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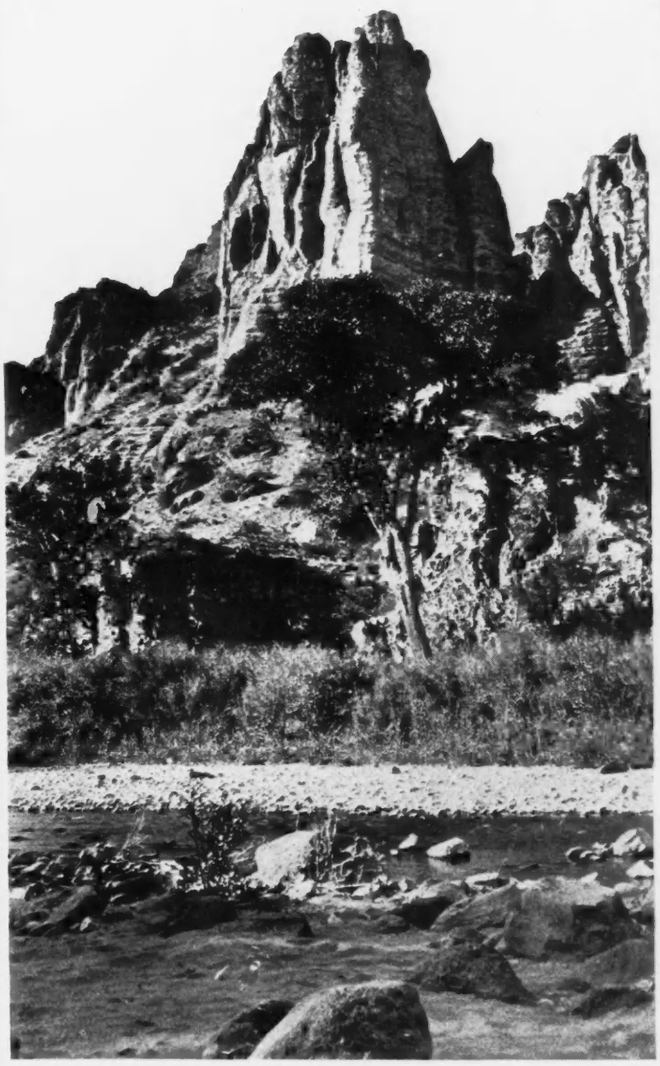
A Proposed Plant for the Electro-thermic Dry Distillation of Zinc Ores

By Charles H. Fulton



Eagle Creek, between Bad Canyon and Gold Gulch, in the Clifton-Morenci District, Arizona

Marketing of Sulphur

By Albert G. Wolf

Surface-Tension Phenomena and Electrostatics

By Ralph H. Jarvis and Dana W. Leeke

A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

July 1, 1922

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The Trespassing of Religion on Science

THE veteran Professor W. M. Davis, distinguished physiographer and formerly professor at Harvard, in a Phi Beta Kappa address at Cambridge, recently discussed vigorously the latest attack on scientific investigation and research. Professor Davis made a memorable phrase: "Much has been written about what is called the conflict between religion and science. The cause of the conflict lies not in the trespass of science upon the proper field of religion but in the trespass of religion upon the proper field of science. Religion attempted, while thus trespassing, to dictate beliefs concerning the age of the earth, the origin of man, and the many other mundane matters."

The persecution of science, in the days when Galileo was haled to Rome and imprisoned because of his publication of the results of his astronomical research, happily passed away in its acute stages, though not so very long ago. Since then, religion and science have been drifting along comfortably side by side, tending slightly to approach; but so slightly that at present the facts of nature as taught to the masses by theologians of the less intelligent but most numerous type are startlingly medieval as compared with the thoroughly demonstrated discoveries of naturalists. The agitation raised by Bryan in the effort to exclude from the colleges study of the monumental researches of Darwin, Huxley, and other great leaders of thought, and the strength of the support of his views which was revealed, have thrown light on a condition of general ignorance which should not go unstudied and unchecked. The facts of physics and chemistry are no longer challenged or branded as impious heresy; the wireless and the phonograph are too evident to be disputed. But the equally evident facts of geology have not yet been made part of the common thought; therefore the common thought, or lack of thought, recoils from them as heresy. The fact that the earth is of incalculable antiquity, and that life has existed and developed gradually for many hundreds of millions of years, is as evident and as thoroughly demonstrated as the phonograph or the electric light; but the masses are still instructed by theologians that the world is some six thousand years old—a statement of the same order of intelligence as that the moon is made of green cheese.

We have before written upon the great need of writing popularly of geology. Therein lies the whole solution of the difficulty. Turn on the light. Meanwhile, if there is to be a general argument between the colleges and the general masses which support them as to whether or not science shall be studied in the universities, the sooner it comes the better. The fault, after all, lies not with the uninstructed people but with the leaders of geologic thought. And if Professor Davis, for example, would write popularly on physiography, speaking the language of the common schools, there is nothing that would be more enlightening.

The Birth of Molybdenite Ores

SOME METALS characteristically have been deposited in concentrated form, as ore deposits, at relatively great depths—that is to say, a number of miles below the surface; others are formed characteristically near the surface—that is to say, within a few hundred or at most a few thousand feet from it. Molybdenite is an example of ore deposits that have been thus formed in the relatively great depths of the earth's crust.

Molybdenite—the sulphide of molybdenum—which is the common and well-nigh exclusive ore of this metal, occurs not infrequently as a rock-forming mineral, especially in pegmatites, where it may be intercrystallized with quartz, feldspar, mica, and other minerals, showing that the conditions of its consolidation from the rock magma were not greatly different from these other rock minerals—that it crystallized at the same, or nearly the same, high temperature. Such pegmatites are often mined as ore; but in many other cases the proportion of molybdenite is not sufficient to make commercial extraction profitable.

But molybdenum has a greater degree of volatility than most of the elements contained in the rocks; and therefore, we find in molybdenite-bearing pegmatites, that in some cases the molybdenite has partially escaped from the rock mass, to segregate and concentrate along the cooler margins of the molten intrusion, which we can visualize as a great, irregular slag-pot. Thus, contact-deposits of molybdenite are formed in many places, as in Quebec, in Canada. The molybdenite may even escape entirely out of the slag-pot, and impregnate or replace in spots the wall-rock which incloses the igneous mass. This is another type of contact deposit—one step further removed from the magma. And in smaller quantity the molybdenite may, under favorable conditions, still escape and travel further and eventually be found in conjunction with other sulphides.

In the main, however, molybdenite is essentially a mineral which solidifies close to the formation of the igneous rock, and at nearly or quite the temperature of pegmatites; it is essentially a mineral which forms near the bottom of the zone in the crust where ore deposits are formed—which zone, after all, does not appear to be interminably deep—and is very evidently in many cases concentrated in a manner which is as clear and simple a process and example of magmatic differentiation as could be desired.

Of course, then, miles of rock, ordinarily, have to be stripped off from above a molybdenite orebody, by the slow processes of erosion, before the ore is exposed at the surface. Since this tremendous erosion takes millions of years, it follows that molybdenite ores, as they confront us at the earth's surface, are usually very old—so old in fact that the entire recorded history of mankind would in comparison be only a drop in the bucket of time elapsed.

The Denison Bill

THE DENISON BILL, known as H. R. 10,598, is not a national "blue-sky" law, in spite of the many assertions to that effect. The proposed act makes it unlawful for any person to send by mail, express, or other agency of interstate commerce any security or securities for sale or delivery to any person in a state, territory, or district if the securities in question at the time cannot be offered for sale lawfully in that state, territory, or district. Various kinds of securities are especially exempted and the type of securities aimed at is the highly speculative and fraudulent stock that fails of recognition by the "blue-sky" laws of the various states.

Since many states have passed "blue-sky" laws in an effort to restrict the marketing of fly-by-night and fraudulent stocks, a condition has arisen which makes the provisions of the Denison Bill logically necessary. A promoter at present can market his securities by mail in a state in which they are unlawful, owing to noncompliance with the "blue-sky" law of that state. Legally he should obtain a permit from the state. As long as he remains out of the state, he can sell by the use of the mails. Thus there is an evasion of the law of the state. It is to remove this condition that an interstate law or Federal statute becomes necessary.

Undoubtedly this bill, if it is passed, will embarrass honest promoters to some extent, but it will also be a difficult obstacle to the dishonest and unscrupulous peddler of bad securities. It is unfortunately true that mining and petroleum enterprises have attracted a group of the most unconscionable parasites. So large has this group grown and so widespread have been its activities that there is no question that legitimate mining and meritorious speculative enterprises suffer from the competition. If mining men wish to protect their opportunities to attract capital to their enterprises they must combine to eliminate as far as practicable the aphis that is sucking the sap of the flower. There is undoubtedly sufficient capital to support legitimate enterprise. Whatever will curtail the waste caused by the parasites will benefit mining.

We are in accord with the evident purpose of the Denison Bill. We are not in accord with all of its provisions.

The "blue-sky" laws of the various states attempt a discrimination between promotions which are obviously fraudulent, those which are speculative, and those which are sound. Necessarily, this requires a more or less intimate inspection by a competent person, and the element of individual judgment enters. We doubt the efficacy of legislation to prevent a man from wanting to get something for nothing. The promoter of questionable enterprises makes a special appeal to the greed, vanity, and laziness of the individual and to his innate desire to achieve wealth by an apparently short and easy route. Legislation can and does restrict, but cannot prevent. A national "blue-sky" law in our opinion would be extraordinarily difficult of administration and would have less chance of success than have the state laws. We believe that publicity, not only concerning the enterprise but also showing the history of the men back of it, would be a more effective way for the elimination of parasitic promotion than the existing methods. However we support the state "blue-sky" laws, as a worthy attempt to protect innocent capital.

The Eight-Hour Day

THE PROPOSED ABOLITION of the twelve-hour day in the steel industry marks another stage of the movement in favor of a standard working period of eight hours. The President is reported to have said that he was in favor of the change on humanitarian grounds. Secretary of Labor Davis maintains that the reduction of working hours would benefit the working man materially. Without intention to minimize the logic in the contentions of both President Harding and Secretary Davis, we would emphasize another important aspect of the matter: that the adoption of a universal eight-hour day is good business for all concerned—for employer, for employee, and, last but by no means least, for the nation.

In reviewing the trend of popular thought and corporate action in this most important phase of industrial relations one is struck by the fact that barriers to standardization of working hours, although considered insuperable, have been overcome with apparent ease. Industry has demanded of its workers an increasing degree of mental efficiency, an increasing interest in the work. This is possible only when a reasonable proportion of the time can be allotted to recreation, diversion, and rest.

National requirements during the war made it imperative that a high degree of efficiency should be attained by operators. Carefully compiled statistics proved beyond a doubt that, within reasonable limits, shorter working hours meant higher individual output and improved quality of work done. In England it was found that the best results among women workers were obtained when the daily shift was reduced to six hours. Some attempt was made, particularly by Lord Leverhume, to show that this indicated a desirable length of shift for the average worker in all industries, but without success. It is generally agreed that the eight-hour day must eventually be recognized as the standard, just as the eight-hour shift is the logical division of the day where continuous operation is imperative, as in the mining and metallurgical industries.

The remedy for monotony in continuous, treble-shift operations has been found in a weekly change of shift. Statistics have proved that there is no alteration in efficiency if such change be made at regular and fairly close intervals. The mental and physical output of a worker is constant, whether he be on the day shift or on the night shift or on the "graveyard" shift.

Few engineers can look back with complacency to the time when twelve-hour shifts were in vogue; few do not realize that the results were poor. The eight-hour shift insures a logical division of the twenty-four-hour day; it permits ample time for recreation, mental improvement, and rest. Its proposed adoption in the steel industry indicates that the employer is awakening to the fact that what is best for the men is best for the business.

The Cart Before the Horse

A REPORT on the Boston & Montana mine, as of June 1, 1922, has been made by Mr. John D. Pope, general manager, to Mr. W. R. Allen, president. It is satisfactory in this, that it gives the facts briefly. And one of these facts is that not enough ore has been developed to run the 750-ton mill even on part time, even from the start. The details of development work given by Mr. Pope show that the work falls

under the general head of prospecting. Various crosscuts and raises have disclosed low-grade ore of milling grade, but, so far as the report states, no tonnage has been demonstrated, and no ore is blocked out ready to stope. Mr. Pope calls attention to the fact that six months before the mill was completed he asked for a special appropriation for mine development, but did not get it.

This situation is a typical one, frequently created by business men who may perhaps be well-meaning, but who lack a knowledge of the technique of mining. The rule for a sound mining enterprise is—first, get your mine, with sufficient ore developed to justify equipment. Then put up the preliminary equipment in accordance with ore developed, not in accordance with ore hoped for. In the case of Boston & Montana, the normal process has been reversed—first the railroad, then a mill of large capacity. Then comes the problem which should have been solved in the beginning—is there a mine to fit this equipment? That the essence of a mine is, after all, the ore in the ground, is a detail often lost sight of in considering problems of milling and transportation.

The responsibility for guiding promoters who are not sufficiently familiar with mining rests with the mining engineer, and he should not be willing to remain associated with any enterprise not properly managed from the point of view of proper mining technique. Also, it rests with the promoter, for securing competent, conservative, and honest advice, even at some cost. Certainly, with the $5,000,000 or so which it has been estimated has been spent on the Boston & Montana, it would have been enormously profitable in the long run to have paid liberally for adequate engineering advice.

Dark Plots Are Not Hatched in Open Meeting

A CURE for any possible evil that may reside in the trade association is frank publicity. There is no use trying to deny that a thoroughly organized trade association affords an industry a medium for gouging the public if the individuals or companies represented desire to use their organization to that end. It is probable that in a few instances this malevolent power has been exercised, but that is no reason for condemning all associations when it is conceded that they perform certain legitimate functions that are of unquestioned benefit to the public at large as well as to the particular industry that they represent.

The prices demanded for a commodity must be reasonable; and, by a reasonable price is meant one that will permit the payment of adequate wages to employees, provide for the earning of reasonable dividends, set up a reserve for amortization of the invested capital, and accumulate a modest surplus against possible periods of depression. But if, after determining a fair price for their product the members of a trade association should conspire to secure an additional 50 or 100 per cent, on the theory that the public had to have a certain amount of the commodity produced, no matter what the price, they would seriously menace the general welfare, and the government should, and doubtless would, intervene. However, the trade association is free of one bad feature of a monopoly or trust: instead of stifling it stimulates competition in respect to maintaining a product of high quality, to filling orders promptly, and to adjusting complaints without squabbling.

We believe that the average trade association can and will go along collecting and distributing statistical information concerning the current production, current sales, and stocks on hand without doing any harmful price fixing. Steady and uniform production in any industry is desirable from every viewpoint, just as the accumulation of surplus stocks and the temporary shutting down of plants is against the public interest. The distribution of statistics undoubtedly promotes efficient production and steady employment for those engaged in the industry.

Meetings of trade associations should be open to representatives of the press, and the statistics gathered likewise should be made public. So long as there are no star-chamber proceedings, it is unlikely that "anything will be put over." Black plots do not flourish in the broad light of general publicity.

Booms That Hurt

A YEAR AGO activity reigned in the old Union Pass district in Mohave County, northwestern Arizona. Situated on the western slope of the River range, and reaching to the Colorado River, the section covered an area ten miles square. Promoters and newspaper men were much in evidence, and at the same time a lot of money was really being spent. The Katherine mine was the center of attraction, so the district became known as the Katherine district. Almost it seemed as if another Porcupine had been discovered. Today the Katherine district is dead.

More recently there has been another burst of feverish activity in the Oatman district, which lies in the same range about twenty miles to the south. Here the focus of interest has been a promising discovery of gold reported to have been made in one diamond-drill hole put down by the Oatman United. The fever seems abating, however; the excitement has disappeared, and any recrudescence will probably depend on the proving up by underground work of Oatman United's reported strike. But the publicity man remains, and has actually succeeded in getting some cleverly written articles into one of the New York dailies.

There have been other instances in Mohave County's history of booms that have come to naught, which doubtless have cost the public something, to the detriment of mining. It is not to be expected that a bonanza goes with every boom; but a line is to be drawn between a boom that is deliberately manufactured and the one that develops naturally. Rather too many of the former kind have marred the history of some of the Western mining states. Certainly, they have served to make it difficult for the honest promoter to finance his project and for the holder of promising claims to interest the capitalist in them.

Inflation of Mining News

AN ANCIENT FORM of error reappears in the news item that chronicles the finding of "gold and silver ore assaying $58,937 per ton" near Idaho Springs, a pretty town in the mountains that overlook Denver. The announcement comes from "the fiscal agent for the company," so that it need not be taken too seriously, despite the mention of two reputable assayers, as vouchers for the correctness of the valuation. It is easier to assay than to sample; it is much easier to ascertain the quantity of precious metal in a sample than to obtain a sample that represents the

average of a large mass of ore. The fiscal agent is reported to have said that the vein is 20 inches thick and "has been proved for a width of 150 feet." If it should maintain these two dimensions for a vertical extent of only 100 feet, the ore within these limits, at the given assay, would be worth $10,000,000. Such a discovery would do much to revive mining in Colorado; and our only regret is that we disbelieve every statement that has been made about it. We are confirmed in our strong skepticism by a further assertion of the fiscal agent: he says "the ore is pure tellurium." If it were, he could not find a market for any large quantity of it. He means that the gold and silver occur as tellurides. Even that is open to doubt, although the test for a telluride mineral is as easy as it is beautiful. At the close of the news dispatch, we read: "Recently we made a small shipment to the smelter which returned an average of $102 a ton." That is somewhat different from $58,937 per ton! In short, assays are things that fiscal agents are not qualified to interpret.

THE JOURNAL-PRESS STAFF

EDWARD HODGES ROBIE

WHEN the humble scribe whose joyful errand it is to write the biographical sketches of the members of the *Journal-Press* staff made the customary inquiries as to high spots in the experience

EDWARD HODGES ROBIE

of the paper's Metallurgical Editor, Edward Hodges Robie, the subject of this biography presented the following personal flow sheet: "I was born at Whitney Point, N. Y., on Nov. 30, 1886. The anniversary is celebrated as Thanksgiving Day every few years. After living in various parts of the country, from Florida to New York, I was graduated from high school in Washington, D. C., and entered Cornell in the fall of 1907. I spent one year in the chemistry course at Cornell, and then went to the University of Michigan, taking chemical engineering and being graduated with the B.Ch.E. degree in 1911. Was assistant in English in the engineering department and night editor of the college daily newspaper. In the summers was employed (1) as staff photographer of the *Washington Post;* (2) as a farm laborer in the wheat fields of northwestern Manitoba.

"My first job after graduation was in the chemical laboratory of the Harrison Safety Boiler Works, in Philadelphia, doing routine and also research work on water softening, followed by about a year in the advertising department of the same concern, writing advertisements and publicity bulletins. I then decided to take up metallurgical work, in which I had acquired a lively interest while at college. In fact, in my senior year I wrote an extended paper on pyritic smelting, which I would like now much to see, as I think I pointed out that every smelter that was not smelting his ore pyritically was making a big mistake. An opportunity presented itself enabling me to accept a position either with the Canadian Copper Co., at Copper Cliff, Ont., or the Hollinger Gold Mines, at Timmins, Ont., and on the advice of W. W. Mein I decided to accept the former—principally because it was not quite so far north. I began my metallurgical experience in March, 1913, doing research work under the direction of H. Wearn and the late D. H. Browne. Later I was occupied in various capacities about the smelter. In 1917 I went on an extended trip through the Western mining districts to investigate improved smelting practice, visiting plants in Texas, Arizona, California, Utah, Montana, and British Columbia. When it was decided to concentrate some of the nickel-copper ore at Copper Cliff, I spent two years studying the subject and conducting experimental work with a ball mill, and with table and flotation machines. Part of this time was spent in investigating practice at large concentrators in Arizona and Utah."

