the Haiditarod and all lower Yukon River points through Skagway and the White Pass & Yukon railroad and by way of lower Labarge. The freight will be teamed from White Horse over the ice to lower Labarge, where it will be handled by steamers. This is the first time through bills have been obtainable on the through early freight. To get through, the freight will have to leave Seattle by the end of March.

Half a ton of winter gold is now on dog sledges on the trail out from the Haiditarod. The consignors are the banks of Haiditarod City. The trail is in good shape and many are coming out to spend the winter.

Arizona

It will take 60 to 90 days to put affairs of Ray Consolidated and Chino copper companies into shape and make out papers necessary for listing on the New York Stock Exchange. While the directors of both companies have not as yet taken official action looking toward a listing application, counsel for the companies have been rounding up the legal details.

GILA COUNTY

Arizona Michigan Copper Company—This company, whose property is in the Copper-Hill section of the Globe district, suspended operations Dec. 13.

Superior & Globe—The company is still doing exploration.

Copper Reef—The inclined shaft on the Copper Reef Consolidated Mining Company property has reached 400 ft. The bottom is in limestone. The California tunnel is in 603 ft. The face is limestone interbedded with iron-stained seams of lime shale. It is the intention of the management to run this tunnel

about 1500 ft. further and connect with the shaft on the North Star claim. This property is located 35 miles from Globe, and 12 miles from San Carlos, the nearest point on the railroad. Charles T. Martin is the representative, and E. A. Kennedy is in charge.

Superior & Boston—The McGaw shaft has reached 970 ft., corresponding with the 10th level of the Arizona Commercial on the west. As soon as this work is finished, drifting in an easterly and westerly direction will be started.

GRAHAM COUNTY

Arizona Copper Company—The company ended its fiscal year Sept. 30 with a production of 36,218,440 lb. as compared with 35,853,440 lb. in the preceding year. This company is owned in Scotland, but its copper is refined and marketed through the United Metals Selling Company. After J. G. Hopkins resignation from the company, the Scotch management authorized improvements which have been going on during the past year. Among the improvements decided upon were the enlargement of its concentrating mill and the sinking of a new shaft and extension of tunnel connections.

YAVAPAI COUNTY

Pacific Copper Company—This company is operating in the Silver Mountain district, nine miles from the Crown King mine and shipping to Humboldt. John Kelley, Kansas City, is president and C. W. Mitchell, manager.

California

AMADOR COUNTY

Bunker Hill—It is claimed that this mine has ore in sight to keep the mill running many years. Twenty stamps have been added to the 20-stamp mill.

Treasurer—At this mine, A. E. McCurdy superintendent, surface improvements are being made. The shaft is 700 ft. deep.

CALAVERAS COUNTY

Lightner—At this mine, Angels, the compressor is ready and machine drills will be used in sinking the three-compartment shaft. The electric hoist and motor are in position.

Waterman—This company has purchased the Fairfax mine near Angels and active development will be started.

Utica—The machinery for the electric station will be ready soon at this Angels mine. Work has been resumed at the Gold Cliff claim of this company.

Dolling—The 30-stamp mill of this mine will soon be ready.

ELDORADO COUNTY

Eldorado Water and Deep Gravel—It is announced that this company will erect a stamp mill on the Pacific mine at Placerville, A. Baring-Gould, manager. Ore has been found on the 300-ft. level and several oreshoots have been opened at different points.

FRESNO COUNTY

White Cross—From this mine near Dunlap the orebody was found at the end of the 200-ft. tunnel. W. A. Macdonald, Coalinga, is manager.

Davis Flat—The stamp mill of this company at Dunlap has been started up with 700 tons of ore ready.

INYO COUNTY

A movement is on foot for a smeltery at Keeler or Olancho to be erected jointly by the mine owners. The Argus Company is planning a cyanide mill.

Villa Real—At this mine near Darwin, D. F. Shively has found a body of silver-lead ore. Ore is being shipped to the railroad by team.

KERN COUNTY

Windy—From this mine near Randsburg, owned by John Singleton, Patrick and Charles Fahey are taking ore.

Butte—A recent mill run from this mine at Randsburg netted \$50 per ton.

MODOC COUNTY

The initial run of the new mill at Fort Bidwell was made on Dec. 1.

NEVADA COUNTY

South Yuba—The assessments have been paid and plans made to reopen this property. The veins are large and a big mill will be necessary.

Pittsburg—The new gallows-frame to replace that destroyed by the fire has been completed and work is resumed in this Nevada City mine, Mark B. Kerr manager.

Santa Monica—This mine, near the Middle Yuba river, is being reopened by W. S. Gregory, and during operations a rich vein has been found.

Tidal Wave—This mine, near North Bloomfield, is being reopened through the bedrock tunnel. It is owned by James C. Haney and comprises 400 acres of drift mining channel north of the Derbee claim, Hotchkiss & Mercer have the lease.

PLUMAS COUNTY

A deposit of copper ore has been found northeast of the L. V. Tafft ranch near Cromberg. Work has begun.

Four Hills—This company has trans-

ferred to W. F. A. Hood its mining claims, water rights, mill sites and reduction works.

SHASTA COUNTY

Mammoth—The third furnace at Kennet will be blown in soon and operated all winter.

SIERRA COUNTY

A find of rich ore has been made by Miller and Westall a mile from Loganville on the road between Downieville and Sierra City. The vein is small but rich.

SISKIYOU COUNTY

Homestake—R. S. Taylor, of Yreka has purchased the Homestake group on Taylor creek in the Salmon river region adjoining the Highland, which has been recently sold by Herman Mattern to a Holland syndicate, which will develop it extensively and install a plant.

Dunne & Vanderlip—This Scott Bar mine, recently closed on account of financial matters, will resume.

Sheba—This mine on Patterson creek, F. L. Henderson manager, has resumed.

TUOLUMNE COUNTY

J. F. Hargrave is working the Alaris placed claim in American gulch and is putting in new flumes and sluices.

TUOLUMNE COUNTY

Rolleri & Frolli—A deposit of specimen rock was recently found in this mine at Italian camp, and has attracted attention to that section. The property is at the old Comstock ranch and is under bond to Eastern men.

TRINITY COUNTY

Trinity Gold Mining and Reduction Company—This property at Carrville has started its 200-ton cyanide plant. D. W. Shanks is general manager, David Goodale, manager, and H. W. Miller, president.

Colorado

CLEAR CREEK COUNTY

Mendota—Two feet of high-grade smelting ore is reported as having been discovered by the lessees.

Capital Mining and Tunnel Company—The Crescent tunnel of the company is now driven into Griffith mountain 5700 ft. From the portal 4700 ft. the Aetna vein was intersected and in stope seven, 190 ft. above the Aetna drift, the lessees have 10 in. of sulphide ore said to run as high as 18 oz. gold, 35 oz. silver, 55 per cent. lead and 5 per cent. copper. Lessees have 300 ft. of backs on this ore. The strike is 1600 ft. below the surface. The 250-ton concentration mill owned by the company will be started up soon after Jan. 1.

GILPIN COUNTY

Newfoundland—This mine, formerly a good producer, has been unwatered by the Newhouse tunnel since it tapped the

waters of the Gunnell mine and Manager Rose is putting it in shape for renewed production.

Mitchell—This property on Quartz hill recently shipped 97 tons of ore to the Iron City Concentrator at Black Hawk, and the concentrates yielded 1.35 oz. gold to the ton, being an 84 per cent. saving of gross content.

Saratoga—The lower workings are being operated through the Newhouse tunnel, and the upper workings have been leased to a local pool which has just shipped 45 tons from the 600 level, which gave returns of \$29 per ton.

Evergreen—The main shaft on this mine in the Pine Creek district will be sunk to get below a body of ore carrying 20 to 30 per cent. copper, found at 200 feet.

HINSDALE COUNTY

M. Z. Kirk and other owners, it is reported, have sold the Golden Wonder and Golden Mammoth mines, of Gold Hill, to a new company.

LAKE COUNTY—LEADVILLE

Waterloo—Thirty tons of carbonate of zinc is being produced daily by this Carbonate Hill mine by lessee Kranen. It comes from the 450-ft. level and is said to average about 30 per cent. zinc.

Modest Girl—This mine in Carbonate hill is said to have 5 ft. of carbonate of zinc in the upper workings that will average 40 per cent. A tunnel will be started lower down the hill to catch this oreshoot.

Mikado—The lessees on this mine are said to have opened a body of 20 per cent. carbonate of zinc, which, however, is under the average demanded by the zinc buyers, but with the improving of processes now being carried out, it is believed this ore will before long be available.

Cleveland—This mine is credited with shipment of 90 cars in November, yielding 2 oz. gold per ton. The vein is said to have 3 ft. of ore at the 650-ft. level.

Nevada—This mine on Breece hill is reported to have opened a vein of silver-lead ore carrying 2 oz. of gold per ton.

OURAY COUNTY

From the Silver Plume camp word comes that the Silver Plume Mines and Tunnel Company is pushing development and securing additional veins. The high-grade ore has been opened in the Gold Belt tunnel. The Baker mine on Kelso mountain, which was a rich producer in the early '80's, has been fully equipped for a winter's work by a local pool. The Josephine on Kelso mountain has opened 6 in. of high-grade silver-lead ore and development is being pushed. The Smuggler is producing much high-grade ore.

The Pitkin camp is showing up well. The Carter mill, run by water power, is ready for ore. The Gold Links mill is

working. The Raymond tunnel is being driven, as is also the Sandy Hook tunnel.

Atlas—This mine is producing steadily and working 35 men. A heating plant has been installed for the comfort of the employees.

Khedive—An important strike of silver-lead ore is reported. E. Krisher is manager.

Yankee Girl—This mine, in the Red Mountain district, is credited with shipments of 200 tons in November.

Bright Diamond—The mill of the Wanakah company operating the mine is steadily turning out a good grade of concentrates.

SAN JUAN COUNTY

Silver Lodge—The mine on Mineral creek near Chattanooga is said to have opened a body of galena and zinc blende ore on the third level, 100 tons of which is being treated each day at the company mill. The orebody is said to be 350 ft. long and 5 to 20 ft. wide. Robert Hollis is manager.

Iowa Tiger Company—The mill is handling 400 tons of ore per day, resulting in 20 cars of lead concentrates per month. The leasers are said to have 9000 tons of galena ore blocked.

SAN MIGUEL COUNTY

Reports from Telluride are to the effect that discoveries of vanadium ore continue to be made, and many new claims located, and that the Primos Chemical Company, owning Vanadium Alloys Plant at Newmire, is negotiating for additional claims and is going to enlarge the plant and that W. H. Fletcher, representing the General Vanadium Company of America, has purchased three claims from Woods Brothers and is negotiating for other holdings.

Black Bear—This mine is said to have large bodies of ore blocked out and the lessees have started the mill.

Morning Star—Shipments have commenced from this Mount Wilson property, under the management of George Pickett.

TELLER COUNTY—CRIPPLE CREEK

Since the discovery of the Cripple Creek mining district, Squaw mountain, south and almost adjoining the town of Victor, has been the scene of much desultory mining and prospecting. The veins were there but the content was too low grade to warrant extensive development and equipment, and no paying property was established. Now comes a report that in crosscutting from a long exploitation tunnel driven into the hill, a porphyry dike was intersected, and that in a drift on the same run, 100 ft., ore was found for 60 ft., and that a carload shipped gave returns of \$27.50 per ton. This dike traverses the properties of two companies, the United Mines Company and the Petrel Gold company.

El Paso Consolidated—The fifth and

sixth levels are being put in shape for production, and the pump on the sixth level will be raised in a few days. These levels have been flooded for five years.

Portland—It is stated that the Portland mill on Battle mountain, near Victor, will install a fourth chilean mill and be ready to treat 400 tons per day soon after Jan. 1. The extraction is said to be close to 90 per cent. and the average yield of the ore treated, \$3.50 per ton.