Robie was assistant metallurgist of the International Nickel Co. at the end of the war, and in 1919 accepted his present position on the staff of *Engineering and Mining Journal.* His early training in college journalism made it possible for him to slide comfortably into the saddle of the engineer-journalist, and since joining the paper he has done about every sort of reportorial and editorial work that staff and publication routine requires. His literary labors begin with the editorial pages and end in the market quotations, in the final signature of the text pages of the magazine. For the last two years, in addition to his regular work as metallurgical editor, Robie has had charge of the book review page, and has specialized in the difficult computation of authentic and trustworthy weekly quotations on all the metals, minerals and ores quoted in the *Journal* and since April 1 in *Journal-Press.*

In October, 1914, Mr. Robie was married to Agnes P. Parks. Mr. and Mrs. Robie have three small boys, the adjective, in a sense, being redundant. Mr. Robie modestly admits being one of the metallurgical editors of note living in Oyster Bay, Long Island.

In view of the great progress which has been made recently in the mining districts of northern Ontario, Mr. Robie is planning to spend most of July in the mines, mills, and smelters of the Porcupine, Kirkland Lake, Cobalt, and Sudbury districts. In August he will visit the Michigan copper country and also make a trip to the metallurgical plants in the vicinity of Chicago

Mining in Colorado

By T. A. Rickard

THE dry eloquence of statistics is more than enough to depress any friend of Colorado, which has been a source of wealth to the nation and a school of mines to the profession during the period of a generation. In 1900 the total output of the principal metals was worth over $50,000,000, whereas in 1921 the aggregate output was worth less than $14,000,000. The contrast is emphasized by detail, thus:

	1900	1921
Gold	$28,762,036	$6,882,894
Silver	12,488,774	5,400,700
Lead	7,770,196	927,000
Copper	1,293,011	457,500
Zinc	.....	127,840
	$50,314,017	$13,795,934

To the end of last year the State had produced more than a billion and a half, or, to be exact, $1,538,712,732, according to official records. Lake county, which means the Leadville district, had produced over $400,000,000; and Teller county, which means Cripple Creek, had contributed $300,000,000. These figures bespeak the magnitude of Colorado's mining industry in the past and indicate how deep is the depression at the present. In 1900 a dozen smelters were active; at that time the American Smelting & Refining Co. had seven smelters with 32 furnaces in blast; today only one furnace is at work in the Durango plant and three in the Arkansas Valley plant at Leadville.

In Gilpin county, the birth-place of mining in Colorado, a few small leasing parties continue at work precariously. The old Pewabic mine, in Russell gulch, is being re-opened by the Mack Mines Company of Denver. In Clear Creek county, the dumps of the Dives-Pelican group of mines, at Silver Plume, are being exploited and the old Wasatch mill is being remodeled under the management of Mr. Oscar Rohn, in behalf of capitalists identified with the East Butte company of Montana. This venture is likely to prove profitable. In Boulder county, there is some activity at Caribou, where the old Caribou and Yellow Pine mines are producing a little high-grade silver ore, which is shipped to Leadville, there being no smelter in operation either at Denver or at Pueblo. A deep adit, to cut the veins of Caribou hill, is to be started soon. At Cripple Creek the Cresson is still in good ore and continues to be highly productive, under the superintendency of Mr. Luke Shepard. The Portland and Vindicator mines are being gleaned for remnants of ore. Salida has come into prominence in consequence of the resuscitation of the Rawley Mines Company at Bonanza, near Salida. This property was bought ten years ago by Mr. Everly M. Davis, well known in the chemical industry. There is said to be 350,000 tons of ore assured; the vein is of generous width, and the ore, which carries silver, lead, and copper, although complex and refractory, promises to yield a moderate profit. When Mr. Davis found that he could not make a satisfactory contract with the A. S. & R. for the smelting of his ore, he bought the Salida smelter. Before he started his own smelting operations, however, he came to terms with the A. S. & R. through the intermediation of Mr. Bulkeley Wells, of the Metals Exploration Company. Mr. Wells examined the mine and agreed to furnish $100,000 of working capital, to which the American Smelting company contributed $100,000 more, as part of a development fund amounting to $600,000. If the Salida smelter had started, it would have made conditions worse, rather than better, because the supply of ore in the State did not suffice for the operations of three separate plants. At the Mary Murphy mine, at St. Elmo, still under the management of Mr. George E. Collins, the upper workings are being gleaned by lessees. The poorest ore that can be shipped has an assay-value of $15 per ton. At Leadville the Yak Tunnel is being operated under Guggenheim management as a feeder to the Arkansas Valley smelter. A few leases are active. Mr. John Cortellini and associates, in the name of the Leadville Mine Development Co., a local enterprise, are exploring the Canterbury Hill area by means of an adit. This part of Leadville has been but little mined as yet and those who are well informed consider it to be a promising field for systematic exploration. Mr. Wells and his company is assisting this venture also. In the San Juan region, there is talk of the Sunnyside mine being re-opened. The condition of Silverton is pathetic. Only 18 men are at work in that famous, and beautiful, district. At Rico, a few small leasing parties continue at work, but no enlargement of operations is likely until the market for complex ores improves. Such an improvement is expected in the event that the Coolbaugh process proves to be successful. Of this I shall speak anon.

In this sketch of the conditions prevailing in Colorado, I have mentioned one or two minor enterprises; it will be understood, of course, that there are many other prospects and leases scattered over the many mining districts of the State and that any one of them at any time may lead to an important discovery. The future of mining in an old mining region lies largely with the finding of orebodies that have been missed by former operators.

At Telluride, the Tomboy is supplying 600 tons per day to the mill, but the margin of profit is small. The development of this mine was neglected by the late manager, and the new one, Mr. N. S. Kelsey, is making a resolute effort to put the enterprise on its feet again. The neighboring property, the Smuggler-Union, is the brightest spot in Colorado mining. This property is owned by the Metals Exploration Company, which is backed by Mr. Harry Payne Whitney and Boston capitalists identified with the Calumet & Hecla. Mr. Bulkeley Wells is the vice-president and managing director of the company, which controls and operates several important subsidiary enterprises not only in Colorado but also in Nevada and California. The old Smuggler-Union vein had been pretty well exhausted when in May 1915 another vein was cut on the eleventh level, 1,180 feet below the surface. At that point it appeared as a small branch-vein, inviting but not rich. A drift was started and soon got into good ore, assaying $12 to $15 in gold per ton. In its approach to surface this vein, like many others in this district, split into several members. It was on one of these branches

that Arthur L. Collins did some work, under an option for the Smuggler-Union company, in 1902, shortly before he was assassinated during a strike started by the Western Federation of Miners. He found some pretty specimen ore in workings then 250 feet deep, but the run-of-mine was too poor for milling. Since 1915 this vein, named the Little Mary, has been explored by means of two raises for a height of 1,450 feet, on the dip, which is 59° south-west. Later these workings were connected with the Bullion Tunnel, or ninth level. The result has been to prove over 1,200,000 tons of ore, of which 700,000 tons has been milled for an average yield of $3 in gold, 7 ounces of silver, and 1½% lead. There remains about 500,000 tons averaging $11 per ton. Just now the yield is $13 per ton. The ore goes to the Smuggler mill, which has 60 stamps and one ball-mill, the total capacity being 800 tons daily. Apropos of local metallurgy, it may be said that the Tomboy cyanide plant, designed by a South African specialist, has proved a disappointment. It has been superseded by a flotation plant, using the Callow cell, whereas the Allen machine is used in the Smuggler mill.

The Black Bear mine is shut-down pending tests with the Coolbaugh process. Preliminary tests with this process have been so satisfactory that the American Smelting company and the Metals Exploration Company jointly are erecting a 40-ton plant at Durango. The process, the invention of Mr. M. F. Coolbaugh, is based upon sulphate-roasting and the leaching of the soluble products. The roasting is done in a furnace with a super-imposed hearth of the Wedge or Godfrey type. Rapid rabbling in the presence of an excess of pre-heated air is requisite. The ores most suitable are those containing multiple sulphides, the essential operation being the conversion of SO_2 to SO_3, with the production of water-soluble sulphates of zinc and copper. The iron is roasted to an oxide with the zinc and copper, the gold and silver remaining with the lead in the residue, which is sent to the smelter. The leach material, or 'calcine', is free from arsenic, antimony, or silica. The copper is precipitated by granular zinc, with agitation, whereas the zinc is precipitated electrolytically on an aluminum cathode according to the usual procedure.

Before summarizing the present condition of mining in Colorado it is well to note that in 1918 the State produced, chiefly from the Leadville district, 20,130 tons of manganese ore. In 1919 the output of such ore was 19,962 tons. Even more interesting is the output of rare earths. In 1920 Colorado yielded 1329 tons of roscoelite ore containing 374 tons of vanadium pentoxide valued at $1,176,309; besides 12,220 tons of uranium ores worth $1,174,071. This uranium ore was chiefly carnotite from Montrose county. That is the reason why the Radium Company of Colorado is established at Denver. It is another subsidiary of the Metals Exploration Company. Of the total amount of radium produced in the world last year—38 grammes—the Radium Company produced 12 grammes. Indeed, this company and its affiliated enterprise, the Standard Chemical Company, were responsible for 85% of the world's output of a metallic element that depends for a market largely on philanthropic activity, for radium is so costly that most of it is given to hospitals by prosperous citizens with benevolent proclivities. It is worth today $120,000 per gramme. The ores treated at Denver came from Paradox, in San Miguel county, and Gateway, in Mesa county, as well as from Montrose. A little of it comes from Dry Valley, just over the line in Utah. The ore as shipped contains 2% uranium oxide (U_3O_8), or 5 mgm. radium per metric ton, equivalent to one part radium in 200,000,000 parts of ore. As the ore is sorted in the ratio of 2:1, the original ratio is one part radium in 400,000,000. This is concentrated successively to one in a million parts; then one in 10,000; then 1%; and finally to a product containing 53% radium. Besides the medicinal salts, used chiefly for treating cancer, the company makes many kinds of luminous articles, from push-buttons to religious images. In addition, the company's operations yield about 20,000 pounds per month of vanadium pentoxide from the carnotite ores.

Mr. Wells is at the head of this enterprise also, in his capacity as managing director for the Metals Exploration Company. Indeed, he is the key-man of Colorado mining in a manner quite unique, and entirely different from that in which sundry accidental millionaires in times past have exercised a paramount influence. The election of Mr. Wells as a director of the American Smelting & Refining Company was announced recently, and was received with keen approval in Colorado. It is evident that he is in a position to be greatly useful in assisting to revive the mining industry, and he is making the most of the opportunity accorded to him. Complaint has been made of the high smelter rates; nevertheless the A. S. & R. lost money in Colorado last year. From most of the mining districts even a $20 dry ore cannot be shipped profitably. The Procrustean tariff of the Smelting company has failed to meet the decline of production; an attitude more sympathetic and more co-operative is needed in order to lift the mining industry of Colorado out of the slough of despond into which it has been pushed by the collapse of the metal markets in the latter part of 1920. The Smelting company recognizes this fact and shows wisdom in co-opting Mr. Wells, who, besides his direction of the more important mining operations in the State, is also a director of the Denver & Rio Grande railroad, the principal mineral-carrier of Colorado.

Freight-rates unfortunately have been burdensome; one reduction has been made, and there is promise of another on concentrates shipped to Leadville. The function of Mr. Wells is to bring the railroad and smelting companies to realize the position of affairs and to persuade them to helpful co-operation. This he seems to be doing. His wide knowledge of mining and his remarkably engaging personality combine to fit him for the task.

It is announced that Mr. Kuno Doerr, formerly manager of the El Paso smelter, to which he is about to return, has been acting head of the Smelting company's office at Denver and during his stay he has prepared a schedule of rates likely to encourage the production of ore, more particularly concentrates containing the precious metals. In all this there is cause for hope. The revival of the market for the base metals, notably lead and copper, gives ground for further encouragement. The State of Colorado is one of the great mining regions of the world and is far from being exhausted; I knew it well in days gone-by, and I rejoice that it has found men capable of facing this crisis in its economic life.

DISCUSSION

The Wrong Word

THE EDITOR:

Sir—The efforts of T. A. Rickard to improve the taste and elevate the standards of engineers in their use of English are worthy of praise, support—and emulation. It is a truism to say that words are tools, but so they are, and they are keen or blunt depending upon how we use them. It is odd, as well as deplorable, that engineers and workers in the sciences are so often badly trained in the correct use of language and that their perception of the exact meaning of words is frequently blunt.

It is painful to witness the misuse of any tool and a pleasure to see one properly handled. This perhaps arises from some instinct for efficiency which we possess, but which we too frequently abort or fail to develop. Regardless of its source, we all take pleasure in witnessing the splendid action of the race horse, the finished form of the athlete, the clean-cut work of the skilled mechanic; while we are amused by the gait of an old nag and alarmed at the sight of a tyro attempting to use an adze.

Only by conscious effort and continual self-criticism can we hope to improve our standards and performance, and even so there is no prospect that we shall ever attain perfection, but the effort is worth while if it reduces the mass of inaccurate, obscure, and time-wasting letters and reports which most of us write and read.

Having thus expressed my interest and appreciation, you will pardon my friendly suggestion that in the same issue of the *Journal-Press* in which Mr. Rickard's paper, "The Wrong Word," appeared, there are two excellent examples for his future use. In the second paragraph of your editorial, page 897, on the use of the tractor in mine operation, you say, "With the *advent* of the automobile, etc"; and on page 901, in the second part of the third paragraph of the article by Mr. T. A. Rickard entitled 'Alaskan Affairs', he says, "Mr. Leehy *claims* that the withdrawal, etc." This use of "claims" in the sense of "asserts" or "maintains" or "states" is one often objected to by writers on style, and is, I believe, as objectionable as the common misuse of the word "proposition." Even Jove nods! That, however, does not justify the rest of us in remaining asleep!

Austinville, Va. W. O. BORCHERDT.

Temperature and Copper Shingles

THE EDITOR:

Sir—Referring to the editorial in your issue of April 29 on the interesting subject of copper shingles, I note it is claimed that the principal difficulties in the way of copper shingles—namely, a suitable joint and finish—have been overcome.

It would be interesting to obtain opinions as to the probable relative interior temperature of a copper shingled and sided house, as against a similar structure in the building of which wood, slate, or asbestos shingles had been used.

It would seem that the property of copper to readily transmit heat might be a greater problem than the ones which you mention. R. L. SITES.

New York City.

The Prospector Protests

THE EDITOR:

Sir—In the *Engineering and Mining Journal-Press*, p. 949, of the June 3, 1922, issue, is published a discussion by Louis J. Brunel. He states that the finding and development of prospects is our pressing need, and to this I will say enuf sed. I have mined and prospected for twenty-seven years in different parts of the world and at present am looking for a grub stake on a 50-50 basis. After reading this article it is my opinion that it will cause money to take to the brush. This J. L. Brunel, I believe, is a person who is trained to prospect the prospector. He tries to make the point that financier and prospector should meet on a reasonable basis. What does he call fair, and can he prove that prospectors have a guess system? He writes about a Mr. X, who might have been a sheep herder for fifty years before he had a dream and staked some ground that a spiritualist put him next to for a $2 fee. If he knows so much about prospecting, why doesn't he take his knowledge out on the desert and open up a mine? This bird ought to see about 150 ft. into the ground without digging, and when he was ready to sell his mine he ought to know the difference between a hog and a financier. I am sure he would fight shy of a sulphide zone and water. He would prospect for a tunnel site and about all I would find on his dump would be "pickite," "shovelite," and "gold brokite."

Kingman, Ariz. E. B. FOSTER.

Concerning Oatman Gold Deposits

THE EDITOR:

Sir—In the news from Oatman, Ariz., in your issue of June 10, it is stated that E. L. Ransome, of the U. S. Geological Survey, is working on a report on the Oatman district. This evidently refers to me. The note goes on to state that "Mr. Ransome, who has done much similar work in other camps of the Southwest, is said to disagree with other geologists in his theory concerning the deposition of gold at Oatman." Your correspondent appears to have had his imagination heated by the present boom conditions in Oatman superposed on the Arizona summer. I have expressed no opinion on the mode of deposition of the Oatman gold, and am sorry to say have reached no very definite conclusion as yet on that topic. While quite ready to disagree with other geologists when necessary, I am not anxious to be advertised in advance as trumpeting opinions on ore genesis at variance with those of Hershey, Burgess, and other good geologists who have studied these deposits. It may be quite possible that we shall be as harmonious in our views as the expert witnesses on one side of an apex suit. F. L. RANSOME.

Washington, D. C.

Heat Requirements in Volatilization

THE EDITOR:

Sir—Mr. Gahl's article on chloride volatilization, in the June 3 issue, was most interesting. I would like, however, to call your attention to an error in the tabulated data in the second paragraph, in which the salt consumption is placed at 3.45 lb. per ton. This is evidently intended for 3.45 per cent of the weight of ore charge. EDWARD E. BUGBEE.

Cambridge, Mass.

A Proposed Plant for the Electrothermic Dry Distillation of Zinc Ores

Design Based on Experimental Unit Operated at East St. Louis—Advantages Claimed Include High Recoveries of Zinc, Adaptability to All Types of Ores, and Lower Costs of Operation Than Either the Retort or Electrolytic Process

By Charles H. Fulton
Director School of Mines and Metallurgy, University of Missouri

THE PURPOSE of this paper is to discuss a proposed commercial plant to operate an electrothermic process for the recovery of zinc. The equipment and process were developed technically in East St. Louis in 1917-18 and have been described in detail elsewhere.[1]

The essential features of the process are: 1. Oxidized zinc ore or roasted zinc concentrate (jig, table, or flotation concentrate) is mixed with crushed coke (maximum size about ⅛ in.) and with hard coal-tar pitch and formed into large briquets or ore electrodes. The composition of these briquets varies with the nature of the ore within the following limits: Ore, 100 parts; coke, 60 to 85 parts; pitch, 18 to 25 parts. This briquet is strong and hard when it comes from the press, and is baked at a temperature from 450 to 500 deg. C. to distill off the volatile constituents of the pitch and make the briquet a conductor of the electrical current. Under neutral or reducing conditions it will maintain its form and volume during and after the distillation of the zinc. The distinguishing characteristics of the briquet are that it is composed of a porous reducing and conducting material, coke, and that the ore particles are united intimately with the coke by pitch, which, on baking at 500 deg. C., loses its volatile constituents and also becomes a coke. In the baked briquet the ore particles are imbedded in a porous coke matrix, and on heating, the zinc is reduced and the vapor is discharged freely from all parts of the briquet. The briquets are inserted between the terminal electrodes of an electric circuit and become a resistor which may be heated to any desirable temperature, like a lamp filament in an electric light bulb.

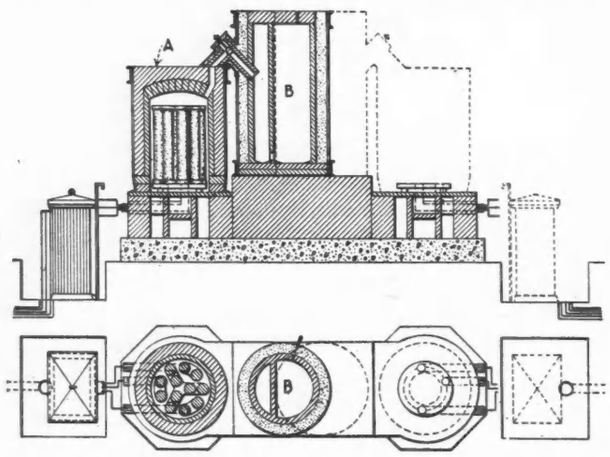


Fig. 1. Details of East St. Louis furnace

In the furnace used at East St. Louis, briquets 9¼ in. in diameter and 21 in. high were set up as a charge, illustrated in Fig. 2. This charge consisted of twelve columns of three briquets each, or thirty-six briquets, the weight of which was 3,160 lb., and contained from 1,700 to 2,000 lb. of concentrate.

Figure 1 illustrates the furnace. It consists of two bases upon which a charge is alternately placed, a retort (*A*) which is a steel shell heavily lined with refractory and non-conducting material and is movable from the base by a crane; and a condenser (*B*), also a cylindrical steel shell lined with a refractory material and which may be moved by the crane. After the charge is in position on the base, the retort is lowered over it and the condenser swung into position by the crane so that the opening of the vapor connection registers with the opening in the top of the retort. The alternating three-phase current is then applied to the electrodes in the base, and when the charge is distilled (eight hours) the condenser is lifted away, rotated 180 deg., and set on its support. Then the retort is lifted a few inches and pulled sidewise, sweeping the charge over an apron plate into a car below. The red-hot retort is then transferred to the charge on the other base, the condenser placed as described, and distillation begun on the second charge. Another charge is then set up on the first base, and the operation is repeated.