Rexall—A report is to hand that 18 in. of \$100 gold ore has been opened on the 900-ft. level of this mine, which has its main shaft between Second and Third streets, Victor. It is stated that the company will build a cyanide mill.

Ajax—Twenty-five sets of lessees are operating this mine and a strike of very rich ore is reported on the fifth level.

Modoc—This property, on the saddle between Battle mountain and Bull hill, is said to be shipping ten cars of 3-oz. gold ore per month to the Eiler smeltery at Pueblo.

Moon-Anchor—This Gold Hill mine was not a rich producer in the early days, but like its next-door neighbor, the Anchor-Leland, its best ore was above the 300 level. A new plant has now been installed by lessees and a shaft will be sunk from the 900- to the 1200-ft. point.

Trilby—In November the lessees on this mine produced about 1200 tons of ore. Most of this averaged \$18 per ton in gold.

Idaho

Domingo—A payment of \$20,000 was made in Spokane recently by James F. Stokes, of Chicago, who has obtained a five-year lease and bond of \$150,000 on this group of five mining claims in the Salmon River copper belt, central Idaho. The terms of sale require a payment of \$10,000 every three months. The property was located six years ago, and has been developed. A 450-ft. crosscut has opened a 7-ft. ledge of copper ore.

The Kirtly Creek Gold Dredging Company—A deal has been closed by which was transferred 600 acres of placer ground, 10 miles east of Salmon, on Kirtley creek, for \$50,000 to this company. John Martin, of Ross, Cal., is at the head of the new company. It is reported that a San Francisco company has a contract for the construction of a dredge to cost \$142,000, with a capacity of 150,000 cu.yd. per month, using electrical power from the Andrews Power and Light plant, at Salmon.

COUER D'ALENE DISTRICT

Standard—New ground in the Federal company's Mace lead mine has been explored and an unknown oreshoot encountered. This has been developed on the 1400 level to an extent that shows it to average 8 ft. in width. It has been followed for 200 feet.

Snowstorm—Shipments have materially increased from this copper producer, and 25 cars from the upper workings are going out every week. This is over double the amount produced during the past six months and the increase is due to the resumption of the Coram, Cal., smeltery.

Douglas—Over 1000 tons of shipping galena ore is ready to be sent to the smeltery, but is retained at the Pine creek mine, owing to lack of transportation. For two years the company has been developing a shoot of lead-silver ore. The Chicago, Milwaukee & Puget Sound is expected to build through the district next year and give an outlet for the mine.

Black Bear Consolidated—Peter Bernier, manager, says that the construction of a 300-ton mill will begin early in 1911.

Caledonia—The November output was curtailed by weather conditions and was only \$19,000 as against \$81,000 in October. Work on the tunnel is being continued. Charles McKinnis is manager.

Indiana

GREENE COUNTY

F. W. Larkins, of Chicago, a large coal operator at Bicknell, Knox county, is negotiating for the New Summit mine, now owned by Elmer Neal, of Bloomfield, and T. J. O'Gara, of Chicago.

Active work has begun on the McGee farm in the Linton district by drillers in the employ of the Standard Oil Company.

SULLIVAN COUNTY

Bullion Coal Company—Suit has been filed in the Sullivan Circuit Court, by W. H. Hays for the bondholders against their company to foreclose a mortgage of \$50,000 and for sale of the mine near Carlisle. The shaft at present is being operated by Joseph T. Akin, of Sullivan, as receiver.

VIGO COUNTY

W. F. Wagner Company—This company, principal office Terre Haute, has incorporated to operate coal mines. W. F. Wagner, E. G. Lockwood, and D. J. Higginbotham, directors.

Maine

L. M. Linnell, of West Gardiner, has purchased all the mineral rights in 1000 acres in Skowhegan and Canaan, formerly owned by the Nye-Purinton Company. This land is known to contain iron ore, but hitherto has not attracted attention.

Michigan COPPER

Mohawk—The crosscut from the seventh level of No. 6 shaft is nearing the lode. The drifts from the fourth, fifth and sixth levels are opening an average grade of stamp rock.

Oneco—This company has completed

the unwatering of its shaft and sinking will be resumed.

Laurium—The shaft on this property is down 1100 ft. on the Kearsarge lode; the openings are showing good run of copper ground.

Gratiot—The lower openings at No. 1 shaft are opening good rock which is going to the mill. At No. 2 shaft operations have been temporarily suspended.

Tamarack—No. 5 shaft of this company has temporarily suspended operations, while it is being overhauled.

Isle Royale—The company has discontinued exploratory work at its "A" shaft on the Baltic lode without revealing any commercial copper.

Atlantic—The company is drifting north at the 16th level and is shipping the rock from this opening to the mill, but a small amount of ground has been opened so that the extent of the mineralization is not known. At the 25th level drifting is underway with varying results and at his point a drill is sinking to determine conditions at depth.

Senter-Dupee Development Company—This is the name of an unincorporated close syndicate that has taken options on 1520 acres near the middle of Keeweenaw county and has inaugurated exploration. Capt. Thomas Hoatson, of Calumet, is the active head, and Howard Wright, superintendent. Drilling contracts have been let to A. P. Silliman & Co., of Duluth.

IRON

The Bank of Scotland and the Canadian Bank of Commerce are authorized to receive applications at par for £616,420 six per cent. first-mortgage bonds of the Lake Superior Iron and Chemical Company, organized under the laws of New York, July 1, 1910, to acquire all of the properties of the Lake Superior Iron and Chemical Company, of Michigan. This company has been engaged in the manufacture of charcoal pig iron, with wood alcohol and acetate of lime as by-products. The assets of the old company have been acquired free of all encumbrances, and provision will be made out of the finances for rebuilding the plant.

Montana

The Government assay office, at Helena, reports the receipt of \$182,813 in precious metals during November. Madison county leads, with \$59,918, and Fergus county is second with \$58,411.

BUTTE DISTRICT

Butte Central—Freeman I. Davidson, of Boston, one of the directors of the company, has been inspecting the property. He states that a contract has been let for a concentrator and that work will be begun as soon as the weather permits. The original unit will have a capacity of 100 tons.

FERGUS COUNTY

Rhinestone Mining Company—This company has acquired the New Year mine, 15 miles north of Lewistown, and operations will be resumed. The property has been idle for seven years owing to trouble among stockholders.

GRANITE COUNTY

P. A. Stevens and James Ross have a lease and bond on the Magone & Anderson and the Grant and Hartford groups, in the Garnet district. A 600-ft. tunnel was run before the vein was cut, and shipments were begun over a month ago. Doctor Mussigbrod is doing development on his claims in the same district. Samuel Ritchie, who owns the Nancy Hanks mine, has recently cut an orebody and is sinking. McDermott Brothers are shipping from the Shamrock, while McDonald & Coleman are doing development on the Dandy group.

Cincinnati—Tim Egan and John Nicholson have been given a \$50,000 lease and bond on the property, in the Georgetown district. A 300-ft. tunnel has been driven and ore taken out.

LEWIS AND CLARK COUNTY

Lee Mountain—Davidson & Osborne have taken a three-year lease and bond on the group, near Rimini. Cleaning up the lower tunnel on the property has been begun under the direction of Peter Mack.

LINCOLN COUNTY

Development at the Mountain Morning mine, near Troy, is awaiting the construction of the power plant almost finished. Roberts & Raymond have run a tunnel 300 ft. on the Landslide group, 17 miles south of Troy. The property carries copper and gold.

MADISON COUNTY

Conroy Placer Mining Company—The dredge is almost finished. It is 150 ft. long, 58 ft. wide, 13 ft. deep, has a capacity of 8000 cu.yd. daily and cost \$270,000. It is estimated that it will take nine years to work out the property.

New Mexico

St. Louis, Rocky Mountain & Pacific—This company is opening two large coal mines near Raton; a steam-coal mine at Gardiner and one for domestic coal at Sugarite.

Cerrillos Lead Mining Company—This company has been formed to operate in the Cerrillos district. F. C. Wilson, of Santa Fé, is in charge.

Oregon

BAKER COUNTY

Tahoma—Development on this property is being done by W. B. Bailey, of Kalama, Wash., and work will be continued through the winter.

Sunnybrook—This property is owned by H. J. Reilly and M. A. Allen, of Sumpter. A 6-ft. vein was recently struck.

Imperial—This mine, closed for two years, has been acquired by a Spokane syndicate of which E. R. Davidson is manager. Operations will be resumed.

JOSEPHINE COUNTY

Scandinavian-American—This dredging company has been formed to recover the gold from the sands of the Rogue river. A dredging outfit has been purchased. Joseph Slumpf, William Martin, W. L. Hunter and others, of Seattle, are interested.

South Dakota

Hidden Fortune—Sale of the property under court order has been postponed until Jan. 3. Stuart Crossdale, of Denver, is examining the Hidden Fortune and Columbus properties.

Castle Creek Hydraulic Gold Mining Company—This company will soon start dredging above Mystic.

Texas

One ton of pig tin has been shipped from the tin mine near El Paso to Philadelphia and two more tons are ready for shipment. The mine is on the east side of Franklin mountain, 15 miles from El Paso. There are a small mill and smelting furnace on the property.

Utah

GRAND COUNTY

Green Mountain Gold and Copper Company—A notice has been issued for all persons who have contract with this company for the purchase of treasury stock, and to all other persons having unsettled claims against it, to present sworn statements to George E. Busch, special auditor appointed by the court, before Dec. 20, 1910. The nature and character of the claims should be stated, and if contracts for the purchase of treasury stock, the number of shares which were agreed to be taken under such contracts, and the number, date and aggregate amount of installments which they have paid on account.

IRON COUNTY

Cold Springs Mining and Power Company—An injunction suit was filed against this company by E. J. Kearns and other stockholders to prevent selling certain stock, held by the plaintiffs, under an alleged illegal assessment. The complaint states that the defendant company is the owner of the Snowflake and Jennie mining companies, and that the stock of the latter, a large amount of which is held by the plaintiffs had been illegally assessed and on refusal to pay the assessment was advertised to be sold. A restraining order has been issued by the court.

Big Fourteen—A bond and lease has been taken on this property by R. J. Bryant and F. W. Snow. A 7-ft. vein averaging \$11 per ton in gold and silver has been opened. It is proposed to put in a two-stamp mill.

JUAB COUNTY

Iron Blossom—The question of building a mill and of paying a dividend was discussed at the monthly meeting. It was decided to suspend action on both questions for another week. Drifting is being done on the 800 level south of the No. 1 shaft, and two feet of ore was broken into Dec. 6. Prospecting is also being done on the lower levels, and a crosscut is being driven from the 1700. No change was made in the directorate at the annual meeting. The report for the year shows that ore sales brought \$560,636, which with cash on hand, December, 1909, brought the total receipts to \$618,368. Dividends amounting to \$280,000 were paid. There was a cash balance of \$69,911, Dec. 1, 1910. The average cost of mining ore from the No. 1 shaft, including prospecting and development, was \$6.06 per ton, while from the No. 3 shaft it was \$3.72. The report states that the property consists of 15 patented claims having an area of 147.75 acres. There are two shafts 2300 ft. apart. Shaft No. 1 is 1900 ft. deep; water was encountered in October, and further sinking stopped. Three classes of ore have been developed, dry silicious ore, carrying gold and silver, lead-silver, and copper ores. There is more ore developed than at any previous time and an effort is being made to find a market for the silicious ores.

Gold Chain and Ophongo—By the second week in December the Ophongo will handle its ore through the Gold Chain shaft. Work has been started on the 1000-ft. level of the former, through the Black Jack workings which have been driven to the line. As soon as the railroad builds a switch to the mine, ore will be brought out through the tunnel, and loaded directly into cars. At the present it must be hauled in wagons to Robinson. One car of ore daily is being shipped by the Gold Chain, which is meeting operating expenses.