Figures 3 and 4 are photographs of the furnace, Fig. 4 showing the distilled charge with the retort lifted. The distillation of zinc from the briquets is practically complete, because intimate contact between ore and coke is maintained during the distillation. At the end of the distillation the briquets are still intact. It is this feature which makes the furnace operative, as the briquets maintain the flow of current to the very end without collapse. The condensation of the zinc vapor is almost entirely to liquid zinc, and no blue powder is formed, as the process operates under the same metallurgical conditions that exist in the retort process—namely, a distillation within a uniformly heated space above 1,000 deg. C., so that no carbon dioxide forms.

The energy is applied directly to the charge and is not transmitted to it through walls of refractory material, as is done in the retort process. This feature permits an approach to the theoretical energy consumption. The power consumption at the East St. Louis experimental plant was approximately 1,500 kw.-hr. per ton of concentrate.

The process is applicable to the high-grade ores and concentrate now used in the retort process and to complex ores containing iron, lead, silver, and copper. It is not limited to ores of any particular composition, as is the retort process, and flotation concentrate can be

[1] Laist; Frick, Elton and Caples, "Electrolytic Zinc Plant of Anaby C. H. Fulton. *Trans.* A. I. M. E., 64, 188. "The Condensation of Zinc from Its Vapor," by C. H. Fulton, *Trans.* A. I. M. E., 40, 280.

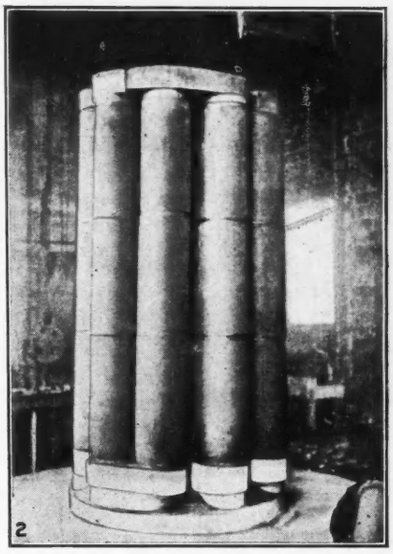


Fig. 2. Arrangement of briquets in furnace

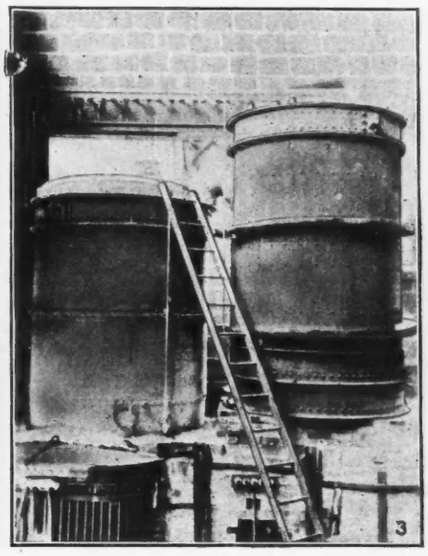


Fig. 3. Exterior view experimental furnace

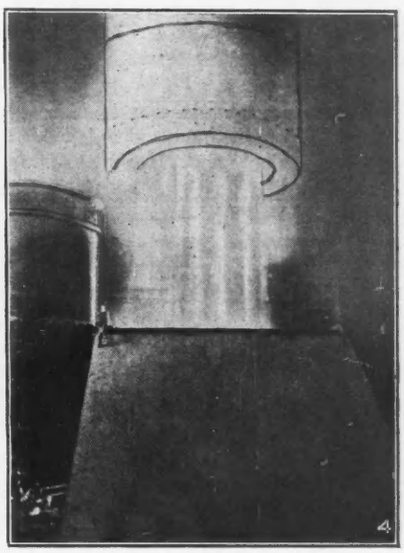


Fig. 4. Distilled charge with retort lifted

worked equally well as jig or table concentrate. The spent or distilled briquets can be crushed and used again as coke, one or more times, dependent upon the amount of residue the ores contain. In this way the valuable metals in the residue may be concentrated.

General Description of the Proposed Commercial Plant

The basis for the proposed commercial plant is the treatment of 2,000 tons of 60 per cent concentrate per month. For the treatment of high-grade zinc-bearing material, it is assumed that one of three processes may be used: 1, The standard retort process; 2, the electrolytic process; 3, an electrothermic process. In all three methods the first step is roasting if sulphide concentrate is used. Therefore, in the proposed plant, the roasting furnaces are not considered and the start is made with calcine.

Figure 5 is a flow sheet of the proposed plant. It consists of three sections: 1, The coke and briquet bins and crushing section; 2, the mixing and briquetting section; 3, the baking ovens and electric distilling furnaces. The crushing plant is standard and needs no description. The coke and spent or distilled briquets are crushed to such fineness that the maximum size of particle is approximately $\frac{1}{8}$ in.

The calcine and the coke are fed in the proportion of 100 to 60 by conveyors to a concrete mixer, and the mixture is elevated to storage bins, from which it passes to the mixing plant which prepares it for briquetting. The mixing of the ore and coke with the pitch is done in a standard asphalt road plant. In this the ore-coke mixture is heated to approximately 200 deg. C. in a sand drier, raised to the sand bin and thence into a weigh box, which in turn discharges into a knife-blade mixer. At this point the eighteen to twenty parts of molten pitch are added. The system of mixing results in a complete coating of the ore and coke particles with pitch. The mixer discharges to the hopper of the briquetting press by means of a conveyor. The press is a standard caking press as used in other industries.

The large briquets (12 x 12 in. cross section and 27 in. high) are discharged on to a traveling table conveyor and then set up by hand in charge form on a furnace base placed on a baking-oven car. These cars pass into the baking oven, which is constructed on the recuperative principle and is shown in diagram form in Fig. 6. The heat for baking is derived from the hot spent briquet charge, which, as it comes from the retorts, is immediately pushed into the baking oven. The distilling retorts, nine in number, are fixed in position, and the furnace base is movable. This is a return to an original design used in the earlier experimental work and differs from the East St. Louis design of a fixed base and movable retort as shown in Figs. 2 and 3.

The fixed-retort design presents advantages for a commercial plant in connection with the baking of the briquets and the handling of the charge. The electrodes

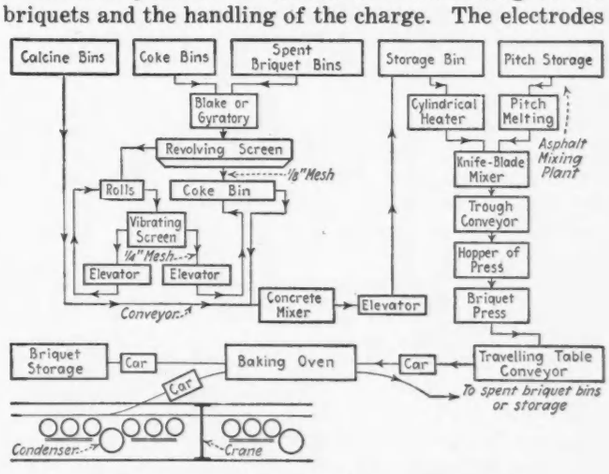


Fig. 5. Flow sheet of proposed plant

(9 in. diameter graphite) are placed in the top of the retort, passing through coke-sealed glands and making contact with the briquet charge by their weight. The electrical equipment is on a platform approximately level with the top of the retorts, and the busbars carrying the current are short.

The furnace base, with its charge, as it comes from the baking oven on a car, is run over the hydraulic lift below the retort and raised into place. The base is made

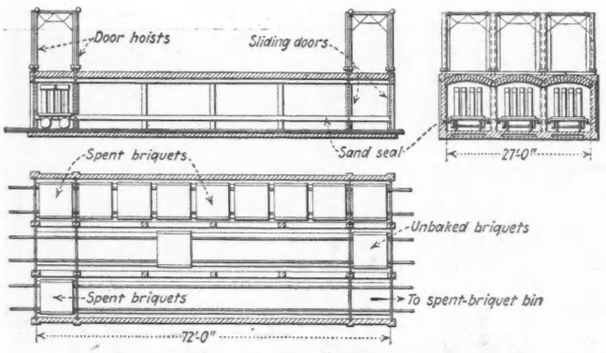


Fig. 6. Oven for baking briquets

tight to the retort by a ring of fireclay luting. In operating, the furnace base, with its distilled or spent charge, will be lowered by the lift to a car and at once transferred to the baking oven, while a furnace base with a baked charge is taken from the oven and immediately lifted to the hot retort.

Arrangement of Retorts and Condenser

The three retorts in a group discharge into one condenser. The arrangement may be as shown in either Fig. 7 or Fig. 8. The connections for conducting the zinc vapor from the retort into the condenser are permanently attached to the condenser, and are as short and simple as possible. The condenser can be removed from its position by a crane and replaced by another one when necessary.

Figure 9 illustrates the retort and condenser in diagram form and gives dimensions. The lining of the retort is high-grade firebrick, and the insulating material sil-o-cel. The lining of the condenser must be of a very pure fire clay or a synthetic refractory practically free from iron. This freedom from iron is one of the essential requirements of the condenser lining, for the presence of iron-oxide particles in the lining will lead to its destruction by carbon deposition from carbon monoxide gas, a reaction active at about 500 deg. C., a prevailing temperature in some regions of the condenser. The arrangement of one condenser for three retorts permits of a continuous flow of zinc vapor to the condenser. The condenser may be arranged with either two or four passes or compartments, this being attained by curtain walls. With the combination of three retorts and one condenser, the volume of the condenser should be not less than twice the volume of the retort.

The factors involved in condensation are temperature, volume, and surface. The temperature in the condenser should range from about 1,050 deg. C. at the intake to about 470 deg. C. at the gas exit. For every pound of zinc condensed from a mixture of equal volume of zinc vapor and carbon monoxide, between 1,050 and 650 deg. C., there is liberated 1,050 B.t.u., or 1,250,000 B.t.u. per hour for the condenser with three retorts as described.

If the radiation from the condenser is greater than the quantity of heat supplied by the condensation of metal, the condenser must be heated. If it is less, the condenser must be cooled. In the design under discussion, cooling would be necessary, and may be accomplished by water sprays. In starting a new condenser, it would be pre-heated to the proper temperature (700 deg. C.) by means of an oil burner introduced into a hand-hole at the bottom of one of the passes, the condenser connection acting as a chimney.

In condensing from a mixture of equal volumes of carbon monoxide and zinc vapor, theoretically 85 per cent of the zinc may be condensed to liquid metal with an exit temperature of 750 deg. In practice it is probable that two condensers would be placed in tandem, one operating between temperatures of 900 and 750 deg. C. and the other between temperatures of 750 and 450 deg. C. This system would afford good control. In the East St. Louis pilot furnace no difficulty was experienced in condensation owing to the formation of blue powder. This is a common difficulty with electrothermic zinc

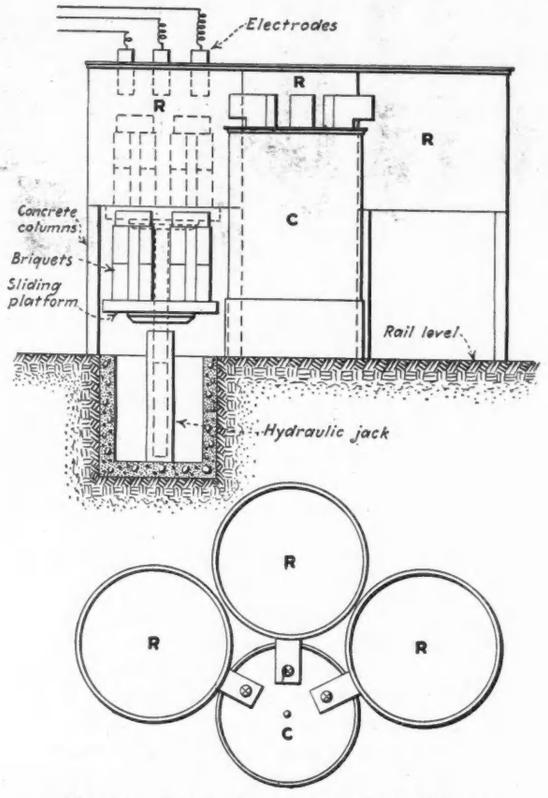


Fig. 7. Plan of retort and condenser

smelting, but in this process the metallurgical conditions of the retort process are retained—namely, a uniformly heated space above 1,000 deg. C. and a pre-heated charge; so that no gases are present in the condenser except zinc vapor and carbon monoxide. It is the presence of such gases as carbon dioxide and water vapor which leads to the formation of blue powder.

The spent briquets contain the residue of the ore. With the usual high-grade zinc concentrate, this ore residue is from 12 to 20 per cent of the weight of the concentrate and from 15 to 25 per cent of the weight of the spent briquet, the rest being carbon; that is, the spent briquet is practically a high-ash coke. The briquets will be recrushed and used over again at least once, and sometimes twice. If the ore contains lead and silver, approximately 80 to 85 per cent of the lead and more than 90 per cent of the silver may be retained in the briquet by the close temperature control of distillation which the process permits. By the repeated use of the spent briquets containing lead and silver, a relatively high concentration of these two metals may be obtained. This applies also to copper in complex zinc ores. By the re-use of the briquets, the reduction fuel for the process is brought down to 30 per cent and less of the weight of the ore.

The following figures give the details of the briquet charge. The briquet mixture is assumed, for example, to be: 100 parts calcine (Missouri concentrate, 60 per cent zinc); 60 parts coke, and 20 parts pitch. In briquetted form this weighs 115 lb. per cubic foot. During baking approximately one-half of the weight of the pitch is distilled off, and baked briquets contain 56 per cent of ore, equivalent to 34 per cent of zinc. The briquet is 12 x 12 in. in cross-section and 27 in. long.

Figure 10 illustrates a charge of briquets set up for introduction into the retort. In this charge, briquets are used as top and bottom connectors, so that the whole charge is made up of briquets. In East St. Louis the bottom and top connectors were made of graphite, but briquet connectors present manifest advantages. The charge consists of twelve columns of two each, six top connectors, and six bottom connectors, a total of thirty-six briquets. For the best electrical connections it is almost essential to use twelve columns. Other numbers, though possible, present decided disadvantages in the set-up.

A briquet contains 2½ cu.ft. and weighs 260 lb. The charge contains 81 cu.ft., weighs 9,315 lb., and contains

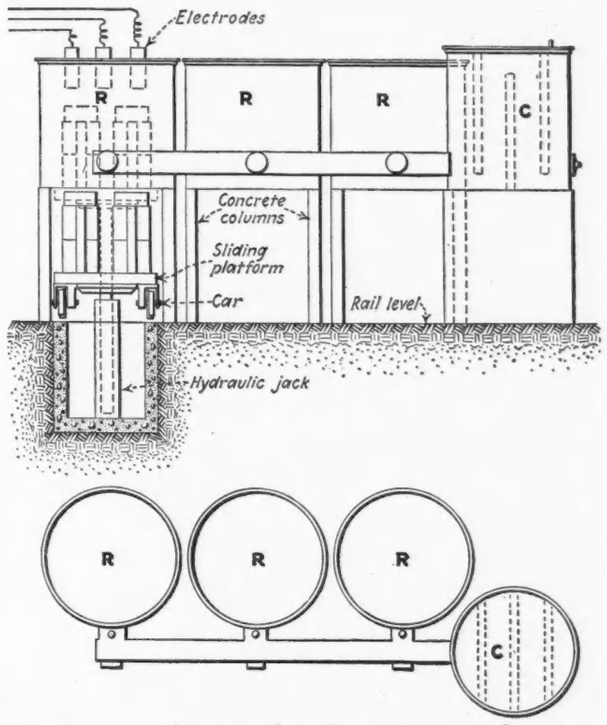


Fig. 8. Alternate plan of retort and condenser

5,216 lb. of ore, equivalent to 3,167 lb. of zinc. A retort distills three charges per twenty-four hours, so that the capacity per retort is 15,648 lb., or 7.824 tons of calcine per day.

Electrical Equipment of the Furnace

The furnace is operated with three-phase alternating current. The graphite electrodes make contact with the charge, and are not consumed. The charge contains approximately 5,400 lb. of concentrate, and on the basis of 1,500 kw.-hr. per ton and a six-hour distillation period (these two figures purposely assumed large to provide proper margin), 4,050 kw.-hr. will be used in six hours, or an intensity of 657 kw. per retort. For the nine retorts, giving a capacity of (2.7 x 3 x 9) = 72.9 tons calcine per day, or 2,187 tons per month of thirty days, or 2,573 tons green concentrate (a margin of 573 tons to allow for delays), there will be required nine 3-phase, 60-cycle, 700 kva. transformers; nine 3-phase, 60-cycle, 160 kva. regulators, and nine complete switchboard equipments. These are designed to give full kva. capacities at secondary voltages from 40 to 250 v., with a primary voltage of 2,300 v. Other primary voltages can be used equally well. It is assumed that the current can be purchased, and is not generated at the plant. Other standard frequencies than 60 may be employed.

The specific resistivity of the briquet ranges from 0.01 to 0.04 ohms per cubic inch, dependent on the nature of the ore; 0.02 to 0.03 ohms is the usual figure. A charge set up as in Fig. 10 shows a standard delta connection in the briquet columns, with four columns in series, and requires a terminal voltage of 217 v. at the electrodes, for an intensity of energy input of 675 kw. Connections within the charge can, however, be made so as to lower this voltage if it should be desired. The transformers are set close to the retorts on a platform to keep the reactance low. By using electrodes in the top of the retorts, the secondary leads of the transformers are about the same elevation as the electrode terminals of the furnaces, and short bus connections are obtained. All high-voltage control and all switchboard equipment will be outside the furnace room.

Recapitulation and Advantages of the Process

The process differs essentially from other electrothermic processes for zinc. It is not a smelting process but a distillation process, like the retort process. Most of the proposed electrothermic processes mix the ore with a limited amount of reduction fuel and smelt by electric heat generated by a buried arc. The furnace space is then not uniformly heated, and carbon dioxide gas and water vapor are present with the zinc vapor and carbon monoxide. Condensation to liquid metal is thus difficult, and the amount of blue powder formed is large. Furthermore, the residue of the ore is smelted to slag which usually contains considerable zinc. It seems questionable whether, in such a furnace, it is possible to recover other metals in the form of bullion or matte, on account of the high temperature prevailing. In Norway and Sweden electrometallurgists have adopted, frankly, vaporization of lead with the zinc.

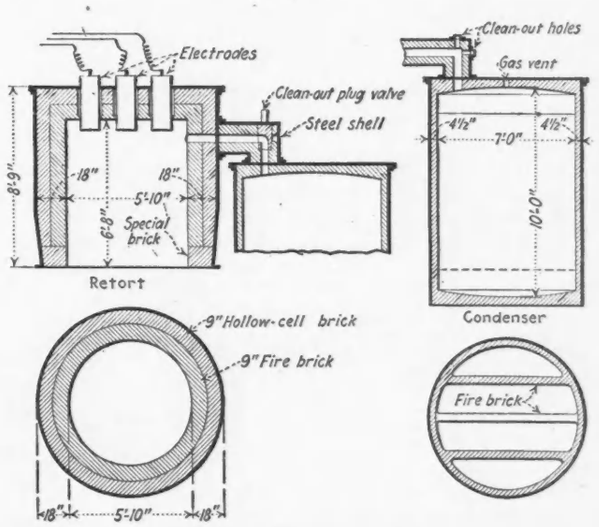


Fig. 9. Dimensional diagram of retort and condenser

The electrothermic distillation process described presents the following advantages:

1. Large-scale units mechanically operated, as in the metallurgy of the other common metals.
2. Low labor cost, mainly unskilled.
3. Practically complete extraction of the zinc from the ore.
4. High recovery of zinc—most of it as liquid metal.
5. Low power consumption, less than electrothermic smelting and less than in the electrolytic process.
6. Applicable to all types of zinc ores, with no limitations on iron, lead, lime, or other substances now barred by the retort process.
7. Applicable to complex ores; for example, the Burma ores.
8. Simplicity of plant and operation. Simpler than the retort process and the electrolytic process.
9. No regular consumption of fire clay; can be built in small units in out-of-the-way places where electric power is available.