Opex—No assessment was levied at the December meeting, and it was stated that development would be continued; also that the water in the shaft is being lowered, presumably by pumping at the Centennial-Eureka, which property it adjoins.

Uncle Sam—The orebody from which shipments are being made was discovered about two months ago, and is holding out as strong as ever. New ore was recently opened in the north end of the property. The output has been increased, and the ore is stated to be of better grade than for several years past.

La Clede—A lease has been taken by R. Long and E. Duncan on this property, near Silver City.

East Crown Point—It has been decided to resume operations, and work will be started in the 330-ft. shaft. The ground lies between the Tintic Central and Crown Point, 600 ft. east of the Iron Blossom.

New Bullion—A lease has been taken by A. F. Nelson. The claims are in North Tintic, near the Scranton, and have produced both lead and zinc ore.

Eagle & Blue Bell—Stations have been cut at the 700-, 800- and 900-ft. levels, and drifting is being done. Shipping ore is being mined from the 1100- and 1200-ft. levels.

SALT LAKE COUNTY

Bingham Mines—Shipments are being made from a body of lead ore in the Brooklyn left in 1907, when the property closed on account of water. Connections were made by a raise between the 1600 level and the West drift, which drained the property. Recently a new body of lead ore 12 ft. wide was cut by a winze from the 1600. A station has been cut, and drifting has opened up the body 75 ft. along the strike. The ore is of shipping grade, carrying 45 per cent. lead, with silver, gold and copper. In raising from the Mascotte tunnel to connect with the Brooklyn workings, copper ore was found. It is planned to raise from the Mascotte tunnel level to drain and develop the Yosemite property. A branch from the tunnel may also be extended west on the Lark vein. On this vein, near the No. 2 Dalton shaft, 4 ft. of lead ore has been opened.

Bingham-New Haven—Between 10,000 and 11,000 tons of copper ore from the new body are being shipped monthly, which nets \$10 per ton. The company is a close corporation, and has issued 229,000 shares.

Utah Copper—The output for November is expected to be about the same as October, which will make a total of over 82,000,000 lb. for 11 months, or approximately 90,000,000 lb. for the year.

Columbus Consolidated—Two additional pumps have been sent out to the property. Water is reported to be standing 100 ft. in the shaft, or a little above the 300 level. The inflow is thought not to be more than 500 gal. per min., and should soon be under control.

South Hecla—Shareholders of the South Columbus Company have been asked to send in their stock for exchange before Dec. 31. The basis of exchange is five shares of South Columbus for one of South Hecla. After the first of the year, this will be increased to six shares for one, or the outstanding stock will have to be assessed to raise money for office rent, corporation tax, etc. The basis of

exchange for the Alta-Hecla will be seven shares for one.

SUMMIT COUNTY

American Flag—As shown by a company report, 8550 dry tons of ore of \$31.84 a ton, or \$272,235 were produced from August, 1904, to Sept., 1910. The average smeltery charges were \$7.31 a ton. Since a lease and bond was granted on the property in September \$6000 worth of ore is reported to have been shipped.

Alta-Germania—This property is near the head of Little Cottonwood, above the old Albion mine. A 750-ft. tunnel is being driven to tap a vein, which outcrops about 12 ft. wide. Control is held by J. G. Stillwell and associates.

TOOELE COUNTY

Dry Cañon—Eighteen inches of ore running in silver, lead, and copper was cut recently from the bottom of the inclined shaft. Shipments of about a car a month are being made. The last ore brought \$42 a ton.

Lion Hill Consolidated—The Buffalo tunnel is being advanced about 6 ft. a day, toward Chloride Point ground, since the air-line has been laid from the Ophir Hill compressor. Work is being done in the Chloride Point inclined shaft. A station has been cut, and a small hoist will be installed.

Ingot—A special meeting is called for Dec. 31, to act on the question of changing the par value of the stock from \$1 to 10c. a share, on account of the State corporation tax, which is considered too heavy. If this is effected, the capitalization will be \$10,000 instead of \$100,000, and the tax will be reduced from \$50 to \$5.

Virginia

Blackwood Coal and Coke Company—This company has been organized to develop a large tract of coal land on Pot Camp fork of Powells river. The property is five miles north of Roaring Fork, and about 12 miles northeast of Appalachia, Va. The coal is stated to be a high-grade domestic, clean and free from partings, 10 ft. thick.

Washington

FERRY COUNTY

Quilp—Development is being done on this property under the direction of William Pearce, of Republic. A tunnel is being driven on the 50-ft. level to tap the main vein.

Second Thought—A recent strike uncovered fine ore. The work is under the direction of J. Dolan, manager, Orient, who states that the shaft will be sunk deeper.

STEVENS COUNTY

United Copper—The shipments from this property average from 2 to 3 cars per week, and as soon as transportation

will permit the production will be doubled. Conrad Wolfe, of Spokane, is manager.

Bead Lake—The tunnel is in 2300 ft. and a force will be operated all winter under the direction of George E. Allen, of Spokane.

SPOKANE COUNTY

Farmer Jones—This property, in the Priest Lake district, has been bonded to a company which will work all winter. C. S. Sutton, Priest Lake, is manager.

Cuba—Silver-lead ore has been located on this property, north of Spokane, and development is being done. E. Yake, Spokane, is president.

West Virginia

BROOKE COUNTY

Reports from this county are to the effect that the Lewis-Findley Coal Company is buying large blocks of coal land, in addition to the property of the Gilchrist Coal Company, acquired some time ago. The Lewis-Findley people are also said to be buying all the coal property they can get north of the Cross Creek district that contains the Pittsburg vein, and to be also about to close a deal for the property of the La Belle Coal Company, which lies south of Buffalo creek, as well as other adjoining tracts.

La Belle Iron Works, Steubenville, O., has awarded a contract to James Coyne, of Steubenville, O., for about \$20,000, to sink a shaft on its coal-mining property in this county. The shaft will be sunk 300 ft. to connect with the mine, which tunnels under the river.

CABELL COUNTY

Pulaski Iron Company—This Philadelphia company has taken a 90-day option on the properties of the Pike Collieries Company, owned by the Blackberry Coal Company, near Huntington. The option specifies a purchase price of \$200,000. The Pike Collieries Company held the coal under a royalty lease from the Blackberry, Kentucky & West Virginia Coal Company. After operating for some months, the Pike company became insolvent, and its affairs drifted into court. When the property finally came to sale under a court decree, it was bought by a syndicate of creditors by whom it was sold to J. C. Miller in the name of the Blackberry Coal Company.

Canadian Coal Company—This company, of Clarksburg, has purchased 2200 acres of land tributary to the Pittsburg division of the Baltimore & Ohio, and expects to start work on a shaft within a short time.

LOGAN COUNTY

Aracoma Coal Company—Recently incorporated with a capital stock of \$100,000, to develop 1450 acres of land and to output daily from 1000 to 2000 tons of coal. The date for the open-

ing of the machinery proposals has not been set. E. B. Hubard is engineer in charge.

Monitor Coal and Coke Company—Incorporated here by Pennsylvania people, is arranging to undertake the development of a 1400-acre tract in the vicinity of Logan.

Gem—This property is being worked by Harry Grove and John Askman, Orient. The tunnel is in 300 feet.

Wisconsin

Frontier—This mine, at Benton, has increased its usual 2 per cent. monthly dividend to 5 per cent. in December; it is producing 500 tons of concentrates monthly, mainly from the core or foot country, that assay 40 to 43 per cent. zinc. It operates the mine on day shift, which keeps the 200-ton mill busy on both shifts.

Pittsburg-Benton—This mine is being profitably operated under lease by the Sheffer Mining Company, a local concern.

Winskell—This mine, near Shullsburg, now controlled by the Wisconsin Zinc Company, has completed its new mill and will become an active shipper.

Lucky Twelve—This mine, at New Diggings, is being energetically operated and recently turned out 55 tons in seven hours.

Fox—This mine has again become an important producer since its recent purchase by the Mineral Point Zinc Company, and outputs about 20 tons of concentrates daily.

Calvert—This mine, under Madison management, has become a steady producer and reached the dividend stage.

Cleveland—This mine, at Hazel Green, has at last unwatered its shaft and resumed developing its large orebody.

Kennedy—This mine has resumed its position as the largest and most profitable producer in the district since it has been thoroughly overhauled by its new owners, the Mineral Point Zinc Company.

Canada

NOVA SCOTIA

Dominion Steel Corporation—The price paid by this company for a controlling interest in the Cumberland Railway and Coal Company's property is stated at \$1,800,000 in securities. The company is negotiating for the purchase of iron-ore areas in St. George's, Newfoundland.

ONTARIO

Shipments for Cobalt for the week ended Dec. 9 were: Drummond, 401,200 lb.; Nipissing, 314,510; Temiskaming, 125,760; Crown Reserve, 124,600; La Rose, 85,310; Cobalt Central, 83,900; Townsite, 78,000; O'Brien, 76,400; Con-

ias, 60,400; Right of Way, 60,130; McKinley-Darragh, 55,340; Trethewey, 44,200; total, 1,509,750 pounds.

Wettlaufer—It is now authoritatively stated that the Adolph Lewisohn interests which control the Kerr Lake mine, have closed the option on this South Lorraine property.

Nipissing—The statement as of Dec. 10 was as follows: Cash in bank, ore in transit and at smelters, \$952,394. Ore at mine ready for shipment, \$296,313. Another rich oreshoot has been opened up at the 170-ft. level of the Meyer shaft.

Millerett—This Gowganda company has made its first shipment of ore over this winter's roads.

Trethewey—The directors are asking the shareholders to consent to increasing the present capital of \$1,000,000 to \$2,000,000 by an issue of treasury stock, to be used only for the acquisition of additional properties.

Floyd—This Cobalt company has gone into liquidation. The stock will be acquired by the Temagami company, which will work the property.

Hargrave—Ore is now being shipped from development on No. 3 vein. In sinking on No. 1 vein from the 125-ft. level a new body of high-grade ore has been encountered.

Beaver—A statement issued for the quarter ended Nov. 30 shows a large amount of development done, including 625 ft. of drifting, 367 ft. of crosscutting, 41 ft. of sinking, 49 ft. of raising, 301 cu.yd. of stoping and a station cut at the 300-ft. level 275 cu.yd. Several good discoveries were made. The cash balance on hand Nov. 30, less accounts payable, was \$36,681.

Preston Claim—This Porcupine property, south of the Dome mine, is reported sold to a Toronto brokerage house for \$250,000.

Hollinger Gold Mines—This Porcupine company has been organized, capitalized at \$3,000,000, with the following directorate: N. A. Timmins, president; John McMartin, vice-president; J. H. Timmins, Duncan McMartin and D. A. Dunlap, treasurers. It owns four claims on which a 3-stamp mill has been steadily at work for some time.

Stewart & Hewitson—Cyrus W. Baker, of Denver, who has an option on this silver property, near Port Arthur, will begin development at once. B. Wilcox, of British Columbia, has been placed in charge and work on the sinking of a shaft will be continued throughout the winter.

Mexico

Mines Company of America—The directors declared a quarterly dividend for the quarter ended Dec. 31 of 2¼ per cent.,

placing the stock on a 9 per cent. basis. Dividends of 4½ per cent. were also declared on the shares of the Dolores company and 7½ per cent. on shares of the El Rayo company. The combined properties have \$290,424 of cash on hand and \$321,970 of ore bullion and concentrates in transit, besides \$351,852 of materials and supplies, giving a net working capital, Dec. 19, of \$964,246. Under the terms of consolidation of these properties into the Mines Company of America, on the basis of 10 shares of El Rayo for seven shares of Mines Company of America and Dolores, share for share, a large majority of the stock of both companies has been converted and before Jan. 11, when the date of exchange expires, it is anticipated that practically all of the stock will have been exchanged. The directors of the Mines Company of America appointed a committee to take the steps to have the shares listed on the New York Stock Exchange. George A. Schroter, the company's engineer who is in Chihuahua, advises that there has been no cessation at either the Dolores or El Rayo due to political troubles, except that for a few days the railroad service west from Chihuahua was blocked.