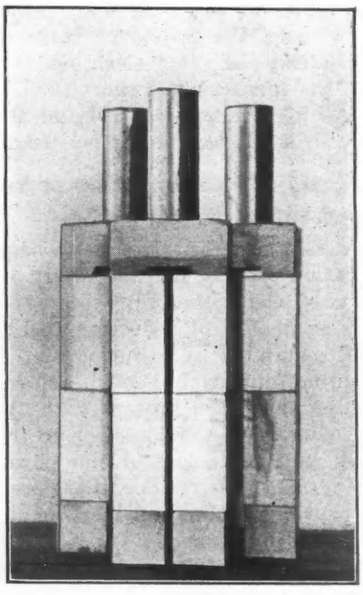


Fig. 10. A model charge of square briquets

10. Lower cost of operation than either retort or electrolytic process, as set forth in a succeeding paragraph.
11. May be introduced as an adjunct to the retort process for the treatment of the blue powder produced by that process.

In plants using non-regenerative gas-fired Hegeler retort furnaces with waste-heat boilers, excess steam for electric power is available.

COST OF PROPOSED ELECTROTHERMIC PLANT

Capacity 2,000 to 2,500 tons of green concentrate per month. The figures are based on the flow sheet, Fig. 5.

Calcine bins, 200 tons and elevator	$15,000
Coke-crushing bin complete with rolls, screens, and 200-ton storage bin.	20,000
Mixing system, drying, pitch melting; up to the briquet presses. This includes preliminary concrete mixer for mixing calcine and coke	22,000
Three briquet presses and table conveyor	25,000
Baking oven and equipment and twenty-seven charge cars	22,000
Nine retorts	20,000
Nine rams	30,000
Three condensers	10,000
Twenty-seven 200 kva. single-phase transformers and switchboard equipment (*a*)	70,000
Buildings and cranes	75,000
Miscellaneous	20,000
Total	$329,000

(*a*) This is based on the assumption that high-tension power can be purchased. If power is generated at the plant an investment of $500,000 is necessary for a 5,000 kw. plant based on the price of $100 per kw.

The cost of a roasting and sulphuric-acid plant will be about $700,000.

Calculation of Cost of Electrothermic Dry Distillation Process

Basis, one ton of roasted concentrate, produced from 60 per cent green concentrate. Sixty tons roasted concentrate per day, or 2,000 tons green concentrate per month. Sixty tons calcine; 36 tons coke; 12 tons pitch or asphalt per day. Cost based on flow sheet. Average cost of labor at $3 per man per shift.

I. Cost of calcine delivered to furnace in form of baked briquets 1 ft. square, 27 in. long.
II. Cost of furnacing and producing metal ready for shipment.
III. Cost of material, coke and pitch.
IV. General expense.
V. Power.

ITEM I. COST OF DELIVERING BRIQUETS TO FURNACE

				Cost Per Ton Calcine
1.	Unloading 60 tons calcine, 36 tons coke, 12 tons pitch			
	Two men @ $3		$6.00	$0.10
2.	Crushing 36 tons coke and briquets in eight hours			
	One man at $3	$3.00		
	Power	.50	3.50	.06
3.	Conveying and mixing ore and coke, eight hours			
	One man @ $3	$3.00		
	Power	1.00	4.00	.07
4.	Mixing for briquets, twenty-four hours			
	Six men @ $3	$18.00		
	Power and fuel	24.00	42.00	.70
5.	Briquetting, twenty-four hours			
	Six Men @ $3	$18.00		
	Power	2.00	20.00	.33
6.	Miscellaneous			
	Two men @ $3	$6.00		
	Supplies	7.00	13.00	.22
	Total			$1.48

ITEM II. COST OF FURNACING AND PRODUCING METAL FOR SHIPMENT

972 briquets = 27 charges. Nine retorts. Three condensers.

1.	Furnace men			
	Three men @ $6	$18		
2.	Helpers			
	Three men @ $3	$9		
3.	Metal-drawers			
	Three men @ $3	$9		
4.	Metal to storehouse			
	Three men @ $3	$9		
5.	Repair gang			
	Three men @ $5	$15		
		—	$60	1.00
				$2.48

ITEM III. COST OF MATERIAL

1.	Coke. 18 tons @ $5.50	$99		
	Spent briquets used once again.			
2.	Pitch. 12 tons @ $9.00	108	$207	$3.44

ITEM IV. GENERAL EXPENSE

1.	Superintendence	$10		
2.	Office expense	10		
3.	Laboratory expense	15		
4.	Yardmen. Three @ $3	9		
5.	Taxes, insurance and miscellaneous	60		
6.	Repair supplies	50		
		—	$154	2.57

ITEM V. POWER

1.	1,400 kw.-hr. @ 0.5c			7.00
				$15.49
	Calculated to the basis of raw concentrate, assuming 15 per cent loss in roasting			13.13
	Credit on 9 per cent extra recovery, 108 lb. zinc @ 5c			5.40
				$7.73

This tabulation does not include capital investment and amortization.

The Retort, Electrolytic and Electrothermic Distillation Processes Compared

The Retort Process.—Some metallurgists believe that the retort process has reached a stage where further major improvements to reduce the cost of production are not probable. If zinc is to maintain itself as a cheap metal, some method of production at lower cost is necessary. One of the main items of cost in the retort proc-

ess is that of fuel, and nearly all plants are situated convenient to coal fields or in gas districts. Three types of retort furnaces are in use[2]:

1. The Hegeler producer-gas-fired furnace.
2. The natural-gas furnace (Hegeler type).
3. The regenerative furnace (Siemens or Neureuther).

Fuel is used for firing the retort furnace; for reducing the zinc oxide; and admixed with earth loam as a luting material. The fuel consumption per ton of green concentrate (not including the fuel for calcining) is as follows:

Type of Furnace	For Heating, Lb.	Coal for Reduction Lb.	Reduction Coal For Blue Powder, Lb.	Luting Coal, Lb.	Total, Lb.
Hegeler	2,860 to 4,000 coal	750	130	120	4,200 (av.)
Natural gas	30,000 cu.ft. gas	750	130	120	1,000 lb. plus gas
Regenerative	2,000 coal	750	130	120	3,000 lb.

The amount of coal required for reduction and luting is approximately 50 per cent of the weight of the green concentrate.

The item of *fuel* is of particular significance, as it is sometimes stated that the cost of power for the electrothermic process for zinc is prohibitive, and such a process is a possibility only where cheap hydro-electric power is available.

The electrothermic process will require about 1,400 kw.-hr. per ton of green concentrate as a maximum. In a modern power plant this can be generated with 2½ lb. of good coal per kw.-hr., or 3,250 lb. of coal per ton of concentrate. If to this be added 600 lb. of reduction fuel required, the total fuel consumption is 3,850 lb. The cost of converting fuel into electric energy will not be greater than burning it in gas producers and furnaces, considering capital expenditure and labor items. It is possible to generate electrical energy for 0.4 to 0.5c. per kw.-hr. at the switchboard.

The figures given below apply at the present writing to the retort process: Roasting in Hegeler kilns for sulphuric acid costs $350 per ton of green concentrate, Missouri 60 per cent concentrate taken as standard. The loss of weight, or the shrinkage, is 15 per cent. The loss of zinc in roasting is 1.5 per cent, and an additional 1 per cent is lost in handling between the unloading track and the mixing of the furnace charge.

The cost of producing metal from calcine in a large, highly perfected regenerative furnace plant operating at full capacity is $22 per ton of calcine. In a producer-gas-fired Hegeler furnace it is $23 to $24 per ton. Natural-gas furnaces have at present few advantages aside from capital invested over the regenerative type, on account of the increasing cost of gas. The costs cover all charges, including amortization. In the zinc-smelting districts, common labor costs 30c. to 35c. per hour, and the average cost of labor, skilled and unskilled, is approximately $3.35 per eight-hour shift. On Jan. 15, 1922, the price of Joplin 60 per cent concentrate was $28 per ton and the freight rate to certain Illinois smelting points was 22½c. per 100 lb.

In 1913 the cost of a retort plant of the best type, complete, with a capacity of 2,500 tons of green concentrate per month, was as follows: Two Hegeler kilns and acid plant and four regenerative zinc furnaces (including all equipment), $1,300,000. At present prices the cost would be about $2,000,000.

[2]For a concise brief discussion of the retort process see F. E. Pierce, "The Zinc Smelter of Today," *Proc.* Eng. Soc. of West Penn., 32, 20. 1916.

The recovery of metal in the retort process is dependent on the nature of the ore and the care and skill of the labor employed. On Missouri 60 per cent green concentrate containing 1,200 lb. of zinc, a recovery of 86 per cent, or 1,032 lb., represents good work. This is made up of a recovery of 88 per cent in the distilling furnace, and allows for a 2½ per cent loss in roasting.

The Electrolytic Process.[3]—I have no information on the electrolytic process except as gleaned from the current literature. The process for low-grade (35 per cent zinc) complex Butte ores consists essentially of the following steps:

1. Roasting.
2. Leaching.
3. Purification of solution.
4. Electrolytic deposition.
5. Melting and casting.
6. Production of zinc dust used for purification of solution.
7. Recovery of lead and copper in residues.
8. Recovery of zinc from zinc-bearing slag from 7.

It is understood that the management of the Anaconda plant at Great Falls has under consideration the addition of the eighth step. A study of the flow sheet of the electrolytic process reveals its relative complexity as compared to the proposed electrothermic process. In the electrothermic process no provision is made in the description for treatment corresponding to 7 above—namely, that for the recovery of lead and copper in residues; but the treatment will be simpler than in the electrolytic process, for the residue will contain no zinc and will be in the form of high-ash coke, which can be smelted in the lead blast furnace into bullion and matte. The accompanying table gives figures for power required for the electrolytic and the electrothermic processes.

POWER CONSUMPTION FOR PRODUCING ZINC ELECTROLYTICALLY AND ELECTROTHERMICALLY (*a*)

Method	Kw.-Hr. Per Lb. Of Zinc	Kw.-Hr. Per Ton Of Zinc	Kw.-Hr. Per Ton 60% Conc. = 1,200 Lb. Zinc
Theoretic figure for electrolysis from sulphate sol.	0.7367	.....	884
Theoretic figure for electrothermic briquet process	.....	.....	1,372(*b*)
Electrolytic at Martinez (high current density)	1.77	3,540	2,024
Electrolytic at Anaconda (low density.)	1.50	3,000 3,250 A.C.	1,800 1,950
Electrothermic dry distillation	1.17	2,340	1,400 1,635(*c*) 1,750(*c*)
Electrothermic smelting Sweden	.....	4,000	2,400

(*a*) Figures are for deposition from solution, and for the electric distillation only.
(*b*) Of this 378 kw.-hr. may be recovered from the spent hot briquets by recuperation.
(*c*) East St. Louis plant.

The Electrothermic Process.—The electrothermic process will consume 20 to 40 per cent less power than the electrolytic process. At Great Falls, the recovery of zinc on 35 per cent zinc concentrate high in iron and lead is 80 per cent. Frederick Laist makes the statement that on high-grade Missouri concentrate, 92 to 95 per cent of the zinc can be recovered. The electrothermic process will make a recovery of 94 to 96 per cent on all types of ores. In his address on electrolytic zinc before the American Zinc Institute in May, 1921, Mr. Laist makes the following statements:

"With the development of the process and the extension of our operations, my optimism as to the future of electrolytic zinc has steadily grown, until now I am not sure

[3]Laist, Frick, Elton and Caples, "Electrolytic Zinc Plant of Anaconda Copper Min. Co." *Trans.* A. I. M. E., 64, 699. F. Laist, "Present and Future Possibilities of Electrolytic Zinc," *Bul.* Am. Zinc Inst., 4, No. 6, 7, 8; 79. W. R. Ingalls, "Electrometallurgy of Zinc." *Trans.* Am. Electrochem. Soc., Sept. 29, 1921. H. B. Hanley, "Electrolytic Zinc Methods," *Min & Sci. Press*, Vol. 121, 795.

but that we will yet see electrolytic plants operating on high-grade concentrate and actually producing their power by the combustion of coal or oil or gas.

"This statement may seem somewhat extreme, but it is based on the following general premises:

"1. The fuel required for distillation and reduction of a ton of zinc in a modern retort plant will, when burned in an efficient modern plant, generate sufficient electric energy to deposit a ton of zinc from sulphate solution.

"2. The labor required for producing a ton of zinc electrolytically from a given concentrate will be no more than one-third the labor required by the furnace method.

"3. The total investment required to produce a ton of zinc electrolytically will, in general, be little, if any, greater than by distillation—it being assumed, of course, that both plants are constructed with a view to permanence.

"4. The great purity of electrolytic zinc and the desirable qualities which it possesses by reason of its purity will, as they become better known, give electrolytic zinc a distinct advantage on the market to the detriment of less pure grades of zinc.

"While the correctness of the above premises has not been absolutely proven, I have from time to time come into possession of data which lead me to believe that in the main they are not far off. An accurate comparison can, of course, only be made where all local conditions are known, such as character of ore to be treated, cost and kind of fuel, unit construction costs, etc."

In comparing the electrolytic and electrothermic dry distillation processes in the light of the four items of Mr. Laist's statement, I believe the following is true:

1. The fuel or the power required for electrothermic distillation is 20 to 40 per cent lower than for the electrolytic process.

2. The electrothermic will not use more labor than the electrolytic process, and probably less.

3. The investment for an electrothermic plant is about one-half that for the electrolytic.

4. The electrothermic zinc will be of the same grade as is made in the retort plant, but, with the increase in the production of electrolytic zinc, the latter probably cannot maintain a premium in the market.

Metallurgical Operations of Nevada Consolidated in 1921

Changes in the mill flow sheet made in 1920 were followed by better work in the three months of 1921 operation, according to the annual report of the Nevada Consolidated Copper Co., operating at McGill, Nev. The milling cost given in the following table is the net operating cost, including all overhead except depreciation and taxes:

MILL OPERATIONS

	Percentage of Recovery	Lb. Copper Recovered per Ton of Ore	Per Cent of Copper in Concentrates	Milling Cost Cents per Ton	Tons Milled per Man-Shift
1918	67.28	20.26	8.33	91.3	16.7
1919	70.49	22.54	9.26	107.5	15.3
1920	70.20	20.34	8.38	96.9	17.5
1921	75.23	22.48	10.66	88.1	24.9

Total tonnage milled in 1921 was 392,645 dry tons, averaging 1.49 per cent copper, compared with 2,568,588 dry tons, averaging 1.45 per cent copper, in 1920.

The principal changes which were made to increase efficiencies included the substitution of ball mills and Dorr classifiers for rolls, screens, and hydraulic classifiers; and flotation machines and tables, instead of vanners and tables. This was described in the *Mining and Scientific Press* of Sept. 3, 1921.

Improvements to the roasting furnaces included the substitution of specially designed tile hearths for the old brick hearths. Two of the reverberatories were redesigned and rebuilt. No. 2 furnace is now 134 x 27 ft. interior dimensions, with an expected charge capacity of 780 tons daily; No. 5 is 134 x 24½ ft., of over 700 tons' estimated daily capacity. Four 1,600-hp. waste-heat boilers will be connected in parallel to each of these enlarged furnaces. Reverberatory performance for the last four years is shown as follows, in solid tons of charge per 100 sq.ft. of hearth area: 1918, 19.64; 1919, 18.21; 1920, 21.60; 1921, 21.20. Coal-dust firing continued satisfactory, the Holbeck system being used. Powdered coal is also used under the power-house boilers because of economies over the stoking system.

Fast Shaft Sinking at Oatman

Advance Per Day 8 Ft. 3 In., Working Three Shifts —Clipper Drills Used

BY W. F. BOERICKE

THE Oatman Gold Mining & Milling Co., of Oatman, Ariz., recently started a new shaft, of 17 x 7-ft. rock section, having three compartments each 4½ x 5 ft. in the clear. It was sunk on company account by hand to a depth of 46 ft., from which point sinking was continued by contract to a depth of 300 ft.

For the 254 ft. sunk under contract an average of 8 ft. 3 in. was made per day, which is said to be the fastest time ever made on a three-compartment shaft in Arizona. Work was done on three eight-hour shifts, and the advance was 2.7 ft. per shift.

The shaft was sunk in the dry all the way. The formation consisted of a rather soft andesite, which lies above the green chloritic andesite of Schrader, which is the usual ore-bearing formation. The ground broke well, but had to be timbered throughout with 8 x 8-in. wall plates and end plates, and 6 x 8-in. dividers. The shaft was lagged solid with 2 x 12-in. planks. All timbers were brought to the ground already cut and framed.

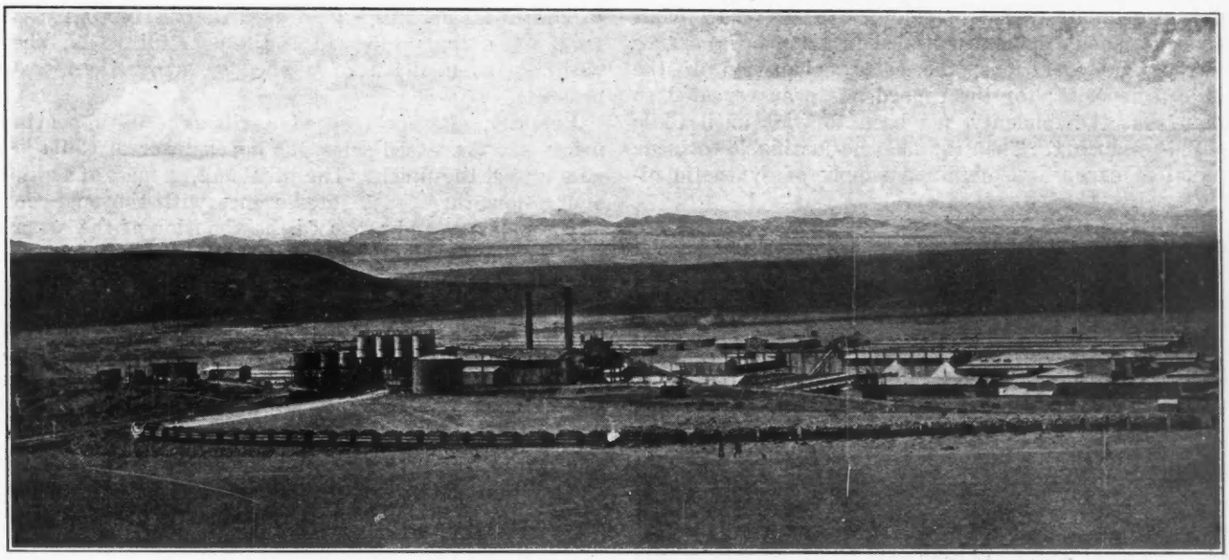
The contractors, Johnson and Burris, worked five men to a shift underground. Each shift drilled, shot, and mucked out the ground. From twenty-four to thirty holes were drilled per round, the holes averaging 6 to 7½ ft. in depth. Drilling occupied about one and one-quarter hours with three Clipper machines. For shooting, 40 per cent gelatine was used, fired by electric detonator caps with delay fuses. The entire round was drilled and shot at one time. An average of 13 lb. of powder per foot was required.

It took about forty minutes after shooting for the smoke to clear so that the men could return down the shaft. An exhaust fan, pulling through an 8-in. pipe, helped maintain ventilation.

The equipment consisted of a 40-hp. Western gasoline hoist and a 50-hp. gasoline hot-point compressor. Drills were run at 100 lb. pressure.

Under the terms of the contract, the contractors furnished all labor for breaking ground and mucking; provided their own powder, caps and fuse; placed the timbers in the shaft; and employed their hoistman and topman for dumping cars. The company provided power, timber, steel equipment, and superintendence, besides sharpening the steel. The contract price is said to have been $28 per foot.

Credit is due the contractor for this record, which was not marred by a single accident, as well as to Charles F. Pugh, superintendent in charge of the work.