DURANGO

West Mexico Exploration Company—This Denver company, Thomas B. Crawford, secretary, has built a small mill for plates and cyanide near Sianori on the Humayi river. Development is being done.

SONORA

Moctezuma Copper Company—Owing to a scarcity of water the output for 1910 was less than the previous year. It is estimated that the year's tonnage will be about 450,000; whereas 510,094 tons were treated in 1909, producing 110,725 tons of concentrates.

Calumet & Sonora—An agreement has been reached whereby the Greene-Cananea will supply the company with electrical power from its main plant in Ronquillo. Work on the transmission line will commence in January.

San Pablo—This property, in the Moctezuma district, is being worked by lessees.

Tharsis-York—A contract has been let for the sinking of a two-compartment shaft near Nacozari.

La Palma—A 20-ton Nissen mill is in erection, also an aerial tramway connecting mine and mill.

Roy Mining Company—Work has temporarily ceased at this property, Moctezuma district.

Cordon de Cobre—This concern has won its claim against the Cananea Consolidated for a small section of ground near Cananea.

Greene-Cananea—Work has started on a shaft from the surface of the Elisa mine to the 600-ft. level.

THE MARKETS

Current Prices of Metal, Minerals, Coal and
Stocks, Conditions and Commercial Statistics

Coal Trade Review

New York, Dec. 21—The coal trade in the West is active, but continues to depend largely on car supply and transportation conditions. These are a little better, especially in the Indiana field and to some extent also in Illinois. Prices generally have an upward tendency, on account of the advances in railroad rates.

In the East the seaboard bituminous trade has lapsed into present dullness, and no immediate improvement is looked for. The anthracite trade is steady. Car supply in the East is causing more trouble.

Alabama Coal Rates—Testimony is being taken at Birmingham, Ala., on the application of the Alabama Coal Operators' Association to the Interstate Commerce Commission. The petition is to equalize coal rates on the Louisville & Nashville and the Southern railroads, the petitioners charging that the present rates discriminate in favor of Kentucky and Tennessee mines and against Alabama coal.

COAL TRAFFIC NOTES

Coal and coke tonnage originating on all lines of the Pennsylvania Railroad Company east of Pittsburg and Erie, 11 months ended Nov. 30, short tons:

	1909.	1910.	Changes.
Anthracite.....	10,128,629	10,337,945	I. 209,316
Bituminous.....	35,283,701	37,685,169	I. 2,401,468
Coke.....	10,683,665	12,024,687	I. 1,341,022
Total.....	56,095,995	60,047,801	I. 3,951,806

The total increase this year was 7 per cent.

Coal receipts at Boston, 11 months ended Nov. 30, reported by Chamber of Commerce, in long tons:

	1909.	1910.	Changes
Anthracite.....	1,575,789	1,624,408	I. 48,619
Bituminous.....	3,214,652	3,776,732	I. 562,080
Total domestic....	4,790,441	5,401,140	I. 610,699
Foreign.....	204,106	270,364	I. 66,258
Total.....	4,994,547	5,671,504	I. 676,957

The total increase this year was 13.6 per cent. The foreign coal is nearly all from Nova Scotia.

Coal and coke tonnage of Chesapeake & Ohio railway, four months of fiscal year, July 1 to Oct. 31, short tons:

	Coal.	Coke.	Total.
New River.....	2,559,268	105,739	2,665,007
Kanawha.....	2,648,389	22,405	2,670,794
Kentucky.....	291,545	.....	291,545
Connecting lines.....	33,929	10,359	44,288
Total.....	5,533,131	138,503	5,671,634
Total, 1909.....	4,948,288	147,071	5,095,359

Total increase, 576,275 tons, or 11.3 per cent. Deliveries this year to points west of mines, 3,577,277 tons coal and 58,364 coke; points east, 515,991 tons coal and 15,316 coke; tidewater, 1,432,-

877 tons coal and 15,316 coke; anthracite to line points, 6986 tons.

Coal tonnage of Norfolk & Western railway five months of fiscal year July 1 to Nov. 30, in short tons:

Field.	Com- mercial.	Com- pany.	Total.
Pocahontas.....	4,647,614	445,318	5,092,932
Tug River.....	647,347	190,379	837,726
Thacker.....	670,761	253,999	924,760
Kenova.....	310,385	64,238	374,623
Clinch Valley.....	315,291	20,200	335,491
Total.....	6,591,398	974,134	7,565,532

As compared with the corresponding period in 1909, the total shows an increase of 1,067,782 tons, or 16.6 per cent.

New York

ANTHRACITE

Dec. 21—The hard-coal market is without change. Business is good, both for domestic and steam coal. Buckwheat and rice are still in rather short supply.

Schedule prices for domestic sizes are \$4.75 for lump, \$5 for egg and stove and \$5.25 for chestnut, all f.o.b. New York harbor. Steam sizes are unchanged. We quote for pea, \$3@3.25; buckwheat, \$2.25@2.75; No. 2 buckwheat, or rice, \$1.80@2.25; barley, \$1.40@1.75; all according to quality, f.o.b. New York harbor.

BITUMINOUS

Trade is dull. The support which the market received for a time from the West has dropped out, now that the Illinois and Indiana mines are all at work. Dealers here begin to realize how much that demand held up business. Local and New England trades are not taking much coal just now.

Prices have dropped 5 or 10c. Gas coals bring about \$1.05 at mine for ¾-in., 95c. for run-of-mine and 75c. for slack. Good steam coals can be had at prices which work out from \$1 up to \$1.40 at mine, for run-of-mine.

Car supply is poor again. The Baltimore & Ohio is in bad shape and the Pennsylvania is also behind. Transportation is slow, largely on account of snow, which has been much heavier inland than along the coast.

In the coastwise vessel market stormy weather and delays at unloading ports have made vessels scarce, and rates are higher. From Philadelphia to Boston, Salem and Portland, rates range from 85c. for large vessels, up to \$1 for small boats. From New York 70@75c. is charged to points around Cape Cod.

Birmingham

Dec. 19—If the miners can be kept at work there will be no hesitation in the

coal production in Alabama through the holidays. There is need for every ton of coal that can be mined. The output at mines in this State is big and the indications point to a steady condition through several months to come. Much of the coal being mined is leaving the State. Orders in hand and in sight call for a large amount of coal. As far as can be learned, the mine workers are not anxious to take much time off for the holidays.

Considerable development work is going on in the Alabama coalfields and more of it is contemplated. The Pratt Consolidated Coal Company, an independent company now producing more coal than any other in the South, has just acquired a large tract of coal lands from the Long estate and will during the coming year begin developing the same. The property is in Walker county. There are new mines being opened in Jefferson, St. Clair, Shelby, Bibb and Walker counties. Work is also about to start on new mines in Blount and Cullman counties.

Chicago

Dec. 19—Cold weather throughout Chicago territory has not strengthened the market greatly; though prices remain nearly unchanged. There is difficulty in disposing of all the coal that is coming in for both steam and domestic uses. This can be due, of course, only to over-shipments at the present time, large stocking up by the principal consumers or a less consumption by the steam users. A combination of the three causes seems to be probable. Receipts from Illinois mines have been large since the resumption of mining early in September; some though probably not most consumers have laid in large stocks, and some lines of steam consumption have lessened their activities. That more coal than usual has been diverted to this market seems most explanatory. The significant feature is that shippers of coal should not rush surplus stocks to Chicago until the market is somewhat stronger.

Illinois and Indiana lump brings \$2.15 @2.80, run-of-mine \$1.90@2.10 and screenings—still strong in comparison with lump and run-of-mine—\$1.50@1.70 on most of the sales made. Eastern coals share with western the tendency to weakness, though prices on smokeless nominally remain as in previous weeks, \$4.20 for lump and \$3.30 for run-of-mine. Hocking is apparently the strongest of coals from east of Indiana, because of restricted shipments, and sells for \$3.40 as heretofore. The anthracite trade is

fair, with the demand for chestnut unabated. The market continues to be sensitive to weather changes and there is little trouble about transportation, speaking generally.

Cleveland

Dec. 19—Demand is active, especially for domestic coal. Now that Lake shipments are over, the mines have plenty of coal to ship; but car supply is still poor and irregular. Transportation also is slow, and the market alternates between scarcity and surplus.

Middle district coal, f.o.b. Cleveland, brings \$2.15 for 1¼-in., \$1.90 for ¾-in., \$1.80 for run-of-mine and \$1.55@1.70 for slack, which is scarce. No. 8 and Cambridge districts 5c. or 10c. more. Pocahontas is nominally \$3.60 for lump and \$2.60 for run-of-mine, but is hard to get.

Indianapolis

Dec. 20—There has been a gradual improvement in mining conditions in Indiana during the past week. With a better supply of cars for coal shipments the mines have resumed operations on full time. The indications point to an increase in the price of coal at the mines. Buying by dealers in the country districts has been a little slow because the prices are high and they fear a slump. The demand from the Northwest, however, is good and the buying is steady.

Pittsburg

Dec. 20—Demand for coal is still lighter, domestic supplies being laid in while industrial operations are decreased and very little coal indeed is needed beyond what consumers get on regular contracts. The small demand for screened coal has caused a scarcity of slack, which has been advancing. Occasionally sales are made at about \$1 per ton, while odd cars in danger of demurrage are occasionally offered at as low as 75c. The leading interest is not selling mine-run at less than \$1.22½, inasmuch as it has a number of contracts on this basis, but now and then there are sellers at even below \$1.15. Car supply is good, except on the Baltimore & Ohio, which has been short for a few days. Today the leading interest has four mines down on that road on this account. We continue to quote: Mine-run and nut, \$1.15; ¾-in., \$1.35; 1¼-in., \$1.40; slack, 82½@85c. per ton.

Connellsville Coke—A contract has been put through for 2000 tons of furnace coke monthly over the first half at the flat price of \$1.60, and it is reported that a couple of others of like character have been put through, making a total of 10,000 tons a month. This is the first coke sold at a flat price for a year or half year for some time, and establishes the market at \$1.60 for first half, although for the entire year a slightly high-

er price would probably obtain. For some time we have quoted the contract furnace-coke market as purely nominal, the business done, and not much of it at that, being on a scale basis. One or two lots have been sold for first quarter; otherwise the market has been practically bare of business. Two or three scale contracts are being negotiated in a desultory fashion, while a large merchant furnace interest is negotiating on a flat-price basis. We quote: Prompt furnace, \$1.40@1.50; contract furnace, \$1.60@1.75; prompt foundry, \$2@2.10; contract foundry, \$2.25@2.50, at ovens.

The *Courier* reports production in the Connellsville and lower Connellsville region in the week ending Dec. 10 at 292,435 tons, an increase of 3000 tons; shipments at 2740 cars to Pittsburg, 4913 cars to points west and 597 cars to points east, a total of 8250 cars.

St. Louis

Dec. 19—The market has been dull all week. Though the weather has been cold and it would seem that coal should be in good demand, yet the reverse is the fact and the market, if anything, is getting worse. Cartersville lump shows a little improvement for shipment to the Northwest and to the Southwest, particularly the latter. All other sizes and grades of coal remain practically at the same prices as last week.

Current prices in the St. Louis market are as follows:

	F.o.b. Mine.	F.o.b. St. Louis.
Standard:		
6-in. lump.....	1.40	1.92
2-in. lump.....	1.20	1.72
Mine-run.....	1.00	1.52
2-nut.....	1.00	1.52
2-in. screenings.....	0.50	0.92
Pea and slack.....	0.30	0.82
Staunton, Mt. Olive & Springfield:		
6-in. lump.....	2.00	2.52
3-in. lump.....	1.75	2.27
Mine-run.....	1.40	1.92
2-in. nut.....	1.00	1.52
2-in. screenings.....	0.50	1.02
Cartersville:		
6-in. lump or egg.....	1.75	2.42
3-in. nut.....	1.60	2.27
Mine-run.....	1.20	1.87
1½-in. screenings.....	0.75	1.42
Franklin County:		
6-in. lump or egg.....	2.00	2.67
3-in. nut.....	1.75	2.42
2-in. nut.....	1.50	2.17
1½-in. screenings.....	0.75	1.42
Trenton:		
6-in. lump.....	2.50	3.02
6-in. egg.....	2.50	3.02
3-in. nut.....	2.00	2.52
Pennsylvania Anthracite:		
Chestnut.....		7.20
Stove and egg.....		6.95
Grate.....		6.70
Coke:		
Connellsville foundry.....	2.50	5.30
Gas house.....		5.00
Smithing coal.....	1.65	4.15
Pocahontas Smokeless:		
Lump and egg.....	2.25	4.75
Mine-run.....	1.25	3.75

Prices at East St. Louis are 20c. per ton below the St. Louis quotations.

Dealers are not doing much locally though they seem able to keep busy without any trouble. A fairly good volume of

coal seems to be moving; the trouble is that there is no price. Screenings are moving quite well and the prices are about 55c. per ton at mine for Standard and 70c. for Cartersville, with slight variations from day to day.

The rate situation, which has been so mixed up for the last four or five months, has at last been definitely settled by a general advance of 7c. per ton to nearly all northern points including Chicago and Peoria. The railroads attempted to enforce a general advance of 10c. per ton in July, but were restrained by the Interstate Commerce Commission. The matter was finally compromised, the commission sanctioning a 7c. advance.

The market for smokeless coal has been a little off and the demand light, though prices are kept up by the heavy demand in other places.

Anthracite—The market is much slower on all sizes though chestnut is still in good demand. Egg and grate were a little hard to move this week, though a good tonnage was placed.

FOREIGN COAL TRADE

British Fuel Exports—Exports of fuel from Great Britain, with coal sent abroad for use of steamships in foreign trade, 11 months ended Nov. 30, long tons:

	1909.	1910.	Changes.
Coal.....	57,748,100	56,895,997	D. 852,103
Coke.....	1,040,890	863,892	D. 176,998
Briquets.....	1,362,009	1,376,890	I. 14,881
Total exports.....	60,150,999	59,136,779	D. 1,014,220
Steamer coal.....	18,085,868	17,877,686	D. 208,182
Total.....	78,236,867	77,014,465	D. 1,222,402

Imports are insignificant; they were only 5305 tons in 1909, and 32,095 this year.

Welsh Coal Prices—Messrs. Hull, Blyth & Co., London and Cardiff, report prices of coal on Dec. 10 as follows: Best Welsh steam coal, \$3.96; seconds, \$3.78; thirds, \$3.60; dry coals, \$3.72; best Monmouthshire, \$3.54; seconds, \$3.36; best steam small coal, \$2.28; seconds, \$2.04. All prices are per long ton, f.o.b. shipping port, cash in 30 days, less 2½ per cent. discount.

IRON TRADE REVIEW

New York, Dec. 21—The iron and steel markets have been quiet, with little new business doing. They have settled into a waiting position, which promises to last for the rest of the month, at least. Part of this is, of course, due to the usual lull at the end of the year. Part of it is also the result of the recently announced determination of the principal producers to maintain prices. Buyers are not likely to do much ahead in the face of this; especially when there is a general belief that the decision is not permanent, and that there will be a general reduction in January. That such a movement will be made few doubt. Indeed it is reported

that a few contracts have been made with protection clauses for the buyers. Waiting is the only position that can be expected under the circumstances.

About the only business that has been done is in structural contracts; and here it is reported that fabricating companies are discounting the expected reduction in prices of steel.

In pig iron, which is not protected by an "understanding," some business has been done, but nothing on a large scale. There are, however, quite a number of inquiries for first-half contracts.

Alabama Consolidation—It is stated that negotiations are pending for the consolidation of the Woodward Iron Company, and the Birmingham Coal and Iron Company, in Alabama. The consolidated company would own a number of coal mines, a large tract of ore lands and five blast furnaces.

Lake Superior Iron Ore Association—F. B. Richards, of M. A. Hanna & Co., has been elected president to succeed William G. Mather, of the Cleveland-Cliffs Iron Company, who has been president of the association for a number of years. H. G. Dalton, of Pickands, Mather & Co., was elected vice-president, and H. S. Stebbins, of Oglebay, Norton & Co., treasurer. W. B. Treat resigned as secretary and is succeeded by W. L. Tinker.

Birmingham

Dec. 19—Quietness prevails in the Southern pig-iron market. The manufacturers in this section are not looking for any activity whatsoever until after the turn of the year. There will be a further curtailment in production from now on, the resumption to take place when the demand improves. Very few sales are reported in the last week or two. Despite the announcement that several orders for steel rails have come to hand recently, it is understood that the steel plant at Ensley may shut down for the holidays with no haste in the resumption. The iron make for the month in Alabama is likely to fall under 150,000 tons. The quotations are still weak, and \$11 per ton, No. 2 foundry, is about the average. Furnace companies are not anxious to sell beyond the first half, inquiries that are now being received being for iron to be delivered on during the entire year 1911. There will hardly be any sales of consequence made during the balance of the year.

The demand for steel, in practically all shapes save structural, plates, bars and angles, is dull.

Chicago

Dec. 19—The iron market is very quiet. Neither buyers nor sellers seem to be anxious to force trading; both appear to be willing to wait until after the beginning of the new year for active negotiations. Such sales as are occur-

ring are of small lots, up to 500 tons, for first-quarter delivery chiefly, but with some running into the second quarter. No tendency exists toward providing for needs beyond the second quarter, inquiries being few. Quotations nominally continue at \$11, Birmingham, or \$15.35, Chicago, for No. 2 Southern, and \$16 for Northern No. 2, but these apply only to small purchases and it is difficult to say at what figures a good-sized lot could be contracted for. Some sales, indeed, are said to have been made at 25 or 50c. less than these quotations. Lake Superior charcoal iron has developed weakness under the conditions so forcibly depressing the coke-iron market and is down to \$17.50. With the publication of reports showing general lessening in steel production, foundry melters have become more cautious and a feeling that the waiting policy is a good one is apparent.

Buying of iron and steel products continues small, though much structural business is being figured on. Coke is dull, with the best Connellsville at \$4.90, Chicago.

Cleveland

Dec. 19—There has been no action yet as to ore prices, and very little talk. Stocks on lower lake docks are large.

Pig Iron—Local sales are small. No one is buying any iron not absolutely needed, and this condition will probably last until the end of the year. Prices are nominally unchanged.

Finished Material—The market is quiet, except for some small structural orders and a little buying of bars and sheets. The Pittsburg meeting has apparently stopped the cutting on sheets, which had been going on for some time.

Philadelphia

Dec. 21—Eastern Pennsylvania furnace interests are at a complete standstill. There is just one glimmer of encouragement shown in the receipt of inquiries for quite large lots, in some cases running into a thousand or two tons for delivery in New Jersey, New York and New England during the first half of the year. It cannot be ascertained today whether the quotations made are below last week's, but it is regarded as a favorable indication that the parties inquiring are willing to close with the question of price as satisfactory. The week's business of small orders has been exceptionally light. Virginia and farther south makers have so far not taken any business from us. Bessemer is quoted strongly and basic is offered at rumored concessions. No. 2 X foundry is quoted at \$15.50@16; forge at \$14.50 per ton.

Steel Billets—Billets were inquired for a week or two ago, but no sales have been made.

Bars—Latest mill advices indicate

lessened activity incidental to the holiday season. Stocks at the mills are large.

Sheets—Sheets are dull, but quotations are not as weak as early in the month. The only inquiries are from large eastern consumers who are sounding the market.

Pipes and Tubes—Cast-iron pipe makers are doing a fair December business on new orders for winter delivery.

Plates—Steel plate continues dull with slight shading in response to inquiries for early delivery.

Structural Material—Structural material is held at old quotations because the only business offered is not attractive. Small winter construction requirements in some southern cities and a few small orders from New England quarters constitute the week's business.

Scrap—Sales of scrap iron are trifling. Considerable shipments have been made from yards to interior buyers on old contracts. Dealers report that inquiries for heavy steel scrap and railroad scrap have been received this week and that the bulk of the supply now controlled by them will soon be moved.

Pittsburg

Dec. 20—The market has been bare of developments and is practically stagnant. Superficially, prices of finished-steel products are firm, almost absolutely so, and therefore much firmer than a month ago, but there is no business going to test them. As to what January will develop is a matter of conjecture, but there are a number of reasons for believing that an orderly reduction will be made in a number of finished-steel products. As already noted in these reports, the aim of steel producers is to hold prices firm during this period of absolute quietness, so that if reductions are made in January they will be the more impressive and the more likely to induce liberal buying, while another object is to have production curtailed to the absolute requirements, which are light.

Wall Street and the daily press have taken a special interest in the iron and steel market the past week and have discovered that conditions are very bad. This may be a new discovery for them, but it is no new fact for the steel trade. An instance of the kind of news dished up is the item that the La Belle and Laughlin tinplate plants in the Wheeling district are closed and are not likely to run for a year. Inasmuch as these plants have already been idle for a year and a half, outside of the operation of about 25 per cent. of the capacity for a few weeks in September and October, the prospect that the plants may be idle for a year to come can hardly be regarded as of profound importance.

Pig Iron—A sale of approximately 2000 tons of bessemer for December delivery has been made at the regular market of \$15, Valley. The basic market

cannot yet be definitely quoted for prompt, as there have been no sales, but repeated bids at \$13, Valley, have failed to bring out metal, and we now quote basic nominally at \$13.25, for prompt, while on the basis of sales made some time ago for first half at between \$13.25 and \$13.50 the market for delivery over the whole half year can be quoted nominally at \$13.50, Valley. Foundry iron remains openly quotable at \$13.75@14, Valley, but there are definite reports that at least one interest would sell at \$13.50 on an attractive tonnage and delivery.

Ferromanganese—The market has continued very quiet and remains nominally quotable at \$38.50, but this price could possibly be shaded.

Steel—The steel mills have gotten closer together in the past fortnight and this has served to put up open-hearth prices to the level of bessemer, which is \$23 for billets and \$24 for sheet bars, f.o.b. Pittsburg or Youngstown mill, with freight to destination added from the nearer of these two points. Rods have weakened in the past fortnight and are quotable at \$27.50, Pittsburg.

Sheets—Demand is very light and production has been curtailed further, being only 50 or 60 per cent. of capacity, with prospects of further curtailment next week as mills close for inventory and repairs. Prices as discussed at the meeting of Dec. 15 are understood to be well held: Black, 2.20c.; galvanized, 3.20c.; painted corrugated, \$1.55; galvanized corrugated, \$2.75, Pittsburg.

St. Louis

Dec. 19—The pig-iron market has been dull during the past week, scarcely an order worth mentioning being received. Prices are a little weaker and there seems to be no chance for improvement in the near future. The current price is \$11@11.50 per ton, Birmingham, or \$14.75@15.25, St. Louis, for No. 2 foundry.

FOREIGN IRON TRADE

German Iron Production—The German Iron and Steel Union reports the production of pig iron in the German Empire for the 10 months ended Oct. 31 as follows, in metric tons:

	1909.	1910.	Changes.
Foundry iron.....	2,028,817	2,415,026	I. 386,209
Forge iron.....	553,973	535,974	D. 37,999
Steel pig.....	909,957	1,119,316	I. 209,359
Bessemer pig.....	340,831	405,076	I. 64,245
Thomas(basic)pig	6,789,222	7,738,516	I. 949,294
Total.....	10,622,800	12,213,908	I. 1,591,108

Total increase was 15 per cent. Steel pig includes spiegeleisen, ferromanganese and all similar alloys.