Oficina Delaware—one of the few American-owned nitrate plants in Chile

The Supply of Nitrate

Mr. Ford's Proposal Calls Attention to the Vital Importance of an Adequate Supply of the Mineral in Peace as Well as in War—Chilean Deposits Are Far from Exhaustion—Synthetic Production a Problem of Economics

BY A. W. ALLEN
Assistant Editor, *Engineering and Mining Journal-Press*

THE VARIOUS OFFERS made recently to lease the Muscle Shoals installation and to complete the power plants near by have drawn attention to a matter of vital importance—the adequate supply of nitrogenous fertilizer at a reasonable price in time of peace, and the provision of explosives in time of war. It is fortunate that the development of the nitrate industry in the United States is essentially a requirement for peaceful, agricultural progress; it is merely a coincidence that the plants can be converted for the production of the basic requirement for modern warfare. Mr. Ford has approached the problem from a fresh angle; his proposals, however visionary they may appear to the majority, are economically sound; he would combine the two industries of nitrate production and manufacturing enterprise, so that each shares a common power supply, so that each is under the same capable management. One thing is certain: if Mr. Ford's offer be accepted, the undertaking will be carried out on a strictly business basis.

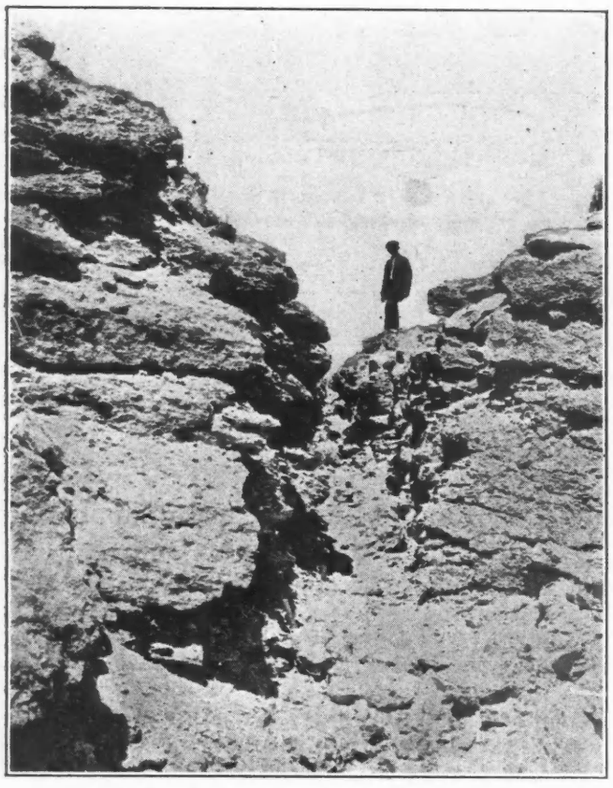
At various periods during the war it was evident that Chile was scared by the bogey of synthetic nitrate. But it was known that Germany had absorbed enormous stocks of fertilizer (?) prior to August, 1914; so that, even if the production of synthetic nitrate in Central Europe was a technical success, it was obvious that Germany preferred to be on the safe side; she had no intention of relying entirely on the output of her chemical plants. But in time the stock of natural nitrate became depleted; and, toward the end of the war, the Central Empires were dependent on synthetic products for the basis of the most important explosives. Although the results reflected great credit on German chemists and German technicians, it was obvious that the cost of production could not be reduced below a figure that was almost prohibitive. There is little doubt that the nitrate problem constituted one of the fundamental reasons on the part of Germany for the signing of the Armistice.

It is interesting to note that the Great War was won with Chilean nitrate as the basis of the explosives used by the United States and the Allies. The industry in Chile, prior to and during the war, was largely in the hands of British companies, directly and indirectly. Germany's early efforts to sink ships of the Allies that were carrying nitrate will be recalled by the recollection of the aggressiveness of von Spee off the west coast of South America in 1914; but his success was short lived. The Allies were obtaining, from Chile, all the nitrate they needed, and at a moderate cost.

Before the United States entered the war, work had been begun at Muscle Shoals in connection with the erection of synthetic nitrate plants. This indicated an urgent national necessity, for the interest that Americans had taken in the Chilean industry was almost nil. With American participation in the war the efforts to produce synthetic nitrates were increased, but with no immediate tangible result. When it became necessary to enter the conflict, the United States, with no appreciable interest in the Chilean industry and no synthetic nitrate plan in successful operation, had to make overtures to Great Britian for co-operation in the matter of a supply of a basic product that was essential to the success of her arms on land and on sea. This is how it happened that the Great War was won with Chilean nitrate.

It is unfortunate, in a way, that Chilean nitrate has been obtainable so easily in the United States. It is

also unfortunate that Sir William Crookes, the famous physicist, should have prophesied in 1898, in ignorance of the true conditions, the early exhaustion of the Chilean deposits; for the canard has been repeated so often that the tendency has been to wait until Chile ceased producing. Then it would be justifiable to incur unlimited expense to obtain a supply of synthetic ni-



Sampling channel in the "Caliche"

trate. Unfortunately for the supporters of this attitude, the Crookes' prophecy has been proved to be entirely erroneous. Vasts deposits in Chile remained untouched and unexplored. How long the industry there will continue to prosper is a matter than cannot be decided with mathematical precision; for an estimate of the total amount of *caliche* remaining would entail an enormous expenditure, which Chile, naturally, is not likely to consider as justified.

The standard technical methods in vogue on the pampa are crude, and the percentage of nitrate recovered has been absurdly low. Vast amounts of semi-treated material are available for efficient methods when the average grade of the total reserves is such that large-scale operations are indicated as imperative. Chile, secure in her monopoly of the world's supply of this fertilizer, has been obtaining the major portion of her national income from an export tax. The results have been undesirable from the economic point of view, for the nitrate operators have confined their attention to rich patches of ground, so that the ton of product, on which the duty has to be paid (ultimately by the consumer), is produced at a minimum of expense. Immense amounts of medium and low-grade *caliche* have been rejected during occasional booms, when the price of nitrate has been sent skyward by the action of the Nitrate Producers' Association—a trust that has succeeded in maintaining prices at an unreasonable level, in successful defiance of the periodic scares that arise from a fear that Chile will, in the near future, be faced with the competition of a cheaper, synthetic nitrate product.

Recently, matters reached a climax. With soaring prices and decreased sales, the government of Chile began to feel the pinch. The president, a man of ability and action, threatened interference with the operation of the industry and proposed the abolition of the export tax, the suppression of the Nitrate Producers' Association, and the sharing of all profits between the government and the operating companies. This was an eminently sensible proposal; but such a scheme was opposed by foreign capital. Nevertheless, if put into effect, it would have drawn attention to the economic waste to which the country's resources have been subjected in consequence of the profiteering tactics of the trust, as well as to the lethargy and unscientific attitude of secrecy that have characterized the actions of those in control of the technology of the industry.

The question of policy is again to the front as a result of Mr. Ford's somewhat indefinite proposal to manufacture fertilizer for the American farmer at a fair price. A recognition of the true status of affairs will act as a stimulus to economical production in the nitrate industry in both the United States and in Chile; it must inevitably lead to a lowering in price of fertilizer to the ultimate consumer.

Competition in Potash

On the subject of the competition between the German and the Alsatian potash industries in the matter of export trade, the *Journée Industrielle* remarks, according to *The Review* of the American Chamber of Commerce in France, that the Germans, and particularly the interests that work for them abroad, are trying to give the impression that the Alsatian potash fields are unable to compete successfully. Figures are cited by the Germans to show that they have 200 shafts, as against only seventeen for the Alsatians, but on the French side it is argued that, in the present conditions of the world market, the advantage in number is likely to be a disadvantage. The world's consumption of potash is not great enough to warrant full production. In round figures, the world's needs annually amount to about 1,030,000 metric tons. Deducting from this the amount needed in Germany alone, 750,000 metric tons, there remains a total of 280,000 metric tons for all other countries. Alsace alone easily can furnish all this tonnage.

The movement in the German potash industry at present is to reduce the number of exploitations and to close those mines which are not yielding a profit. By this means it is hoped to develop as desired the competition against the Alsatian mines. The Germans, however, in the method of reducing or suppressing certain mine productions, are obliged to take into account the indemnities thus necessitated.

Statistics of the shipments of Alsatian potash show 64,610 metric tons for the first quarter of 1922, as compared with 43,990 metric tons for the same period of last year, thus indicating an advance of about 46 per cent. German figures also show an increase, but it amounts to only 26.5 per cent. In 1921 the Alsatian mines exported 50 per cent of their production, whereas the German mines exported only 16 per cent of their production.

Surface-Tension Phenomena and Electrostatics

Simple Experiments That Aid in Making Clear Some of the Principles on Which the Flotation of Minerals Is Based

By Ralph H. Jarvis and Dana W. Leeke

TO UNDERSTAND flotation phenomena, a clear conception of fundamental physical principles is necessary. Quoting from Kimball's "College Physics":

"Attraction and Repulsion.—When the liquid rises around floating bodies they are drawn together as soon as they are near enough for the curvature of the surface due to one to affect the other. Notice how small floating pieces of wood or coke cling together as soon as they are wet, so also bubbles in a cup of cocoa cling together, and are also drawn to the sides of the cup where the surface curves up.

"If the cup is filled to the brim and enough added to make the surface curve down slightly at the edges, the bubbles will at once rush away from the edge.

"Bodies which are not wetted and around which the surface curves down are also drawn together, but are driven away from bodies around which the surface curves up.

"Explanation of Attraction of Floating Bodies.—When two small floating objects are both wetted the liquid rises higher between them than it does on the outside, as shown in the upper part of Fig. 147 [Fig. 5 in this text], and since the pressure at any point in the liquid higher than the level surface is less than the atmospheric pressure, the pressure on the outside is greater and they are forced together.

"In the second case the liquid stands higher around the floating bodies on the outside than it does between them, and since the pressure in the liquid at points below the level surface is greater than the atmospheric pressure, they are pushed toward each other in this case also.

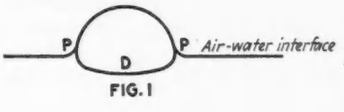


FIG. 1

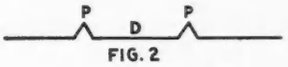


FIG. 2

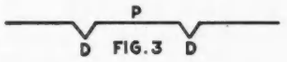


FIG. 3

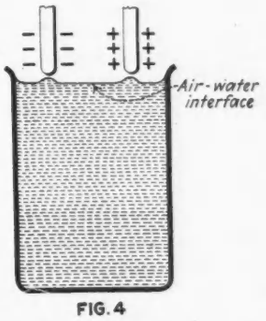


FIG. 4

"But when the liquid wets one and not the other, the surface is lowered on the inside of the wetted one and raised on the inside of the other so that in each case the pressure on the inside is greater than on the outside and the two are urged apart."

If a vertical plane were passed through the center of a bubble floating at the air-water interface, the result would be a combination of two projections and one depression, as illustrated in Fig. 1. Strips of zinc, tin, gold, and molybdenite, 1 cm. long and 1 mm. wide, of various thicknesses, were used to demonstrate that, regardless of chemical composition, substances forming depressions on the surfaces of water attract each other, and also substances forming projections of water on the surface of water attract each other.

Experimental Procedure Simple

The metals were prepared as films. With care, bend slightly 1 mm. from each end, strips of zinc, tin, gold and molybdenite, and place them on the surface of water as represented in Fig. 2. Fig. 2 is a combination

Fig. 5. Illustrating attraction and repulsion

of two projections and one depression, and exhibits many of the properties possessed by a bubble. The strips of metal attract each other, and may rest either as a continuous straight line, with projection attracting projection, or lie parallel to each other with projection attracting projection and depression attracting depression.

If the strips are floated as illustrated in Fig. 3, they are not attracted to the meniscus. Force one of those which forms a complete depression on the surface of water to the meniscus with a glass rod. When released from the pressure of the glass rod the floating object immediately recoils from the meniscus of the beaker.

Zinc shavings, 1 cm. long, floated as illustrated in Fig. 2 on the surface of the solution in zinc boxes, are attracted by hydrogen bubbles. The impact between the zinc shaving and the hydrogen bubble is sufficient, at times, to cause the bubble to break. Transfer froth bubbles from a thickener in a cyanide plant to a clear electrolyte, and place a zinc shaving as illustrated in Fig. 2 in the near proximity of the bubbles. The zinc shaving is immediately attracted. Substances which, when placed upon the surface of water, form a complete depression as in Fig. 3 are repulsed from bubbles at the air-water interface.

It is difficult to float either metals or sulphides on ethyl alcohol or oils, but what experiments were possible demonstrated that, as with water, substances forming projections attracted each other, and substances forming depressions attracted each other, regardless of their chemical composition.

Below is outlined a method of studying the effects of over-oiling at the air-water interface. By using tin foil, prepare a combination of two projections and one depression as in Fig. 2 and place it carefully on a beaker partly filled with water. The tin foil is immediately attracted to the meniscus of the beaker. Add just sufficient wood creosote to form a film on the surface of the water. Then withdraw the tin foil from the meniscus, and release it. It is reattracted to the meniscus, but the impact with which it strikes the beaker has decreased in intensity. On increasing the thickness of the film of wood creosote, the movements

of the tin foil become dormant, as compared with its movements on distilled water.

In a recent issue of the *Mining and Scientific Press* a contributor suggested that an impact method of measuring surface tension would be of service. It should be feasible to devise an impact method of measuring surface tension by employing a combination of two projections and one depression.

What function have projections and depressions in flotation? The attraction of bubbles for each other, or the attraction by bubbles for any substance forming projections at the air-water interface, must be considered in any theory of flotation. Perhaps in performing analytical work many chemists and assayers have been troubled with molybdenite and graphite particles clinging to the meniscus of casseroles.

PHENOMENA OF ELECTROSTATICS

A hard-rubber rod, if rubbed vigorously with wool, possesses a minus charge of static electricity; and a glass rod, if similarly rubbed with silk, possesses a positive charge. If a hard-rubber rod is not obtainable, use a fountain pen.

If either a minus or positive charge of static electricity is placed in the vicinity of a bubble floating at the air-water interface, the bubble is attracted. Place either a negative or positive charge of static electricity in the vicinity of any substance which forms a projection on the surface of water, and an attraction is noticed. If the substance forms a depression on the surface of water it is apparently repulsed by either minus or plus charges of static electricity. The same phenomena may be seen with the strips already mentioned, used as in Figs. 2 and 3.

A particle of mercury, if placed upon the surface of water, is apparently repulsed by either positive or negative charges of static electricity. At the air-water interface, the majority of molybdenite and graphite particles are seemingly attracted by either plus or minus charges of static electricity.

To observe the effects of electrostatic action, watch the surface of water carefully while either minus or plus charges of static electricity are brought near. Either will form a slight projection on the water, as illustrated in Fig. 4. Therefore, any substance which forms a projection, or lies in a zone of high pressure, is attracted seemingly by either minus or plus charges of static electricity. Similarly, any substance which forms a depression or lies in a zone of low pressure at the air-water interface is repulsed.

We wish to thank Walter L. Gibson for many thoughtful suggestions.

Operations of the Superior & Boston Copper Co.

The quarterly report of the Superior & Boston Copper Co., for the three months ended March 31, 1922, states that during this period 2,927 tons of ore was shipped, averaging 4.20 per cent copper and 7.66 oz. of silver per ton. This contained 246,072 lb. of copper and 22,425 oz. of silver. All of the ore was shipped to the International Smelter, at Miami, Ariz. In addition to this, one car of silver ore was shipped to the El Paso smelter, which contained 1,911 oz. of silver. The remainder of the report is concerned with mine development.

The New Candelaria Mill

The Candelaria properties first flourished in the late 60's, but comparatively recent discoveries of new orebodies, and metallurgical developments which have made ore out of what was once waste, have led to the construction of a new 300-ton milling plant, with reserves already developed sufficient to supply it for five and a half years. Most of the ore that it is proposed to mill averages from 8 to 14 oz. of silver per ton, and a dollar or less in gold.

Tests made by J. A. Carpenter, according to the annual report of the Candelaria Mines Co. for 1921, indicated that an extraction of about 84 per cent can be made on Lucky Hill ores by fine grinding, cyanidation, and filtration, and 5 per cent lower extraction by the same method on the Northern Belle and Holmes ores. Tests also demonstrated conclusively that chloridizing with salt was beneficial. Sixty per cent, or more, of the silver in the ore is in the form of chloride, or finely divided sulphide, and cyanidation tests on the raw ore, when ground to 12 mesh, showed that this silver is extracted rapidly with small consumption of cyanide.

In the new mill, the ore will be brought from the mine in electrically hauled trains to a double crusher-bin, keeping separate the high- and medium-grade ore. It will be crushed dry to one-half inch, using a gyratory, screens, and rolls, and will be conveyed by belt to a double-compartment mill bin. The mill-bin feeders will deliver it to two 6 x 5-ft. Union Iron Works ball mills operating in closed circuit with Dorr classifiers and crushing in cyanide solution. The ore will be ground to pass 30 mesh, and separated into two products by Dorr bowl classifiers. The slime, which should be not more than 33 per cent by volume, will be agitated, decanted, and filtered, using standard Dorr and Oliver equipment. The sand will be leached in vats.

All high-grade ore will receive a chloridizing roast after cyaniding, and be recyanided, whereas the medium-grade ore will be sent to waste after the first cyanide treatment. The entire plan is based upon accepting a comparatively low recovery of silver from the medium-grade ore, but having a process so low in cost that the net result will be as if the more expensive process were used and a higher recovery of silver secured. At the same time the mill is designed so elastically that the high-grade ore can receive a further treatment if necessary.

With little additional equipment, the mill could treat 500 tons, for all of the larger machines, together with the conveying and transmission machinery, pipe lines, pumps, and slime plant, are considerably oversize, according to the report.

The estimated unit operating costs are as follows, the basis being 108,000 tons per year:

Mining, including timbering	$1.75
Tramming to ore passes	0.20
Mucking and drawing	0.34
Mule haulage	0.07
Electric haulage	0.05
Reduction, including refining	2.00
Marketing bullion	0.05
Office, superintendent, and general expense	0.28
Taxes, insurance, administration expense	0.23
Royalties	$0.75 and 0.37
Development	$0.20 to 1.25
Roasting	1.50
Recyanidation	0.60

The average mill feed is estimated to run about $11.20 per ton, the average recovery 67 per cent, the average operating cost $4.40 per ton, and the operating profit $350,000 per year.

Marketing of Sulphur

A Raw Material That Is a Constituent of, or a Necessary Reagent in the Manufacture of, an Unusual Variety of Articles—Domestic Production from Texas and Louisiana —Capacity Exists for Over-Production—New Uses Sought

By Albert G. Wolf

More than 99 per cent of the sulphur mined in the United States and 75 per cent of the world's production comes from three mines on the Gulf Coast. In the order of their present and probable future importance as sulphur producers these are the Texas Gulf Sulphur Co., Matagorda County, Tex.; the Union Sulphur Co., Calcasieu Parish, La.; and the Freeport Sulphur Co., Brazoria County, Tex. These three mines supply practically all the sulphur used in this country. In this article the word "sulphur" is used to designate crude sulphur or brimstone, and not sulphur produced from sulphides of metals. Wherever tons are mentioned in connection with sulphur the unit of weight is the long ton or 2,240 lb.

Uses of Sulphur Are Many

It is no exaggeration to say that sulphur is a constituent of, or a necessary reagent in, the manufacture of a large proportion of the articles in common use today. The average man does not suspect that sulphur is a raw material in the making of the paper of the magazine he buys, the coloring matter, glue, and photographic reproductions required; of the motor fuel, lubricant, tires, and upholstery of the car he drives; of the leather in his shoes, the paint on his house, the galvanizing of its screens, the dye in rugs, the soap he washes with, the preservatives in his foods, the fertilizers that helped grow his foodstuffs, and the glassware on his table.

The list in Table 1, though probably far from complete, gives a good idea of the multiplicity of specific uses of sulphur. Every item either contains sulphur or requires sulphur in its manufacture.