Foreign Trade of the United States

Iron and Steel—Exports and imports of iron and steel in the United States for

the 10 months ended Oct. 31 are valued as below by the Bureau of Statistics of the Department of Commerce and Labor:

	1909.	1910.	Changes.
Exports.....	\$128,170,458	\$164,376,387	I. \$36,205,929
Imports.....	23,567,183	32,937,752	I. 9,370,569
Excess, exp.	\$104,603,275	\$131,438,635	I. \$26,835,360

Increase in exports, 28.2 per cent.; in imports, 39.8 per cent. The leading articles of imports and exports were, in long tons:

	Exports		Imports	
	1909.	1910.	1909.	1910.
Pig iron.....	48,745	95,091	113,128	196,895
Scrap.....	24,137	18,554	25,522	68,850
Billets, blooms, etc.	98,522	29,655	13,770	39,119
Bars.....	70,610	105,622	13,969	32,880
Rails.....	211,820	283,324	.....	.....
Sheets and plates..	141,363	225,625	3,057	5,668
Structural steel....	74,473	124,494	.....	.....
Wire-rods.....	14,418	19,140	9,514	16,941
Wire.....	123,853	137,558	.....	.....
Nails and spikes..	38,727	50,729	.....	.....
Tinplates.....	7,456	8,947	49,351	55,470
Pipe and fittings..	132,347	132,267	.....	.....

Imports of wire not reported in quantities. Imports of structural steel and rails not reported this year. Reexports of imported iron and steel were valued at \$177,413 in 1909, and \$288,981 this year.

Iron Ore Movement—Imports and exports of iron ore in the United States 10 months ended Oct. 31, long tons:

	1909.	1910.	Changes.
Imports.....	1,297,382	2,219,488	I. 922,106
Exports.....	433,623	611,648	I. 78,025

Of the imports this year 1,251,960 tons were from Cuba, 401,612 from Spain, 209,017 from Sweden and 140,040 from Canada.

Manganese Ores—Imports of manganese ores into the United States 10 months ended Oct. 31 were 178,112 tons in 1909, and 216,827 in 1910; increase, 38,715 tons.

METAL MARKETS

New York, Dec. 21—The metal market generally continues dull, and there seems little prospect of change before the end of the year.

Gold, Silver and Platinum

UNITED STATES GOLD AND SILVER MOVEMENT

Metal.	Exports.	Imports.	Excess.
Gold:			
Nov. 1910..	\$1,376,011	\$ 4,313,500	Imp. \$ 2,937,489
" 1909..	15,649,281	3,863,637	Exp. 11,785,644
Year 1910..	57,444,422	54,245,886	" 3,198,536
" 1909..	122,301,517	42,003,194	" 80,298,323
Silver:			
Nov. 1910..	5,265,595	4,827,254	Exp. 438,341
" 1909..	4,951,483	4,694,807	" 256,676
Year 1910..	51,299,913	41,479,718	" 9,820,195
" 1909..	52,294,344	41,984,006	" 10,310,338

Exports from the port of New York, week ended Dec. 17: Gold, \$75,400, to the West Indies and South America; silver, \$1,121,504, to London and Germany. Imports: Gold, \$382,593, from Cuba and Australia; silver, \$160,121, from Central and South America.

Gold—The price of gold on the open market in London has been unchanged at 77s. 9d. per oz. for bars and 76s. 4½d. per oz. for American coin. Much of the supply for the week was taken by Germany, and some for India.

Platinum—The market has been weak and prices are a little lower, at \$38.50 per oz. for refined platinum, and \$40.50@41 for hard metal. An unusual movement this week has been the purchase of some round lots of platinum in New York for reshipment to Europe. The exact quantity cannot be ascertained.

Our Russian correspondent writes, under date of Dec. 8, that the market is unchanged. A decrease in demand is expected, as is usually the case before the Christmas holidays. Quotations are 8.60 rubles per pood—\$32.34 per oz.—at Ekaterinburg for crude metal, 83 per cent. platinum; 33,000 rubles per pood—\$32.34 per oz.—for the same grade at St. Petersburg. These quotations, however, are nominal and subject to negotiation.

Silver—The market in silver has been quiet the last week with a slightly declining tendency. No movement of special interest seems to be on foot at present. Interest will center on whether the India government will be in the market the coming year.

SILVER AND STERLING EXCHANGE

Dec.	15	16	17	19	20	21
New York....	54½	54½	54½	54½	54½	54½
London....	25¼	25¼	25¼	25¼	25¼	25¼
Sterling Ex.	4.8535	4.8535	4.8530	4.8540	4.8550	4.8525

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Exports of silver from London to the East, as reported by Messrs. Pixley & Abell, Jan. 1 to Dec. 8:

	1909.	1910.	Changes.
India.....	£6,094,000	£6,689,500	I. £ 595,500
China.....	1,885,000	1,373,500	D. 511,500
Straits.....	114,600	.....	D. 114,600
Total.....	£8,093,600	£8,063,000	D. £ 30,600

Copper, Tin, Lead and Zinc

NEW YORK

Dec.	Copper.		Tin.	Lead.		Zinc.	
	Lake, Cts. per lb.	Electrolytic, Cts. per lb.	Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.
15	12¾ @13	12.50 @12.60	37½	4.50	4.35 @4.37½	5.57½ @5.62½	5.42½ @5.47½
16	12¾ @13	12.55 @12.60	38½	4.50	4.35 @4.37½	5.55 @5.57½	5.40 @5.42½
17	12¾ @13	12.55 @12.60	38½	4.50	4.35 @4.37½	5.52½ @5.57½	5.37½ @5.42½
19	12¾ @13	12.55 @12.60	38½	4.50	4.35 @4.37½	5.50 @5.55	5.35 @5.40
20	12¾ @13	12.55 @12.60	38	4.50	4.35 @4.37½	5.50 @5.55	5.35 @5.40
21	12¾ @13	12.55 @12.60	37½	4.50	4.35 @4.37½	5.47½ @5.50	5.32½ @5.35

The New York quotations for electrolytic copper are for cakes, ingots and wirebars, and represent the bulk of the transactions made with consumers, basis New York, cash. The prices of casting copper and of electrolytic cathodes are usually 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary Western brands; special brands command a premium.

LONDON							
Dec.	Copper.			Tin.		Lead, Spanish.	Zinc, Ordinaries.
	Spot.	3 Mos.	Best Sel'td	Spot.	3 Mos.		
15	56½	57½	60½	173½	174	13½	24
16	57½	57½	61	175	175½	13½	24½
17	.....	.....	.....	.....	.....	.....	.....
19	57½	57½	61	174½	175½	13½	24
20	57½	57½	61	173½	173½	13½	24
21	56½	57½	61	172½	172½	13½	24

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £12 = 2.61c.; £23 = 5c.; £60 = 13.04c. ± £1 = ± 0.21¾c.

Copper—During the week of Dec. 15-21 there has been a slight improvement in the volume of business, and as a consequence the market has displayed a firmer tone. At no time during the recent period of dullness has there been any serious pressure to sell, although several of the agencies have been willing to do business at concessions, and this, of course, has enabled the situation to be kept well in hand. The leading agencies have continued to maintain their asking price of 13c., delivered, 30 days, for electrolytic, but others have been offering at 12¾c., delivered, 30 days, which is equivalent to about 12.60c. cash, New York, and the business in December and January copper has been done at 12.55 @ 12.60c., some substantial transactions having been effected. It is noteworthy that the business has been chiefly for early shipment, indicating that buyers are not well covered. An increase in the inquiries is also regarded as encouraging. The business of the week in Lake copper has been insignificant and the market for that class of metal is largely nominal. At the close Lake copper is quoted at 12¾ @ 13c., and electrolytic copper in cakes, wirebars and ingots at 12.55 @ 12.60c. Casting copper is quoted nominally at 12¼ @ 12½c. as the average for the week.

Copper sheets are 18 @ 19c. base for large lots. Full extras are charged, and higher prices for small quantities. Copper wire is 14½c. base, carload lots at mill.

The London market for standard copper has also been somewhat firmer. Three months' copper at one time touched £57 18s. 9d. Sentiment in London seems to be more favorable. At the close spot standard is quoted at £56 18s. 9d., and three months at £57 13s. 9d. per ton.

Exports of copper from New York for the week were 8609 long tons. Our special correspondent reports the exports

from Baltimore for the week at 3930 tons.

The American Smelting and Refining Company has appointed Paul Koning—who, up to the present has been the American representative of Messrs. Brandeis, Goldschmidt & Co., of London—its general European sales agent, with offices in Berlin, Germany. Mr. Koning will hold power of attorney, and will be in charge of the company's whole export copper business.

Tin—Under heavy selling on the part of East Indian interests, the London market became weak on Thursday of last week. At the lower level, some orders were placed for American account, which helped the market to the extent of about one-half of its previous losses. The market remained very dull on about this basis until Dec. 20, when it declined again, touching its low point at £172 for spot, and £172 7s. 6d. for three months on Dec. 21, but closing somewhat better at £172 5s. for spot, and £172 12s. 6d. for three months.

In this market, January tin can be bought at about 37½ cents.

Lead—The market is unchanged at last prices, 4.50c. New York, and 4.35 @ 4.37½c. St. Louis.

The foreign market is also unchanged, Spanish lead being quoted at £13 5s., English lead at £13 7s. 6d. per ton.

One of the financial papers reported this week that the Guggenheim interests have become very bullish on lead, officials thereof being credited with the statement that the supply on hand is now very small, and that the demand lately has been large. During November the surplus of domestic lead is said to have been reduced by more than 5000 tons, and sales so far in December have been greater than at any time during the last two years. There is also a large demand for January and February shipments. The National Lead Company is operating to full capacity. Two years ago it had a surplus of 50,000 tons, but now it has but a week's supply on hand. The foregoing is important, if true, but with respect to the threatening depletion of stocks, we are conservatively doubtful. However, there is no question that stocks have been reduced during the current year.

Spelter—The market has been quiet. But little business has presented itself and this has been eagerly competed for, resulting in a further decline in price. At the close, St. Louis is quoted at 5.32½ @ 5.35c., and New York at 5.47½ @ 5.50 cents.

The London market is unchanged at £24 for good ordinaries, and £24 5s. for specials.

Base price of zinc sheets is \$7.75 per 100 lb., f.o.b. La Salle-Peru, Ill., less 8 per cent. discount.

Other Metals

Aluminum—The market has continued very dull. In the absence of any large sales, we continue to quote nominally 22½ @ 23c. per lb. for No. 1 ingots.

Antimony—The market is still dull. Cookson's is ⅛c. lower, being quoted at 7½ @ 7¾c. per lb. U. S. is unchanged, at 7¾ @ 7½c.; while 7 @ 7½c. is named for outside brands.

Quicksilver—The market is steady, with prices unchanged. The New York quotations are \$42 per flask of 75 lb. for large lots; \$44 @ 45 for jobbing orders. San Francisco, \$41.50 for domestic business and \$2 less for export. London price is £8 per flask; £7 12s. 6d. being quoted by second hands.

Cadmium—Current quotations are 60 @ 70c. per lb. in 100-lb. lots, f.o.b. New York, according to quantity of metal.

Magnesium—The price of pure metal is \$1.50 per lb. for 100 lb. lots, f.o.b. New York.

Nickel—Large lots, contract business, 40 @ 45c. per lb. Retail spot, from 50c. for 500-lb. lots up to 55c. for 200-lb. lots. The usual price of electrolytic is 5c. higher.

Zinc and Lead Ore Markets

Platteville, Wis., Dec. 17—The highest price paid this week for zinc ore was \$46; the base price, 60 per cent. zinc, was \$43 @ 44. The base price paid for 80 per cent. lead ore was \$54 @ 55 per ton.