TABLE 1.—LIST OF PRODUCTS IN THE MANUFACTURE OF WHICH SULPHUR IS REQUIRED

Acids, organic and inorganic	Hose
Alum	Insecticides
Aniline	Leather
Artificial silk	Livestock food
Belting	Lubricating oils
Binding medium	Matches
Bleaching materials	Medicine
Celluloid	Paints
Cements	Paper
Chemicals (miscellaneous)	Photo supplies
Dyes	Plastics (wood pulp)
Ebonite	Poison (rat and other)
Elastics	Preservative for food
Explosives	Reagents, laboratory
Fabrics	Rubber products
Fertilizers	Shoe polish
Films, moving picture	Soap
Fire extinguishers	Sodium thiosulphate
Fireworks	Steel (pickling)
Fumigating reagents	Storage batteries
Fungicides	Sugar
Gasoline	Textiles
Galvanized iron	Tires
Glue	Weed killer
Glycerine	

The industries that use sulphur most are those which burn it to form sulphur dioxide, and employ that gas in their operations. These account for 75 per cent of the sulphur consumption in this country; the principal ones are the sulphuric acid, paper, chemical, and fertilizer industries.

The industries, in the order of their importance, that purchase sulphur as a "raw material" are:

1. Acid phosphate.
2. Paper.
3. Chemicals (other than sulphuric acid).
4. Sulphuric acid (other than for industries enumerated in this list).
5. Agriculture (other than acid phosphate).
6. Rubber.
7. Galvanizing.
8. Explosives.

This order, of course, is subject to change from time to time; and data for a more detailed tabulation of the sulphur-using industries are difficult to obtain. Furthermore, some of the industries are so interrelated that it is difficult to segregate the figures of consumption. The manufacture of sulphuric acid, under Item 4 above, is by far the most important sulphur-consuming industry in the United States.

Geographic Distribution of Consumption

Gulf Coast sulphur is practically without a competitor, at the present time, in the United States; and it is acquiring a foothold in the European market, despite the much more favorable geographic location of the Sicilian deposits. Today the Sicilian mines are supplying chiefly only those countries bordering on, or readily reached from, the Mediterranean Sea.

Sulphur is sold to consumers in almost all the eastern and southeastern states, most of the central, and some of the western states; likewise in several provinces of Canada and states in Mexico. In the United States, by far the largest proportion is sold east of the Mississippi River. The major buyers may be divided roughly into three groups: The paper manufacturers of the New England states and eastern Canada, the chemical manufacturers of the eastern states, and the acid phosphate manufacturers of the southeastern states.

Lesser groups consist of the various industries of the Great Lakes region; the zinc, powder, and chemical companies of the central states; the powder, pulp, and spray manufacturers of the Pacific Coast; and various industries of British Columbia. Some shipments reach South Africa, the Hawaiian Islands, and Australia.

The Mines Are the Principal Marketing Points

The primary marketing points are the three mines. From these, shipments are made directly to consumers. Secondary marketing points are the Gulf ports of Galveston, Texas City, and Sabine, from which shipments are made to various foreign countries; and the Atlantic Coast ports, whence shipments are again made by rail.

The three primary marketing points are Gulf and Freeport, in Texas, and Sulphur, in Louisana. Gulf is served by a short private branch railroad, connecting with the Gulf, Colorado & Santa Fe R.R. Sulphur is served by two railroads, the Southern Pacific and the Kansas City Southern. Both of these railroads are connected with the mine by the Union Sulphur Co.'s subsidiary, the Brimstone Railroad & Canal Co. This

meets the Southern Pacific at Brimstone Junction, one mile south of Sulphur, and the Kansas City Southern at Lockport Junction, six miles east of the mine. Freeport is on the Houston & Brazos Valley Ry., which connects with the International & Great Northern and the St. Louis, Brownsville & Mexico.

The secondary points of shipment are Sabine, Tex., from which port the Union Sulphur Co.'s sulphur is exported; Texas City and Galveston, where sulphur from the Texas Gulf Sulphur Co. and the Freeport Sulphur Co. is loaded for foreign export or for the water haul to the Atlantic ports; and Freeport itself. At the latter port, however, full cargoes cannot always be loaded, on account of the shallowness of the Brazos River. On the Atlantic Coast the chief distributing points are New York, Baltimore, Portland and Searsport, Me., and Quebec, Que.; on the Pacific Coast, Portland, Ore., and Vancouver, B. C.; and in Europe, Marseilles, Manchester, Hamburg, and Gothenburg. At present the Texas Gulf Sulphur Co. is building at Galveston concrete storage bins, of 30,000 tons' capacity, and loading equipment capable of placing a steamship cargo on board in eight hours.

Probable World Consumption 1,000,000 Tons per Year

In the past the annual consumption of sulphur has been variable. As only three years have passed since the war, three abnormal years, and as complete statistics are not yet available for 1921, it is difficult to form an estimate of future requirements. It is probably safe to say that the normal consumption in the United States and Canada will be 750,000 tons per year, and by the rest of the world 250,000 tons of Coastal sulphur.

The fluctuations in the demand for sulphur are of two kinds, yearly and seasonal. The former is influenced chiefly by general business conditions. A good idea of this yearly fluctuation is obtained from Table 2, adapted from *Mineral Industry*, Vol. 29.

TABLE 2—STATISTICS OF SULPHUR PRODUCTION

	Production in Tons				
Year	World	United States	Domestic Shipments	Gross Value	PerTon Value
1909	804,690	273,983	258,283	$4,783,000	$18.52
1910	775,286	247,060	250,919	4,522,000	18.02
1911	764,358	205,066	253,795	4,573,000	18.02
1912	773,436	287,773	305,390	5,289,000	17.32
1913	793,645	491,080	319,333	5,614,000	17.58
1914	863,143	417,690	341,985	6,214,000	18.17
1915	846,412	520,582	293,803	3,955,000	13.46
1916	1,199,842	649,683	766,835	12,247,000	15.97
1917	1,548,023	1,134,412	1,120,378	23,987,000	21.41
1918	1,655,629	1,353,525	1,266,709	27,868,000	22.00
1919	(a)	1,190,575	678,257	10,252,000	15.12
1920	(a)	1,255,249	1,517,625	(a)	(a)

(a) Statistics not available.

Statistics for 1921 undoubtedly will show an increase in domestic production over 1920, and a considerable falling off in consumption. The above table shows an accumulation of sulphur in the United States, with the exception of the years 1916 and 1920. At present the available supply in stockpiles is approximately 2,000,000 tons.

Seasonal fluctuations in demand are not great except in a few industries. The most important of these is the paper-pulp industry. Many of the mills accumulate their supply during the summer months because of the closing of navigation later by ice. Acid-phosphate manufacturers take between 15 per cent and 20 per cent of the total sulphur mined in the United States; as their product is sold largely during the early spring months, their manufacturing season, and consequently their purchasing of sulphur, is most active in the fall and winter months.

Product Is Almost Pure

Sulphur producers today might safely guarantee to deliver sulphur that is 99.7 per cent pure on a moisture-free basis. As a matter of fact, most of the sulphur sold is even more nearly pure than that. Impurities usually considered are moisture and ash, and sometimes oil. Their influence may be summarized as follows:

Moisture.—No claim is made by the buyer on account of moisture unless it runs more than 0.5 per cent, and then only for weight. Most crude sulphur is sold on a basis of 99.5 per cent pure if moisture-free.

Ash.—This varies from 0.01 per cent to 0.03 per cent, as compared with over 5 per cent[1] in some of the Sicilian sulphur. This minute quantity in no way interferes with the burning quality of the sulphur, and in fact is too small to be considered even when ground sulphur is used directly in various industries.

Oil.—This may be present in the sulphur in quantities varying from a trace to 0.2 per cent. The higher percentage is quite uncommon and is present only in the first sulphur from a new field. Most sulphur, as produced, contains from 0.01 per cent to 0.04 per cent of oil, and this amount does not cause any trouble in burning. When from 0.1 per cent to 0.2 per cent oil is present, the sulphur burns with difficulty in the stationary type of burner, for the oil unites with the sulphur, forming an asphaltic film over the surface that extinguishes the flame.[2] In the rotary and cascade types of burners, it is stated, sulphur containing up to 0.2 per cent of oil can be burned.

Little crude sulphur is sold under specifications requiring special sizing. When it is, simple screening is employed, and the product is shipped in bulk in carload lots or in sacks. Sacked sulphur is sometimes ordered if there are no unloading facilities at the port of debarkation.

Color Not a Reliable Guide as to Purity

Some customers prefer light-colored sulphur. This has its origin in the fact that sulphur containing oil is sometimes of a dark shade. It is not safe, however, to judge the purity by the color alone, for a fairly dark-colored piece may be purer than one of a lighter shade.

No attempt will be made here to discuss in detail the methods of refining sulphur, but this article would not be complete without a brief description of some of the kinds of treated sulphur.

Commercial Flour Sulphur.—This is run-of-mine sulphur that has been ground and sized. Good-grade commercial flour sulphur should contain at least 95 per cent of minus 100-mesh material, and a good percentage of minus 200 mesh. This is used wherever sulphur dust is required; for example, in dusting fruit trees and vines to kill fungus growth, mildew, and for similar purposes; for treating soils to check the growth of potato-scab fungus; in making insecticide powders, and fertilizer mixtures; in cattle and sheep dips; in live-stock salts; and in "conditioning powders" for hogs.

Commercial flour sulphur is usually shipped in burlap sacks containing about 100 lb. net. The sacking is either double or single.

[1] "The Production of Sulphur and Pyrite in 1910," by W. C. Phalen, *Mineral Resources*, 1910, U. S. Geological Survey.

[2] "Recent Advances in the American Sulphur Industry," by Raymond F. Bacon and Harold S. Davis, *Proceedings*, A. I. C. E., December, 1920.

Flowers of Sulphur.—Sulphur sublimed in a room of large volume and caught in the dust form. This is practically 100 per cent pure, or about the same degree of purity as the best crude. It is used largely for medicinal purposes, and in France for dusting grape vines.

Roll Sulphur.—Sulphur that has been vaporized and caught in a small hot receptacle in the molten state and then cast into sticks. This is used in fumigating houses, ships' bottoms, and wine casks. Roll sulphur is shipped in barrels of 333 lb.

An especially fine sulphur is called "superfine," referring to mesh, not purity. This may be either superfine commercial or superfine refined.

Other forms of ground sulphur are those for use in the petroleum industry, in the treatment of food products and in the rubber industry. For the petroleum industry the sulphur must pass a 60-mesh screen. For treating food products, such as nuts and dried fruits, the sulphur is usually ground refined—*i.e.*, either ground roll sulphur or ground concretions that form in the subliming chambers in the making of flowers of sulphur. The rubber industry requires a finely ground product containing a minimum of impurities and with a maximum of solubility in carbon bisulphide. Rubber-goods manufacturers have different requirements as to fineness, purity, quality (whether refined or not), solubility, or other characteristics. Sulphur for this industry, whether refined or not, must be cooled slowly in large receptacles and allowed to "cure" for some time, so that the crystals will assume the orthorhombic form, to meet the requirements of solubility.

Shipments Vary Widely as to Size

Shipments of crude sulphur are made in any quantity. They vary in size from special lots of a few hundred pounds, shipped in sacks, to lots of several carloads and even whole steamship cargoes. Generally speaking, the minimum car lot is the smallest shipment made. The amount shipped in sacks is almost negligible.

Sulphur is sold by the long ton of 2,240 lb., f.o.b. mines or ex vessel Atlantic seaboard. Export sulphur is largely sold f.o.b. Gulf ports.

Problem Is to Enlarge the Market

The great marketing problem of the sulphur producer is to find an outlet for a sufficient tonnage of his product to permit operating at a profit when selling at a price per unit that will make the crude sulphur more desirable than pyrite. The potential production of the Gulf Coastal mines is 2,500,000 tons per year, whereas the actual production, at present, is not over half that. In the near future the largest annual consumption of American sulphur, both domestic and foreign, that can be expected is approximately 1,000,000 tons.

In addition to this main problem each producing company has its own individual problem in obtaining its share of the sulphur trade without resorting to "cut-throat" tactics, which would lead to the undoing of all of them. The market is not influenced by middlemen, because almost all crude sulphur is sold directly by the producer to the consumer.

The one great influence on the price of sulphur, in addition to the general demand, is the price of pyrite. Sulphur is in direct competition with pyrite in the acid-making industry of the United States and Europe and in the paper-pulp industry of the Scandinavian countries. One-half the 1,000,000 tons sold in this country in 1920 was used in sulphuric-acid manufacture. It is possible that sulphur from the United States may replace pyrite to a greater extent than at present in the manufacture of sulphuric acid in Europe.

Price Range

The price of sulphur from 1909 through 1915 was about $18 f.o.b. mines and $22 ex vessel New York. During the war sulphur sold as high as $35 in New York and quite generally for $22 at the mines. This unusual difference was due to the necessity of shipping by all-rail routes. In 1919 the price dropped to $15 to $16 at the mines, and $20 at Atlantic ports. At the present time the price is about $14 to $16 f.o.b. mines per ton of 2,240 lb., and $18 to $20 ex vessel, Atlantic seaboard. This is much below the pre-war average, and the post-war price shrinkage is considerably greater than the average of other basic raw materials.

In addition to the influence exerted by the price of pyrite, the price of sulphur is naturally influenced by general demand, but to a lesser extent. The amount of sulphur sold, rather than the price, is an excellent barometer of industrial conditions because of its widespread use.

Price is not influenced by quality, because, as already pointed out, all sulphur, as produced on the Gulf Coast, has much the same quality; it is pure enough to meet the most exacting specifications for crude sulphur.

Table 2 shows the yearly average price of sulphur from 1909 to 1920. These figures were computed from the United States shipments and total values given in *Mineral Industry.* The price for 1915 seems low and that for 1919 abnormally high. Statistics for 1921 are not yet available.

Table 3, from *Mineral Industry,* Vol. 29, gives the exports and imports of all classes of sulphur of the United States, and shows clearly that foreign competition has no influence on the price in this country now.

The efficient methods of production which have enabled the American producer to compete successfully with pyrites, both domestic and Spanish, in certain industries, have also made it possible to invade to an increasing extent the European market, formerly supplied entirely by the Sicilian mines.

The portion of the United States in which domestic sulphur is most likely to be compelled to meet successful foreign competition is the Pacific Coast. Prior to the war, Japan supplied this territory, and sold sul-

TABLE 3—SULPHUR EXPORTS AND IMPORTS OF THE UNITED STATES

Kind of Imports	1916		1917		1918		1919		1920	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Crude	21,510	$364,787	973	$20,176	55	$1,692	77	$1,997	46	$1,722
Flowers	425	18,408	.....	.....	.....	.....	.....	.....	.....	.....
Refined	455	15,020	.....	.....	.....	.....	.....	15	50	2,530
Precipitated	66	12,940	37	9,164	27	7,850	24	6,621	42	22,576
Total	22,456	$404,784	1,010	$29,340	82	$9,542	101	$8,633	138	$26,828
Exports	128,755	$2,505,857	152,736	$3,500,819	131,092	$3,626,638	224,712	$6,325,552	477,450	$8,994,350

phur in San Francisco and Portland for as low as $17. It is rumored that the Japanese producers will again invade the Pacific Coast states and western Canada, and if, with her cheap labor and low ocean freight rates ($3 to $4 per ton), they can duplicate their pre-war prices, the domestic producer will be compelled to reduce his present prices, which are about $24 at Pacific Coast points. Railroad rates from the Gulf States to San Francisco are excessive, being about $17 per long ton, and the ocean freight rate is $8 plus terminal charges at ports of unloading and loading. On the other hand, the Japanese market is protected by a high tariff. Nevertheless, the lowest-cost producers in the Gulf Coast region may attempt to export to Japan in competition with the sulphur produced in that country.

The Mineral Resources of Ireland

Old Workings, Now Abandoned, Indicate Possibilities of Metal Production—Chief Wealth in Non-Metallics

By E. P. Rathbone

WITH possibly the exception of coal, the mineral resources of Ireland are equal to, if not superior to, those existing within Great Britain, but they have never been systematically exploited, and when prospecting has been carried out it has always been impeded by want of capital and scientific and practical knowledge wherewith to conduct such operations. In the early 60's there was a regular "boom," but, as usual, the company promoters, not the miners, got the money, and the subscribing public received the usual beautifully designed share certificates with which they could paper their walls.

The geological conditions in Ireland, which are largely represented by the older or Paleozoic formations, from the Carboniferous to the Silurian and even more ancient formations, are found in all the wild mountainous districts. It is in these formations that a small amount of prospecting work was done, most of it in a desultory manner, in past ages, dating back even to those romantic days when shields of the knights were made of solid silver and crowns of Irish kings of gold, and there were mints for making money. Then surely it was not poor old Ireland! At another period there were large iron works, and even at this present day bog iron ore is mined and used largely as a gas absorbent. There is some excellent hematite ore in the northern counties, so good that the Barron Haematite Co. at one time worked it, but the lack of cheap transport caused its abandonment. What Ireland wants is economic road and rail transport to its ports, especially in the west and south of Ireland.

Probably the richest mineral regions are to be found in Wexford, in the vale of Ovoca, where mining has long been carried on and where large quantities of low-grade 2½ per cent copper ore are to be found, which under certain economic conditions could be made to pay well. Then there are the counties of Waterford and Cork, and all through them, scattered about and even extending to the beautiful mountainous districts of Kerry, Killarney, and especially Galway, Tipperary, and Limerick, old mining operations for silver, lead, copper pyrites, barytes, and even cobalt and nickel, and valuable silver ores such as tetrahedrite, are found in many places. I have personally made several examinations in these districts, but to prevent unfair company promotion I have invariably condemned where I should at least have been glad to recommend some thoroughly systematic prospecting work, especially with boreholes.

It is not, however, in resources of gold and silver that Ireland can achieve commercial prosperity. This rather might be revived in the exploitation of the earthy minerals, which abound there and are of great commercial value. In Antrim and Clare counties, besides coal, there are valuable deposits of steatite and infusorial earths, of pure silicate of alumina, and other earths used in making soaps, polishing materials, lubricants, and so forth. Most important of all are the best fireproof clays, non-conductors of heat, such as are used for linings in fireproof safes; also, phosphoric earths, and, probably, in the rocks of Achille Island and Galway, unusually pure quartzites and other silicates with high percentages of alumina, and more than a suspicion of the presence of nickel in commercially valuable and extractable quantities.

With regard to ornamental stones, there are some of the most beautiful marbles, of the best polishing character, and even gems and other polishing ornamental crystallized rocks, onyx, and agates. All this potential wealth is absolutely neglected. Besides the steam coal, there is also anthracite of good quality.

The Irish mineral districts properly worked by mining engineers with sufficient capital behind them would yield well, I am certain, and would go far to supplement the country's wonderful agricultural and fishing industries.

Copper Smelting at Braden in 1921

During 1921 the smelter of the Braden Copper Co., in Chile, operated only about one-half of each month, according to the annual report of the company. The remainder of the time the force worked principally on miscellaneous construction. Nodulizing operations for 1920 and 1921 were as follows:

	1920	1921
Total net tons material nodulized	128,598	57,711
Total nodulized per kiln-day	114.6	104.7
Gallons oil per net ton material nodulized	12.68 (*a*)	11.87 (*b*)

(*a*) Includes equivalent of 2,208 tons coal used. (*b*) Includes equivalent of 597 tons coal used.

Only one blast furnace, cut to a length of 28 ft., was operated during the year. Data covering this furnace are as follows:

	1920	1921
Tons concentrate smelted	178,009	56,190
Raw concentrate, per cent of total	28.3	8.99
Nodulized concentrate, per cent of total	71.7	91.01
Net charge smelted, tons	224,243	65,609
Per cent coke on total charge	13.0	11.3
Per cent coke on concentrate smelted	16.4	13.2

The coke to concentrate ratio was the lowest on record, particularly during the last five months, when the percentage averaged 10.4. This was because of a higher percentage of nodulized concentrate smelted, and because of less gangue in the material.

The matte produced at times ran as much as 65 per cent copper, which made converter operation more difficult, but a higher air pressure and a purer silica flux are expected to help to correct this condition.

The four-mile aërial tramway from Sewell to Calestones was put into operation in January, 1922, during which month the new Calestones smelter was given a trial run.