SHIPMENTS, WEEK ENDED DEC. 17.

Camps.	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Mineral Point.....	1,415,740	.....	.....
Platteville.....	859,700	72,740	245,100
Galena.....	557,000	.....	.....
Benton.....	387,600	.....	.....
Harker.....	283,240	.....	.....
Highland.....	282,400	147,800	.....
Cuba City.....	250,920	.....	465,060
Shullsburg.....	64,000	.....	.....
Linden.....	.....	60,000	.....
Total.....	4,100,600	280,540	710,160
Year to date.....	120,103,394	10,785,944	25,586,500

Shipped during the week to the separating plants, 2,903,370 lb. zinc ore.

Joplin, Mo., Dec. 17—The highest price paid for zinc sulphide ore this week was \$47, the base price ranging from \$37 to \$44. Zinc silicate ore sold on a base price of \$23 @ 26 per ton of 40 per cent. zinc. The average price, all grades of zinc ore, was \$40.36. The highest price paid for lead ore this week was \$56.50, and the average price, all grades, was \$55.66 per ton.

The zinc ore market took a decided slump this week and the high base shows a reduction of \$2 per ton over last week's price. Considerable ore sold on a \$42 @ 44 base, but there was also quite a large amount that sold on a \$38 to \$40 base and one buyer claimed to have purchased at least 100 tons on a \$37 base.

The lead market remained steady at \$56 and a few lots brought \$56.50. The gas company has notified operators who use gas under their boilers, of a raise to 25c. per 1000 cu.ft., which makes the further use of gas unprofitable.

SHIPMENTS, WEEK ENDED DEC. 17.

	Zinc lb.	Lead lb.	Value.
Webb City-Carterville	3,819,040	1,791,980	\$132,284
Joplin	1,554,040	390,820	45,130
Galena	753,330	246,170	22,465
Alba-Neck	585,260	92,020	16,237
Duenweg	619,270	64,320	9,928
Oronogo	83,340	245,970	8,588
Granby	568,800	25,640	7,300
Badger	222,010	.....	4,662
Aurora	180,240	.....	3,874
Spurgeon	285,590	.....	3,885
Carthage	140,150	20,910	3,577
Miami	.....	87,090	2,394
Jackson	85,280	.....	1,832
Quapaw	80,000	.....	1,600
Carl Junction	66,860	.....	1,470
Seneca	.....	26,400	660
Totals	9,043,210	2,991,320	\$265,786

51 weeks.....571,902,830 83,153,170 \$13,589,335
 Zinc value, the week, \$182,531; 51 weeks, \$11,414,459
 Lead value, the week, 83,255; 51 weeks, 2,174,877

MONTHLY AVERAGE PRICES.

Month.	ZINC ORE.				LEAD ORE.	
	Base Price.		All Ores.		All Ores.	
	1909.	1910.	1909.	1910.	1909.	1910.
January	\$41.25	\$47.31	\$38.46	\$45.16	\$52.17	\$56.99
February	36.94	40.69	34.37	39.47	50.50	53.64
March	37.40	43.60	34.71	39.71	50.82	51.26
April	38.63	41.00	37.01	39.33	55.63	49.72
May	40.06	40.19	37.42	37.51	56.59	48.16
June	44.15	40.20	40.35	37.83	57.52	48.80
July	43.06	39.63	41.11	36.80	53.74	48.59
August	48.25	40.13	44.54	37.32	57.60	49.75
September	47.70	43.45	44.87	39.06	56.11	54.73
October	49.50	43.31	45.75	40.50	55.52	53.18
November	51.31	47.20	48.29	43.20	53.94	54.80
December	49.45	.....	47.57	.....	55.26	.....
Year	\$43.98	.....	\$41.20	.....	\$54.60	.....

NOTE—Under zinc ore the first two columns give base prices for 60 per cent. zinc ore; the second two the average for all ores sold. Lead ore prices are the average for all ores sold.

Other Ore Markets

Iron Ore—The Lake Superior season is closed and all buying of ore will now be done on next year's prices. No action has yet been taken toward fixing quotations.

In the East there is no organization of sellers, and no general quotations can be given. It may be said, however, that prices on the open market will range from 7 to 8c. per unit of iron delivered to furnace; which would be \$3.50@4 for a 50 per cent. ore. Most ores, however, are sold under yearly contracts.

Manganese Ore—The base price, as fixed by large buyers, is 25c. per unit for manganese and 5c. per unit for iron content, for a base ore containing 49 per cent. or over in manganese, not over 0.20 phosphorus and 8 per cent. silica. Prices range down to 23c. per unit for 40 per cent. manganese; with deductions for excess of phosphorus and silica.

Tungsten Ore—Ferberite, wolframite and huebnerite ores, \$6.50@7 per unit per ton of 2000 lb. of ore containing 60

per cent. of tungsten trioxide. For scheelite ore, 50c.@1.50 per unit less.

Zinc Ores—For Rocky Mountain blends of good quality, especially as to iron and lead contents, the current price is for the zinc content, less 8 units, at the St. Louis price of spelter; with a deduction of \$14@15 per 2000 lb. of ore. See also Joplin and Wisconsin ore markets.

Pyrites—Domestic pyrites are quoted at 11½@12c. per unit of sulphur at mines for furnace sizes. Spanish pyrites, furnace sizes, are 12@12½c. per unit, ex-ship. Arsenical pyrites are from ½@1¼c. per unit less.

New Caledonia Ores

Shipments from New Caledonia for the nine months ended Sept. 30, are reported by the *Bulletin du Commerce*, of Noumea, at 78,001 tons nickel ore, 8 tons copper ore and 25,501 tons chrome ore. In addition to the ores there was exported 155 tons nickel matte.

CHEMICALS

New York, Dec. 21—The general market is still quiet, and the tone is rather one of depression.

Copper Sulphate—Business is fairly steady and prices unchanged at \$4 per 100 lb. for carload lots and \$4.25 per 100 lb. for smaller parcels.

Arsenic—The market is still dull and quotations are nominally unchanged at \$2.25 per 100 lb. for white arsenic.

Nitrate of Soda—There is comparatively little doing in this article, and prices are unchanged at 2.12½c. per lb. for both spot and future positions.

MINING STOCKS

New York, Dec. 21—The markets generally have shown some strength and some advances in quotations; but the amount of business has been small, and almost wholly professional. The price movements have been without significance.

The Curb has followed the Exchange, with some show of strength on a small volume of business. Movements have been chiefly fractional and trading narrow. The copper stocks shared in the general inaction.

There will be a long break, at the end of the week, as the Exchange will adjourn from Friday over to Tuesday, for the Christmas holiday.

Boston, Dec. 20—Sentiment is becoming more hopeful regarding the copper-share market and although it is but barely discernible so far as stock-market quotations are concerned, it is in the air. Copper stocks have been liquidated to a frazzle and any buying of volume would cause a sharp rally in prices.

Stocks have been quiet but firm the

past week and it would be hard to pick out any particular feature. Declaration of regular quarterly dividends of \$1 per share by the Osceola Consolidated and 30c. by the North Butte are stimulating factors, for in many cases a reduction was expected by the Osceola. Neither event, however, had any particular present effect on stocks.

Utah Consolidated holds at or just un-

COPPER PRODUCTION REPORTS.
 Copper contents of blister copper, in pounds.

Company.	Septem-ber.	October.	Novem-ber.
Anaconda	22,200,000	22,100,000	21,900,000
Arizona, Ltd.	2,672,000	3,004,000	3,010,000
Balaklala	nil	928,360	.....
Copper Queen	6,903,759	7,060,796	7,372,776
Calumet & Ariz.	2,535,000	2,340,000	1,930,000
Detroit	2,128,000	1,757,836	1,840,939
East Butte	625,840	948,369	.....
Imperial	nil	nil	.....
Mammoth	.....	.....	.....
Nevada Con.	5,151,208	4,980,300	.....
Old Dominion	2,262,000	2,345,000	2,754,000
Shannon	1,418,000	1,286,000	1,420,000
Superior & Pitts.	2,125,000	2,095,000	2,160,000
United Verde, est.	.....	.....	3,000,000
Utah Copper Co.	7,077,035	7,582,212	.....
Lake Superior dis.	16,700,000	18,500,000	20,400,000
Est. for non-reporting mines	.....	13,250,000	.....
Total production	71,796,842	87,827,873	.....
Imports, bars, etc.	24,303,859	24,292,368	.....
Total blister	96,101,701	112,120,241	.....
Imp. in ore & matte	5,782,067	5,173,277	.....
Total	106,883,768	117,293,518	.....
Brit. Col. Cos.:	.....	.....	.....
British Col. Copper	622,702	702,154	.....
Granby	.....	1,184,234	.....
Mexican Cos.:	.....	.....	.....
Boleo	2,061,300	2,278,454	.....
Cananea	3,565,000	3,576,000	3,658,000
Moctezuma	2,211,435	1,791,108	1,654,235

Lake Superior figures are estimated; others are reports received from companies, unless otherwise stated. Boleo copper does not come to American refiners.

STATISTICS OF COPPER.

Month.	United States Product'n.	Deliveries Domestic.	Deliveries for Export.
XII, 1909	117,828,655	69,519,501	59,546,570
Year, 1909	1,405,403,056	705,051,591	680,942,620
I, 1910	116,547,287	78,158,387	81,691,672
II	112,712,493	66,618,322	37,369,518
III	120,067,467	62,544,818	40,585,767
IV	117,477,639	67,985,951	31,332,434
V	123,242,476	59,305,222	45,495,400
VI	127,219,188	53,363,196	65,895,948
VII	118,370,003	56,708,175	59,407,167
VIII	127,803,618	67,731,271	61,831,780
IX	119,519,983	64,501,018	75,106,496
X	126,469,284	67,814,172	68,186,912
XI	119,353,463	60,801,992	67,424,316

VISIBLE STOCKS.

	United States.	Europe.	Total.
XII, 1909	153,003,527	236,857,600	389,861,127
I, 1910	141,766,111	244,204,800	385,970,911
II	98,463,339	248,236,800	346,700,139
III	107,187,992	254,150,400	361,338,392
IV	123,824,874	249,625,600	373,450,474
V	141,984,159	246,870,400	388,854,559
VI	160,425,973	239,142,400	399,568,373
VII	168,386,017	232,892,800	401,278,817
VIII	170,640,678	222,320,000	392,960,678
IX	168,881,245	218,444,800	387,326,045
X	148,793,714	211,276,800	360,070,514
XI	139,261,914	198,060,800	337,322,714
XII	130,389,069	193,200,000	323,589,069

Figures are in pounds of fine copper. U. S. production includes all copper refined in this country, both from domestic and imported material. Visible stocks are those reported on the first day of each month, as brought over from the preceding month.

der \$13 per share and opinion is very much mixed over the condition of affairs at this mine.

Lake Copper and North Butte are the stocks which are eventually expected to pull this market out of the slough of despond. Both have seen their periods of disappointments and things are now on the mend. Coppers are asleep and while trade conditions are somewhat depressing at the present writing this is expected to be but temporary.

Curb business has been extremely quiet. First National stockholders are in receipt of a letter inviting them to exchange stock up to 50,000 shares for stock of the Aztec Petroleum Company of California, which seems to be a going concern. The 120,000 shares of Butte Central Copper stock, par \$10, have been listed on the Boston Curb.

Assessments

Company.	Delinq.	Sale.	Amt.
Alpha Con., Nev.	Jan. 12	Feb. 12	\$0.05
Amador C. & G., Ida.	Dec. 15	Jan. 15	0.01
Amal Nev. Mines Co.	Dec. 15	Jan. 15	0.05
Beck Tunnel, Utah.	Dec. 13	Jan. 6	0.01
Belcher, Nev.	Jan. 9	Jan. 23	0.10
Bullion, Nev.	Jan. 9	Feb. 7	0.05
Chollar, Nev.	Dec. 5	Dec. 30	0.10
Con. Imperial, Nev.	Jan. 5	Jan. 30	0.01
Copper King, Ida.	Dec. 16	Jan. 16	0.01
Federal Ely, Nev.	Jan. 20		0.01
Florence M. & M., Ida.	Feb. 20	Mar. 20	0.001
Gould & Curry, Nev.		Dec. 27	0.10
Horseshoe, Ida.	Dec. 10	Jan. 10	0.002
Ibex, Ida.	Dec. 17	Jan. 17	0.002
Keystone, Utah.	Dec. 15	Jan. 17	0.05
Leroy G. & C., Ida.	Dec. 21	Jan. 10	0.001
Little North Fork, Ida.	Nov. 15	Dec. 31	0.004
Lucky Swede G. & C., Ida.	Dec. 1	Dec. 31	0.001
Mexican, Nev.	Jan. 10	Jan. 31	0.20
New York Summit, Utah.	Jan. 10		0.02
North Franklin, Ida.	Dec. 15	Jan. 16	0.005
Silver Queen, Utah.	Dec. 15	Jan. 10	0.004
Uintah-Treas. Hill, Utah.	Dec. 12	Jan. 6	0.01
Utah, Nev.	Jan. 10	Jan. 31	0.05
Vienna Vein, Ida.	Dec. 15	Jan. 16	0.001

Monthly Average Prices of Metals SILVER

Month.	New York.		London.	
	1909.	1910.	1909.	1910.
January	51.750	52.375	23.843	24.154
February	51.472	51.534	23.706	23.794
March	50.468	51.454	23.227	23.680
April	51.428	53.221	23.708	24.483
May	52.905	53.870	24.343	24.797
June	52.538	53.402	24.166	24.651
July	51.043	54.150	23.519	25.034
August	51.125	52.912	23.588	24.428
September	51.440	53.295	23.743	24.567
October	50.923	55.490	23.502	25.596
November	50.703	55.635	23.351	25.680
December	52.226		24.030	
Total	51.502		23.706	

New York, cents per fine ounce; London, pence per standard ounce.

COPPER.

Month.	NEW YORK.				London.	
	Electrolytic		Lake.		1909.	1910.
	1909.	1910.	1909.	1910.		
January	13.893	13.620	14.280	13.870	61.198	60.923
February	12.949	13.332	13.205	13.719	57.688	59.388
March	12.387	13.255	12.826	13.586	56.231	59.214
April	12.561	12.733	12.931	13.091	57.363	57.238
May	12.893	12.550	13.238	12.885	59.338	56.313
June	13.214	12.404	13.548	12.798	59.627	55.310
July	12.880	12.215	13.363	12.570	58.556	54.194
August	13.007	12.490	13.296	12.715	59.393	55.733
September	12.870	12.379	13.210	12.668	59.021	55.207
October	12.700	12.553	13.030	12.788	57.551	56.722
November	13.125	12.742	13.354	12.914	58.917	57.634
December	13.298		13.647		59.906	
Year	12.982		13.335		58.732	

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper.

TIN AT NEW YORK

Month.	1909.	1910.	Month.	1909.	1910.
January	28.060	32.700	July	29.125	32.695
February	28.290	32.920	August	29.966	33.972
March	28.727	32.463	September	30.293	34.982
April	29.445	32.976	October	30.475	36.190
May	29.225	33.125	November	30.859	36.547
June	29.322	32.769	December	32.913	
			Av Year.	29.725	

Prices are in cents per pound.

LEAD

Month.	New York.		St. Louis.		London.	
	1909.	1910.	1909.	1910.	1909.	1910.
January	4.175	4.700	4.025	4.582	13.113	13.650
February	4.018	4.613	3.868	4.445	13.313	13.328
March	3.986	4.459	3.835	4.307	13.438	13.063
April	4.168	4.376	4.051	4.225	13.297	12.641
May	4.287	4.315	4.214	4.164	13.225	12.550
June	4.350	4.343	4.291	4.207	13.031	12.688
July	4.321	4.404	4.188	4.291	12.563	12.531
August	4.363	4.400	4.227	4.290	12.475	12.513
September	4.342	4.400	4.215	4.289	12.781	12.582
October	4.341	4.400	4.215	4.271	13.175	13.091
November	4.370	4.442	4.252	4.314	13.047	13.217
December	4.560		4.459		13.125	
Year	4.273		4.153		13.049	

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

SPELTER

Month.	New York.		St. Louis.		London.	
	1909.	1910.	1909.	1910.	1909.	1910.
January	5.141	6.101	4.991	5.951	21.425	23.350
February	4.889	5.569	4.739	5.419	21.562	23.188
March	4.757	5.637	4.607	5.487	21.438	23.031
April	4.965	5.439	4.815	5.289	21.531	22.469
May	5.124	5.191	4.974	5.041	21.975	22.100
June	5.402	5.128	5.252	4.978	22.000	22.094
July	5.402	5.152	5.252	5.002	21.969	22.406
August	5.729	5.279	5.579	5.129	22.125	22.800
September	5.796	5.514	5.646	5.364	22.906	23.165
October	6.199	5.628	6.043	5.478	23.200	23.900
November	6.381	5.976	6.231	5.826	23.188	24.083
December	6.249		6.099		23.094	
Year	5.503		5.352		22.201	

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

PRICES OF PIG IRON AT PITTSBURG.

Month.	Bessemer.		Basic.		No. 2 Foundry.	
	1909.	1910.	1909.	1910.	1909.	1910.
January	\$17.18	\$19.90	\$16.40	\$17.98	\$16.26	\$17.94
February	16.73	18.96	16.09	17.21	15.90	17.38
March	16.40	18.53	15.84	16.93	15.62	17.00
April	15.79	18.28	15.05	16.84	15.06	16.75
May	15.77	17.10	15.02	15.94	15.08	16.18
June	16.13	16.52	15.84	15.60	15.63	15.53
July	16.40	16.40	15.90	15.40	15.96	15.40
August	17.16	16.09	16.17	14.89	16.20	15.16
September	18.44	15.92	16.80	14.73	17.03	14.93
October	19.75	15.90	17.84	14.05	18.02	14.88
November	19.90	15.84	18.37	14.26	18.09	14.78
December	19.90		18.15		17.90	
Year	\$17.46		\$16.46		\$16.40	

STOCK QUOTATIONS

COLO. SPRINGS Dec. 20			SALT LAKE Dec. 20		
Name of Comp.	Bid.		Name of Comp.	Bid.	
Acacia	04 1/2		Bingham Copper	15	
Cripple Crk Con.	02 1/2		Carissa	12	
C. K. & N.	17		Colorado Mining	34	
Doctor Jack Pot.	08 1/2		Columbus Con.	16	
Elkton Con.	74		Daly Judge	24.25	
El Paso	87		Grand Central	80	
Fannie Rawlins	05		Iron Blossom	80	
Findlay	06 1/2		Little Bell	11.00	
Gold Dollar	12 1/2		Little Chief	22	
Gold Sovereign	03 1/2		Lower Mammoth	14	
Isabella	18		Mason Valley	9.75	
Jennie Semple	10 1/2		Maj. Mines	53	
Lexington	03		May Day	08 1/2	
Moon Anchor	02 1/2		Nevada Hills	2.12 1/2	
Old Gold	04 1/2		New York	13	
Mary McKinney	49		Prince Con.	65	
Pharmacist	02		Silver King Coal'n	1.67 1/2	
Portland	1.00		Sioux Con.	30	
Vindicator	90 1/2		Uncle Sam	44	
Work	03		Victoria	11.07 1/2	

SAN FRANCISCO.

Dec. 20.

Name of Comp.	Clg.	Name of Comp.	Clg.
COMSTOCK STOCKS			
Alta	05	Belmont	4.40
Belcher	35	Jim Butler	.25
Best & Belcher	10	MacNamara	.18
Caledonia	31	Midway	.17
Challenge Con.	11	Mont-Tonopah	1.10
Chollar	17	North Star	.04
Confidence	45	West End Con.	.53
Con. Cal. & Va.	79	Atlanta	.12
Crown Point	35	Booth	.07
Gould & Curry	15	C.O.D. Con.	.15
Hale & Norcross	14	Comb. Frac.	.17
Mexican	74	Jumbo Extension	.24
Occidental	41	Oro	.05
Ophir	1.15	Silver Pick	.06
Overman	30	St. Ives	.15
Potosi	30	Tramps Con.	.02
Savage	10	Argonaut	1.00
Sierra Nevada	13	Bunker Hill	7.25
Union Con.	27	Cent. Eureka	1.10
Yellow Jacket	37	So. Eureka	16.25

N. Y. EXCH. Dec. 20

Name of Comp.	Clg.
Amalgamated	64 1/2
Am. Agri. Chem.	46 1/2
Am.Sm.&Ref.com	74 3/4
Am.Sm.&Ref., pf.	103 3/4
Anaconda	39 3/4
Batopilas Min.	2 1/2
BethlehemSteel pf	59
Federal M. & S., pf.	58
Goldfield Con.	8 3/4
Great Nor., ore ctf.	58
Homestake	85
Nat'l Lead, com.	56 3/4
National Lead, pf.	106 3/4
Nev. Consol.	18 3/4
Pittsburg Coal, pf.	166 3/4
Republic I & S, pf.	31
Republic I & S, pf.	93 3/4
Sloss Sheffield, pf.	149 3/4
Sloss Sheffield, pf.	114 3/4
Tennessee Copper	35 1/2
Utah Copper	45 1/2
U. S. Steel, com.	73 1/2
U. S. Steel, pf.	116 3/4
Va. Car. Chem.	62 3/4

N. Y. CURB Dec. 20

Name of Comp.	Clg.
Ariz.-Cananea	3 3/4
Barnes King	1 1/2
Bonanza Creek	3 1/2
Braden Copper	4
B. C. Copper	7 1/2
Buffalo Mines	12 1/2
Butte Coalition	19 3/4
Caledonia	1 1/2
Calumet & Mont.	90
Canadian Mines	16 1/2
Chino	21 3/4
Cobalt Central	8 1/2
Con. Ariz. Sm.	1 1/2
Davis-Daly	1 1/2
Dominion Cop.	17
Ely Con.	33
El Rayo	3 1/2
Florence	1 1/2
Giroux	6 1/2
Greene Cananea	7
Guanajuato	3 1/2
Guerrero	1 1/2
Guggen. Exp.	195
Kerr Lake	6 1/2
La Rose	4 1/2
McKinley-Dar-Sa.	1.23
Miami Copper	19 1/2
Mines Co. of Am.	5 1/2
Mont. Shoshone	14
Nev. Utah M. & S.	10 1/2
Nipissing Mines	1 1/2
Ohio Copper	1 1/2
Pacific Sm. & M.	1 1/2
Precious Metals	1 1/2
Ray Central	2 1/2
Ray Con.	18 1/2
Red Warrior	1 1/2
South Utah M. & S.	1 1/2
Standard Oil	617 3/4
Stewart	3 1/2
Tonopah	8 1/2
Tonopah Ex.	99
Tri-Bullion	1 1/2
Tularosa	1 1/2
Union Mines	3 1/2
Yukon Gold	3 1/2

BOSTON EXCH. Dec. 20

Name of Comp.	Clg.
Adventure	7 1/2
Algomah	8 3/4
Allouez	40
Am. Zinc	26
Arcadian	34
Arizona Com.	14 1/2
Atlantic	26
Bonanza	1.50
Boston & Corbin	13 1/2
Butte & Balak	7
Calumet & Ariz.	49 1/2
Calumet & Hecla	560
Centennial	17
Con. Mercur	26
Copper Range	67 1/2
Daly-West	23 1/2
East Butte	12 1/2
Franklin	9 1/2
Granby	39 1/2
Hancock	