USEFUL OPERATING IDEAS

Distributing Granular Material in Drainage Vats

Some Equipment of Butters-Mein Type Faultily Designed—Arrangement and Length of Delivery Pipes Important

BY A. W. ALLEN

THE Butters-Mein distributor, the patent for which expired long ago, was designed originally to deliver battery pulp evenly in a leaching vat. A fairly close separation of sand from slime was made; the vat was arranged with an annular launder and so remained full of water at all times, the finer material escaping with the excess liquor over the periphery; or it was equipped with a vertical side overflow, which could be raised by means of slats, added so that the level of the pulp in the vat was always just above the level of the deposited sand.

The use of a distributor of this kind is finding application for purposes other than that for which it was designed originally, more particularly in connection with the primary dewatering of granular material. Faulty design of such equipment prompts the publication of these notes. In this connection it is customary to use circular vats of concrete or steel, equipped with a porous bottom of cocoa matting. The top of the vat is provided with an annular launder, which serves to carry away the excess water and a small proportion of fine material, if such be present; this must be recovered by other means. The amount of such fine material escaping with the overflowing liquor may be reduced to a minmum by simply delivering the pulp to the center of the vat, thus allowing maximum time for settlement of solids before the liquor reaches the overflow. The disadvantage of this procedure is seen in imperfect and uneven drainage, because the material deposited near the center is coarse, whereas that nearer the edges is fine. Hence an attempt to dewater further, after gravity drainage, by the application of a vacuum underneath the bottom support, will be ineffective, for the suction will act only on the moisture associated with the coarser material.

The Butters-Mein distributor delivers the solids in such a way that even drainage is assured. It is important, however, that the position and length of the delivery pipes be calculated so that each supplies an equal area of the vat, although it may be found desirable to arrange the outermost one to deliver at a point slightly nearer the center than shown by calculation. The number of pipes adopted depends on the size of the vat and the flow of pulp, better results being obtained when they are operated full bore. To calculate the correct length of the pipes, assuming that they are all of the same diameter, a plan of the vat is marked with concentric circles, arranged so that the entire surface is divided into as many areas as there are pipes, which are then placed to deliver, through a flattened nozzle, midway between the division lines. They are grouped so that the weight is distributed as evenly as possible and so that the apparatus revolves easily, as a result of the impingement of the pulp on the bends or elbows just before the nozzles are reached. If the distributor be designed correctly it will be found that the concentrate or other material in the vat after drainage is of even texture and composition throughout. The application of a vacuum underneath the porous bottom will permit drainage of the maximum amount of associated water. This will facilitate subsequent handling and help to reduce freighting costs.

The discharging of such material can be performed cheaply by mechanical means. The Blaisdell excavator is being used extensively for this purpose. This machine plows the semi-dry sand toward the center of the vat, which is equipped with a bottom-discharge door of the type usually found in cyanide plants.

Notes on Quincy Mining Co.'s Practice

BY HENRY M. PAYNE

FROM his studies over a period of years, C. L. Lawton, general manager of the Quincy Mining Co., in northern Michigan, has determined the percentage of work which annually passes through the carpenter shop, machine shop, blacksmith shop, drill sharpening room, and rock house, and has built these buildings in series from the shaft house, all of fireproof construction, with tracks and traveling crane passing longitudinally from one end to the other.

To secure accurate costs on drill steel, a set of new bits is weighed when issued to a contractor and again when the work is finished, the loss from wear and sharpening on the job thus being determined.

Each set of bits, when sharpened, is placed through an iron ring and fastened with wooden wedges, thus facilitating handling in sets, and avoiding loss.

Old drill steel, when brittle from crystallization, is cut into 5-in. pieces and used in the ball mills.

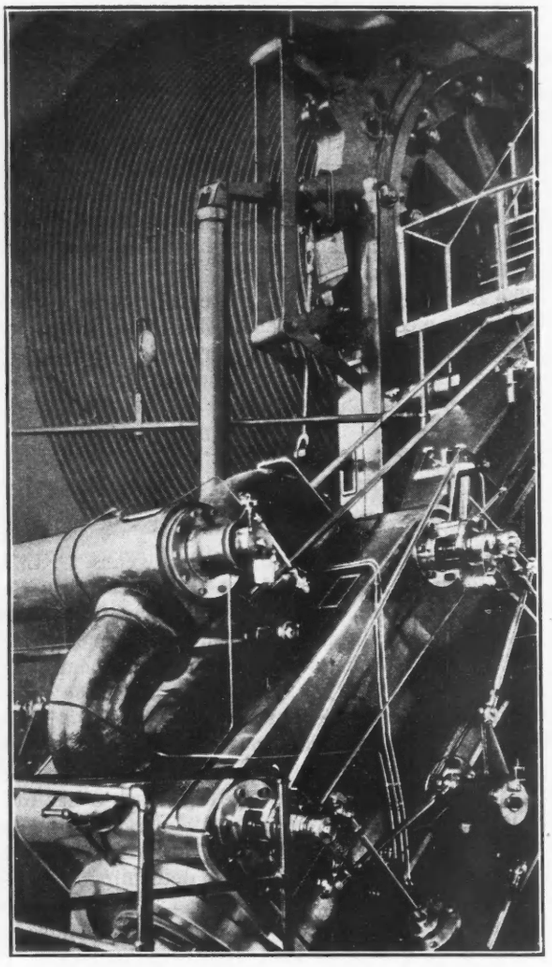
Side-dump cars are used at the Quincy mines. The same cars may thus be used for either poor rock or ore, sent into the mine either end foremost, and dumped either to the right or left, according to the contents.

General practice in this field removes 60 per cent of the ore in advancing, and 20 per cent more on retreating.

The Quincy ore is crushed to 3-in. size at the mine, passes to the stamps at the mill and over $\frac{5}{8}$-in. Cromwell screens into duplex trommels. Everything under $\frac{1}{8}$-in. passes into the mill. Everything over $\frac{1}{8}$-in. and under $\frac{1}{4}$-in. is jigged separately. Sizes over $\frac{1}{4}$-in. go to the crushing rolls and back to the trommels for sorting into $\frac{1}{8}$-in. and $\frac{1}{4}$-in. sizes respectively, as above. All coarse sands, above the slimes, go into the ball mills, discharge to the Dorr classifiers, and thence go to the tables. The tailings, in turn, from the tables go back to the ball mills.

All the tailings from the various clean-up tables go

to the main unit launder for that unit. Each launder has a specially designed automatic sampler which takes out six tons in twenty-four hours. The sample is cut down by a Byzant sampler to about 100 lb. and this is ground up in the laboratory and cut down for a test on each shift. The remainder of the six tons is put on a telltale table smaller in size (to conserve floor space), but identical with the others. The tailings go to the tailings launder, and the concentrates are flushed



Brake mechanism on giant hoist of the Quincy Mining Co.

out as desired by the foreman or superintendent. All the tables are erected on concrete piers, two for the table and one for the head motion.

The Quincy mill has glass sides and low-hung electric lights over all the tables, so that there is no glare, and the exact operation can be clearly followed at all times.

The Hoist at No. 2 Shaft

The compound steam hoisting engine of the Quincy Mining Co. at that company's No. 2 shaft on the hill above Hancock, Mich., is the largest hoist in the world. In operation for a little over a year, it has already shown an annual saving of $2,500 in coal consumption, although operated at only 56 per cent of its capacity. The drum is of the double-conical type, built up of forty-eight sections, bolted and trussed, and weighing 258 tons, unmounted. Its capacity is 13,300 ft. of 1⅝-in. rope, and the plant is at present hoisting from the eighty-third level. When operating in balance, a ten-ton load of rock or ore is hoisted at a speed of 3,200 ft. per minute.

The engine has two high-pressure and two low-pressure Corliss cylinders, mounted independently on triangular frames upon whose apex the main drive shaft of the drum rests. Each cylinder is thus an independent engine, resting at 45 deg., and so designed that the low-pressure cylinders are connected to one crank pin, and the high-pressure cylinder to the other. Each set of cylinders has its own throttle valve, the high-pressure valve being of balanced poppet type and the low-pressure a rocking valve. Between the high and low-pressure cylinders is a reheater, controlled by the operator.

As the skip approaches the landing, the throttle is automatically closed. In the event of overwinding, the brakes operate automatically. An automatic lock-control prevents starting in the wrong direction. The cut-off cams of the valve gear are direct-connected to the governor, so that overspeeding is also automatically prevented. The proper dash pots may be hooked up by throwing the reverse mechanism over and back.

The brakes are of special design, as shown in the accompanying photograph. They are 16 ft. in diameter, actuated by oil cylinders taking their oil from loaded accumulators, and controlled by poppet valves, one controlling the lift and the other the drop, so that both valves cannot be operated simultaneously.

The reverse mechanism and throttle are operated by floating lever equipment under full control of the operator. Every part of the mechanism is designed to be absolutely interlocking and automatic, so that the operator can perform only one movement, and that the proper one, at a time.

Some idea of the stupendous power under the control of one man may be obtained from the dimensions of this engine. The steam cylinders are 32 x 60 x 63 in. and the main bearings 28 x 54 in. The drum is 30 ft. in diameter, the crank pin 15 x 15½ in. in diameter, and the crosshead pins 8 x 12 in. The high-pressure piston rod is 6 in. and the low pressure 10 in. in diameter.

In addition to the main engine, condensing equipment is provided to care for 1,460 lb. of steam per trip. The circulating pumps, each 24 x 12 in. single-acting, set vertically beneath the main floor, are driven from the piston rod of the dry air pump, which is tandem to the steam cylinder, connection being made through a rocker arm. The dry-air cylinder is 22 x 36 in. and the steam cylinder 14 x 36 in. The engine itself stands 60 ft. high, occupying a floor space of 3,240 sq.ft. and, with the condenser, weighs 882½ tons.

The hoist house is of reinforced concrete, designed under the direction of C. L. Lawton, general manager of the Quincy company. The engine and condenser foundations alone required 3,000 cu.yd. of concrete. The main hoist exhaust steam passes into an 8 x 17-ft. drum and thence to the air pumps. The weight of the skip is 10,000 lb., of rope 41,500 lb., of load 20,000 lb., or a total of 35¾ tons, which is hoisted to the surface from the eighty-third level in 3 min., 28 sec.

Trouble in one cylinder head having developed some time ago, the hoist was operated with three cylinders for several hours, and so great was the reserve capacity of the plant that no difference could be observed in the speed, sound of engines, or pulsation of rope. This hoist marks the advance of hoisting engineering at the present time.

THE PETROLEUM INDUSTRY

Mexican Petroleum Production Is Highest on Record

The average monthly exportation of oil from Mexico during the current year has been about 17,830,000 bbl. The monthly averages since 1918 have been steadily increasing, approximately as follows: 4,490,000 bbl., 6,637,000 bbl., 12,816,000 bbl., 15,170,000 bbl. and 17,830,000 bbl. This makes a total to date of nearly 560,000,000 bbl. The following table shows the exports during the last three months of the current year according to companies, the figures being in barrels:

	May	April	March
Mexican Petroleum	3,245,188	3,017,921	2,969,905
Mexican Eagle	2,195,380	2,453,922	1,697,567
Standard, New Jersey	1,903,715	2,077,232	2,878,941
Gulf Oil	1,874,323	1,959,220	1,386,889
Royal Dutch (Corona)	1,843,106	2,005,502	1,429,169
Mexican Seaboard	1,802,697	1,441,569	1,550,288
Atlantic Lobos	997,038	377,573	680,442
Texas Co.	931,946	666,166	731,150
Atlantic Gulf	880,904	1,242,932	941,043
Penn. Mex. Fuel	595,802	265,900	190,075
Sinclair	573,271	1,079,230	862,783
Island Oil	499,850	72,195	136,289
New England Fuel	486,177	287,859	408,117
East Coast	356,694	430,729	414,509
National Petroleum	135,608	186,936	146,427
U. S. Mexican	95,902	100,791	51,325
Continental Mexican	92,553	65,056	123,331
Interocean	50,507	50,219	50,167
Pierce	26,076	66,162	181,678
Miscellaneous	.....	216,269	.....
Total	18,586,737	18,063,383	17,274,062
Daily average	599,572	602,113	557,228

In his annual report E. L. Doheny, president of the Mexican Petroleum Co., the largest producer, states:

"It is conservative to say that all our wells could produce at least 1,000,000 bbl. of oil a day if run to capacity. Some people have, from time to time, attempted to fix a date when our production would be exhausted, but there never has been a time since our Cerro Azul, No. 4, well came in in February, 1916, when we could not have taken at least 250,000 bbl. a day. We took less, because we did not have the tank steamer facilities to move so much oil. All our production at the present time is coming from our wells on the northern border of Cerro Azul, in what is known as Toteco-Cerro Azul district. We are not taking any oil from our wells No. 4 or No. 3, which are further in the interior of the Cerro Azul tract. Our Cierra Blanca, No. 2, well, which came in early this month, is capable of producing over 100,000 bbl. daily, and further proves up our reserves of oil."

Standard Oil Subsidiaries Are Active in Montana

BUTTE CORRESPONDENCE

According to word received from Shelby, Mont., the Ohio Oil Co., a subsidiary of the Standard, has acquired two sections in the Sunburst oil field, in northern Montana. Papers assigning the lease have been filed with the clerk and recorder of Toole County. According to the report, the Ohio company is leasing throughout the area between the Great Northern railroad main line on the south and the Canadian border to the east of the Sweetgrass branch of that road. The Ohio has opened offices and is maintaining a crew at Shelby.

On the west side of the Kevin-Sunburst field, the Standard of California has been active in securing a large acreage. Purchase of 480 acres north and east of the Gordon Campbell discovery well has been made by the California company at a price reported to have been $105,000. The California company also has leased 1,100 acres in what is known as the Gas Ridge district in Township 34, south of the Campbell well. With these recent purchases the California company now has control of approximately 2,000 acres in the Kevin-Sunburst area.

In the vicinity of the Soap Creek district, south of Billings, the California company has taken over a half interest in the Beauvis field from Senator T. S. Hogan, for which $48,000 will be paid upon the completion of two wells. Should production be found the field will be developed on a 50-50 basis.

The Mid-Northern company's well in Sec. 11, Fergus County, is pouring more than 2,000 bbl., according to reports received in Lewistown. This company evidently is making preparations for extensive drilling. Three carloads of casings and a carload of lumber have arrived at Winnett consigned to the company.

Bill Would Conserve Helium Obtained from Natural Gas Wells

Albert B. Fall, Secretary of the Interior Department, has given his unqualified indorsement to the bill recently introduced by Representative Kahn, the chairman of the Military Affairs Committee, providing for the conservation of helium gas. He urges "as a matter vital to the best interests of the country" that the bill be passed.

In his letter to Representative Sinnott, the chairman of the Public Lands Committee, which has jurisdiction, Secretary Fall points out that the United States is in the fortunate position of having practically a natural monopoly of helium — an exceedingly valuable asset which should not under any circumstances be dissipated. He also points out that he has submitted the bill to the President, and that the Chief Executive also strongly indorses the measure.

Secretary Fall says that no private companies have attempted to separate helium from natural gas on a commercial scale. For that reason the needs of the Army and Navy must be supplied by the Government. He calls attention to the fact that of the $5,000,000 asked, $4,000,000 is needed for conservation, and $1,000,000 for drilling wells, the necessary pipe lines and the construction of the plant on or adjacent to the gas field, which it is proposed to purchase, for the purpose of processing such amounts as may be necessary to supply the helium requirements of the Army and Navy. He mentions that the $4,000,000 for conservation is but a temporary outlay, as it is contemplated that the entire

amount will be returned to the Government through the ultimate sale of natural gas from the lands the purchase of which is under consideration.

The investigations of the Bureau of Mines have shown conclusively, Secretary Fall states, that helium can be conserved most effectively by holding the helium-bearing gas under ground. With reference to the construction of a new extraction plant, Secretary Fall refers to the progress which has been made possible by the cryogenic research laboratory and the extensive development work which has led to great efficiencies, resulting in decreased costs. There is every reasonable assurance, he says, that a plant for the extraction of helium now can be constructed in which both the initial cost and the cost of operation will be reduced much below anything that has been possible heretofore. Another economy would be effected by the bill, as it places all of the work under one department. Heretofore the work has been divided among the War, Navy, and Interior departments. The pending bill proposes that the entire responsibility for supervision be placed upon the Interior Department.

Survey Fails to Reveal Favorable Oil Prospects in New Guinea

SPECIAL CORRESPONDENCE

Acting under arrangement made with the company by the commonwealth government, five members of the geological staff in Australia of the Anglo Persian Oil Co., Ltd., were detailed to conduct a geological survey with a view to determining prospects for oil in a part of the main island of New Guinea, which is former German territory now held under mandate by the commonwealth. A summary of a report furnished by A. Gillespie, the officer in charge of the survey party, has been made available. It states that, "The party surveyed or determined prospects over an area of 2,000 square miles in Eitape and Madang districts in the northeast portion of the island. Included in the areas examined in detail was a stretch of about fifty miles of coast in the Eitape district, which included the outfall of the Wakip River, on which oil seepages were known to exist. This river flows into the sea from the north coast of New Guinea, about 150 miles easterly from the Dutch frontier, and oil seepages in its vicinity were known to the German government and were examined during the military occupation by the Australian forces, although no detail study of the geological structure was made."

A small-scale map of this area was made by the Anglo-Persion Co.'s geologists, and its geological structure was studied in detail. The seepages of oil already reported were found. There are two main groups. The geologists reported that though small quantities of oil could probably be obtained in the immediate vicinity of the main seepages, they believed that such operations would probably not repay outlay and working costs, and they could not recommend a test well. The geologists, reporting generally on the areas they examined, said that in their opinion the oil prospects were unfavorable.

The report has been considered by the federal government, which favors the proposal to make additional surveys. In the meantime, the government will maintain its policy of refusing to grant oil leases or licenses for prospecting for oil in the mandated territory.

Pumping Oil Wells from a Central Station

BY HENRY M. PAYNE

The use of central pumping stations where one power plant does all the work for a series of wells is largely confined, in the California oil region, to the Kern River fields. The power is applied by a horizontal belt drive to a vertical shaft on which is affixed an eccentric cam, shown in Fig. 1, just above the roof. In Fig. 2, a similar eccentric is placed just above the floor. In

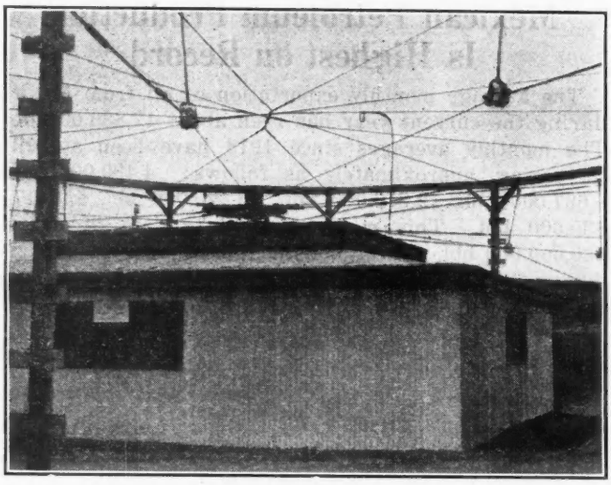


Fig. 1. Jack house showing eccentric drive for pumping several wells from one central station

either arrangement, cables connected to the various wells extended radially on all sides, supported by swinging lugs, and attached to the periphery of the eccentric, which as it revolves gives a pump stroke at the other end of the cable, equivalent to the eccentricity of the cam, and whose speed is controlled by the speed of revolution of the main drive.

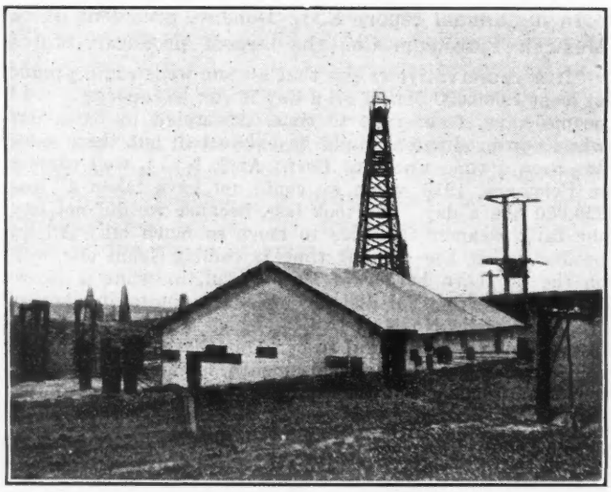


Fig. 2. Jack house from which thirty-two wells are pumped by one eccentric drive

Where a longer stroke is required, it is obtained by connecting the pump end of the cable to a triangle pivoted at one corner, and having its legs proportional to the stroke desired, instead of the usual rocker arm.

The station shown in Fig. 2 is pumping thirty-two wells simultaneously. There are approximately 2,000 wells in this district, varying in depth from 800 to 1,000 ft. and producing an average of 10 bbl. each per day.

SOCIETIES, ADDRESSES, AND REPORTS

Western Mining Conference Held at Denver

Denison "Blue-Sky" Bill Condemned—General Revision of U. S. Mining Law Opposed—Congress Urged to Consider International Stabilization of Silver

A LARGE NUMBER of the leading mining men of the West were drawn to Denver by the Western Mining Conference which was held on June 20 and 21. This conference had been called at the suggestion of Western mining interests and at the special request of the Colorado Metal Mining Fund, the Colorado Metal Mining Association, and the Colorado Chapter of the American Mining Congress. The conference headquarters were in the Capitol building.

Important questions were considered, those of proposed "blue-sky" legislation, mining-law revision, and the maintenance of the purchasing price of silver after the expiration of the Pittman Act being paramount. At the closing session Bulkeley Wells, of Denver, told the mining men present that silver producers controlling approximately 80 per cent of the world's silver output may be organized soon. The purpose of the proposed organization is to stabilize and hold silver prices at a level which will make the industry more profitable. Silver operators of Canada and Latin America are to be included in the new organization.

A new division of the American Mining Congress, known as the Western Division, was created by a resolution adopted by the conference. The states represented in it are: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, North and South Dakota, Utah, Washington, and Wyoming.

Little hope for the discovery of new gold territory was expressed by W. J. Loring, president of the American Mining Congress, in an address on "Gold Production." Hope of the industry lies in the revival of activity in old camps and in the application of modern methods to mining and treatment of ore.

The work of the convention was summed up in a number of resolutions. One of these, protesting against paternalism and Governmental interference with "private business, personal liberties and initiative," was introduced by Sidney Norman, of Spokane. It called for the abolition of many unnecessary bureaus, state and national, as adding to the burden of taxation.

"Blue-sky" legislation was the subject of another resolution. It reads:

"This conference strongly favors whatever legislation may be needed to safeguard the public against fradulent promotions of all kinds, but it condemns all measures containing the principle which sets up an individual or commission to pass upon investments without appeal and unqualifiedly condemns the so-called Denison 'blue-sky' bill and all legislation that proposes to go beyond reasonable protection of the public and to violate those individual rights and destroy that initiative which have made the United States the great nation it is today."

Another resolution also gave consideration to the Denison "blue-sky" bill urging that the aid of metal trades associations be sought to bring about its defeat.

A draft of a new Federal Securities Bill for the prevention of fraud in promotion, which had been prepared and approved by the Colorado mining organization, was the subject of another resolution. It was resolved that it be referred to the directors of the American Mining Congress for their consideration in case they deemed it advisable to present an alternative measure in opposition to the "blue-sky" legislation now pending in Congress.

Consideration of the subject of international stabilization of silver was urged upon Congress in a resolution drawn by A. G. McKenzie and Sidney Norman.

George E. Collins, of Denver, introduced a resolution dealing with the proposed revision of the mining law. Appointment was asked of a deputation of three members to appear before the House Committee on Mines and Mining to express the opposition of the conference to any general revision bill. This deputation was also empowered to offer to the supporters of revision a compromise under which a special law on the general lines advocated by them be passed for the development and working of such limited areas as shall be designated by the U. S. Geological Survey as being probably underlain by ore deposits.

At the proposal of P. G. Harrison, of Colorado, the conference went on record as advocating a "revision in the present mining laws whereby locations on mineral lands may be made in the absence of a discovery, said locations to be valid so long as such work as may be considered necessary by Congress is duly performed; and for the abolition of the extralateral right features of the present laws so far as applied to locations in the future."

National Lime Association Meets at Cleveland

The fourth annual meeting of the National Lime Association, at Cleveland, occupied four days, June 13 to 16, inclusive. The aim of the officials was to give the greatest possible opportunity for round-table discussion of the subjects presented, with a view to laying a sounder foundation for co-operative effort toward better practices in the industry. Among some thirty papers were:

"What the Bureau of Mines Is Doing on Quarry Problems," by Oliver W. Bowles, engineer, U. S. Bureau of Mines; "Mechanical Handling of Lime," by H. D. Pratt, the Link Bolt Co., Philadelphia. Pa.; "The Value of Research to Industrial Associations," by E. R. Weidlein, director of research, Mellon Institute, Pittsburgh, Pa.; "Outlook on Business Conditions," by George A. Coulton, vice-president of the Union Trust Co., Cleveland, Ohio.

Ontario Iron Ore Possibilities

The Ontario Department of Mines, having in view the encouragement of the iron ore industry of the province, has arranged for a conference of those prominently interested, to be held at the Parliament Buildings on July 5. Invitations to attend have been sent to representatives of the iron and steel companies, owners of iron ore deposits, and metallurgists. The main difficulty in the way of developing the iron ore deposits has been that they are composed rather largely of low-grade ore and the conference will be asked to devise plans by which these ores can be made commercially available. This will necessarily involve operations on quite an extensive scale, entailing a large expenditure. One feature which will receive some attention is the possibility of using electricity for smelting, in view of the large water powers capable of development.

Funds for Alaskan Road Recommended

Specific appropriation of $10,000 is recommended for improving the road from Wasilla to Willow Creek to reach that mining district. For the Kantishna road an appropriation of $70,000 is asked in behalf of this placer mining district. Reports of the Bureau of Mines and Geological Survey as to this district being the most promising lode development north of Broad Pass are referred to. It is said that with access to the railroad by a suitable road the cost of mining in this region will be reduced.

MEN YOU SHOULD KNOW ABOUT

Henry Hinds was a recent Washington visitor.

C. W. Washburne was in Washington June 22 and 23.

C. P. Ross is working in the Aravaipa district of Arizona.

John G. Kirchen has returned to Tonopah from New York.

P. S. Smith will be at McKinley Park station, Alaska, until July 15.

G. H. Girty and **P. V. Roundy** will return to Washington on July 1.

F. L. Hess has returned to Washington after a Western field trip.

Frank L. Sizer is examining the Yuba mine, in Nevada County, Cal.

Walter E. Gaby has returned to Salt Lake City from Santa Rita, N. M.

H. C. Dudley, of Duluth, is in New York on his way to Porcupine, Ontario.

C. B. Lakenan, of the Nevada Consolidated, was recently in San Francisco.

D. F. Hewett has returned to Washington after several weeks of field work.

Edwin E. Chase has returned to the White Hills district of Arizona, and will be there until July 1.

J. D. Sears has moved with his geological party west of Little Snake River, in Moffat County, Col.

Robert S. Rose was recently on the Gogebic Range going over explorations and mines at the east end of the range.

Henry Hanson, metallurgical engineer, has established his office in the Hobart Building, San Francisco, Cal.

Charles B. Croner is making a geological survey of the Goldstrike mining district, in southern Utah, for Chicago capital.

D. E. Sutherland spent several days recently in Hibbing, Minn., attending a conference on safety rules and apparatus.

Robert Linton has been on a visit of inspection of the mine of the Seneca Copper Corporation and is now in Butte, Mont.

K. F. Mather and **Ralph G. Lusk** are at Alamosa, Col., continuing work in the San Juan region under the direction of **W. W. Atwood.**

C. R. Longwell and **Alexander Stepanoff** have taken up headquarters at Newcastle, Wyo., where they are doing work in oil geology.

R. C. Wells is in Calumet, Mich., making a study, in co-operation with **L. C. Graton**, of the formation of the copper ores in that region.

L. O. Howard, dean of the Washington School of Mines, is in Boston on a vacation. He will attend the reunion of his class at Harvard.

K. C. Heald is in Oklahoma, at the request of the office of Indian Affairs, to attend the sale to be held at Pawhuska, of oil leases in the Osage lands.

B. C. Yates, superintendent of the Homestake Mining Co., has returned to South Dakota from a vacation spent in California and the Hawaiian Islands.

F. W. Denton, vice-president and managing director of Copper Range Consolidated, with headquarters in Boston, is in the Michigan copper country.

J. Ward Williams has gone to South America on an extended examination trip. He will return to his office at 405 Lexington Ave., New York City, about Nov. 1.

Nichol Thompson, of Vancouver, is in the Stewart district of British Columbia arranging for the development of properties in which he and his associates are interested.

P. L. Foster, of New York, representing the Exploration Company, Ltd., of London, is looking after the interests of the company in the Elbow Lake, Manitoba, gold area.

Dr. L. H. McLearn, of the Canadian Geological Survey, will investigate the Triassic and Cretaceous formations along the Peace River where drilling for oil is now being undertaken.

J. A. Bancroft, assistant manager for the Granby Cons. M. S. & P. Co., of British Columbia, is in the Stewart district, making a number of examinations in the interest of his company.

T. H. Jenks, of Los Angeles, is now engaged upon professional work in the Cochiti district of New Mexico and expects to make his headquarters at Bland, N. M., until about the end of July.

P. G. Beckett, general manager of the Phelps Dodge Corporation, has been appointed by Governor Campbell as an Arizona delegate to the National Tax Conference to be held in Minneapolis Sept. 18.

W. Spencer Hutchinson has been appointed a full professor of mining engineering and put in charge of the option in mining at the Massachusetts Institute of Technology. This appointment becomes effective Jan. 1, 1923.

Prof. H. A. Hersam, of the mining department of the University of California, has been given leave of absence for one year to devote his time to the Committee on Milling Methods of the American Institute of Mining and Metallurgical Engineers.

Allied Engineers, Ltd., announces the reopening of its office and assay laboratories at The Pas, Manitoba, under the management of **Holman I. Pearl, A. K. Knickerbocker** and **E. R. Cullity.** The corporation maintains offices also in Butte, Mont., and Crosby, Minn.

Roy Wethered, who has been chief engineer for many years for the Tamarack & Custer Consolidated Mining Co., Hercules Mining Co. and other Day properties in the Coeur d'Alenes and parts of Washington and Montana, has resigned his position, to take effect July 1.

S. R. Elliott, of Ishpeming, Mich., general superintendent of the Cleveland-Cliffs Iron Co., was a recent visitor on the Mesabi iron range, where he made a tour of inspection of the company's properties, accompanied by **Max H. Barber**, district superintendent on the Mesabi range.

Thomas F. Cole, president of the Seneca Copper Corporation, is in the Lake district on a visit of inspection. **H. F. Fay**, of Boston, president of Mayflower-Old Colony, and **L. P. Yandell**, of Boston, president of the Mohawk and Wolverine companies and a director of Copper Range, also are visitors in the district.

E. S. Moore has resigned as dean of the School of Mines of the Pennsylvania State College to accept the position of professor of economic geology in the University of Toronto. He will remain in State College until Sept. 1 to complete some work on ganister deposits of the state, for the Bureau of Topographic and Geological Survey of Pennsylvania.

Dr. Charles D. Walcott, secretary of the Smithsonian Institution, has left Washington to continue his geological explorations in the Canadian Rocky Mountains. Dr. Walcott's work in previous seasons has done much toward defining the geological formations of this interesting region, and many thousands of fossil specimens have been brought back to add to the completeness of the exhibition and study series of the U. S. National Museum. The section to be studied this year will take in several localities north and south of the Bow Valley between Banff and Lake Louise, on the Canadian Pacific R.R.

Mining and metallurgical engineers visiting New York City last week included: **E. Ramsay**, of Birmingham, Ala.; **Joseph B. Sanfort**, of Houghton, Mich.; **Clarence W. Hoffer**, of Tucson, Ariz.; **W. D. Hubbard**, of Johannesburg, South Africa; **A. L. Webb**, of El Paso, Tex.; and **M. J. Udy**, of Niagara Falls, N. Y.

OBITUARY

Thomas McAllister, a pioneer mining man of the Cariboo and Kootenay districts, died at his home at Milner, B. C., on June 10.

Robert Sticht died on April 30, at Launceton, Tasmania. Mr. Sticht was formerly a lead metallurgist in this country but is best known as an exponent of pyritic smelting, which he developed to a high degree of perfection at the Mount Lyell Mining & Railway Co., in Tasmania.

H. S. Vincent, general manager of the Trojan Mining Co., died at his home in Deadwood, S. D., on June 20. Mr. Vincent was born in Pennsylvania in 1867 and came to the Black Hills in 1896, making his headquarters at Deadwood as a civil engineer. He entered the employment of the Trojan Mining Co. some years ago, and was first appointed superintendent and later general manager. He was mayor of Deadwood for a number of years.

Book Reviews

South American Geology

Johns Hopkins University Studies in Geology, No. 1. "The Geology of the Corocoro Copper District of Bolivia." By Joseph L. Singewald, Jr., and Edward W. Berry. Johns Hopkins Press, Baltimore.

The Spaniards arriving in Bolivia early in the sixteenth century found the Indians working the oxidized outcrops of the Corocoro mines, as a source for copper pigments. The mines have been worked intermittently since.

The Corocoro mines share with the Lake Superior deposits the distinction of being the only commercially important copper deposits in which native copper is the principal form of occurrence of the ore. The ores occur in a thick series of shales, sandstones, and conglomerates, which have been uptilted; numerous beds are impregnated with copper ores. A great fault runs through the district, and the beds dip away from it on both sides. The age of these beds has previously been variously placed in periods from the Carboniferous to the Tertiary; but fossil plants collected by the authors show the age to be Pliocene, probably on both sides of the fault. Younger than these rocks is another unconformably overlying series of sandstones, red, like the underlying beds. The nearest igneous rocks—diorites—are fifteen to twenty kilometers away; but the authors frame the hypothesis that the dioritic mass extends under this Corocoro district, and that the mineralization was accomplished by "solutions rising from the underlying dioritic magma." The ore is native copper; gypsum and also some celestite and borite, occur as gangues. Toward the surface some of the beds have chiefly chalcocite ore, with domeykite; very superficially this copper sulphide has been oxided to copper sulphate, carbonates, and oxide. The sulphides are said to extend to 100 to 150 meters, while lower down only native copper is found. (The reviewer wonders whether the authors have thoroughly checked up this statement from personal observation.) It is suggested that chalcocite and native copper are contemporaneous. The ore deposition has taken place principally in the porous beds (sandstones and conglomerates) rather than in the shales, for reasons which do not have to be explained—and the authors do not explain. The ores carry a little silver. The strata are bleached near the ores.

As to the genesis of the ores, the authors rule out the possibility that they are sedimentary—an old theory for ores in sandstone; and, as above noted, they ascribe the ore to solutions proceeding from an underlying diorite magma.

These deposits belong to a characteristic group. Why from the mineralizing solution native copper was deposited instead of the usual copper sulphides, although the presence of gypsum shows that sulphur existed in the solutions, is a problem which might well be taken up by our students of geology. If the condition above stated is a true one, that certain steeply dipping beds show chalcocite above and native copper in depth, this will eventually furnish a valuable clue to the nature of ore-deposition—a clue the significance of which at present is unknown. J. E. S.

Johns Hopkins University Studies in Geology, No. 2. "The Geology and Paleontology of the Huancavelica Mercury District." By Edward W. Berry and Joseph T. Singewald, Jr.

A peculiarity of the Corocoro report, reviewed above, is accentuated in this one—the conscientious enumeration of the opinions of geologists who have previously written on the district: an enumeration made not only once, but each time a new theme is taken up. The general impression is given of a compilation, and it is somewhat difficult to sift the varying opinions expressed, and find out what the authors think, which is what one wants to know. A system of citing previous views in footnotes would have been better presentation and better editing. Also, there are repetitions and partial statements which could have been eliminated. As it is, the earnest reader has to do a good deal of gleaning.

The Huancavelica mercury mines, in Peru, supplied the mercury for beneficiating the silver ores which were mined during the Spanish Colonial period, in Peru, Bolivia, Chile, and even Mexico; they produced mercury for over two centuries. In 1786 the principal workings caved, burying two hundred miners, and the mines have never recovered from that catastrophe. They are now being reopened.

The most abundant rocks are Cretaceous limestones, with post-Cretaceous conglomerates. The cinnabar occurs chiefly in a fine sandstone (presumably of the Cretaceous series), and is accompanied by bituminous substances and also galena, sphalerite, pyrite, arsenopyrite, and stibnite. Realgar and barite also occur. Igneous rocks are abundant in the vicinity, varied in character but chiefly andesitic. Their age is regarded by the authors as probably Miocene (p. 51). There are warm springs actually existing at Huancavelica, but they do not deposit cinnabar, as they do in California. J. E. S.

Crain's Market Data Book and Directory. Second edition, 1922. G. D. Crain, Jr., 537 S. Dearborn St., Chicago. $5.

This is a directory of the class, trade, and technical publications of the United States and Canada, giving particulars as to the fields they cover.

Technical Papers

Pacific Coast Petroleum Industry—This is the title of the second part of a report by the Federal Trade Commission; it deals with prices, marketing methods, and competitive conditions, and supplements an earlier publication that considered production, ownership, and profits. The conclusion is reached that production, refining, and marketing are controlled by a few companies and their subsidiaries and that the Standard group dominates the oil business. The Standard Oil Co. of California usually takes the lead in announcing price changes for refined products and the others follow. The pamphlet contains 268 pages of reports of hearings, exhibits, and miscellaneous data. Copies can be obtained from the Superintendent of Documents at Washington, D. C. The price is 30c.

Mica—Every present and prospective mica producer will be interested in "Mica," a forty-six-page mimeographed bulletin issued by the U. S. Bureau of Mines, Washington, D. C., as *Reports of Investigations No.* 2,357, obtainable on request. This gives much valuable information on varieties, chemical composition, physical properties, origin and occurrence, inperfections, production and consumption, uses, grades and specifications, mining, trimming and cutting, ground mica manufacture, distribution of deposits, and list of manufacturers, dealers, and grinders. A second part of the bulletin is devoted to recent developments in foreign mica mining. The monograph is the work of Oliver Bowles.

Canadian Mining Directory—Reginald E. Hore, formerly editor of the *Canadian Mining Journal*, co-operating with J. J. Kingsmill, has issued a small 128-page "Mining Handbook of Canada." General statistics are given as to production, and security prices of the various Canadian mines, and, under the individual names, are given the date of organization, officials, financial organization, brief particulars as to the property, and its present condition. The book is obtainable from The Investors' Mining Handbook, Room 34, 56 King St. West, Toronto, Ont., for $1 for the paper-bound edition or $2 for the leather-bound.

Oil in South Dakota—Roy A. Wilson, geologist for the South Dakota Geological and Natural History Survey, has made a thorough reconnaissance survey of the state, to determine the most likely regions for prospecting for petroleum. Up to the present, South Dakota has produced no oil, though some wells have been drilled. Bulletin 10 is the report of the survey, and may be obtained from the South Dakota Geological Survey, Vermilion, S. D. Although the outlook is not promising, sundry geological formations exist and offer possibilities of oil.

THE MINING NEWS

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

Leading Events

HOLLINGER'S purchase of the Schumacher and the Premier Gold Mining Co.'s announcement that its next dividend would total three-quarters of a million dollars are the events leading in interest of the week.

The Western Mining Conference, held at Denver, June 20-21, was of much importance. The resolutions adopted are reported on p. 27 of this issue.

Increasing scarcity of miners is putting a brake on production in the Michigan copper country. Similar conditions are said to obtain in some other districts in the country, particularly at Butte.

Furnaces of the Birmingham district are taking a half-million tons of iron ore weekly, it is estimated. The production of coal and flux is in proportion.

The War Minerals Relief Commissioner, Judge Ira E. Robinson, has been given several engineer assistants to expedite the work of reconsidering the many claims that have been made.

Guggenheim Ticket Elected at A. S. & R. Meeting

Number of Directors Holding No Official Position Increased to Seventeen —Eilers and Investigating Committee Satisfied

The ticket nominated by the management of the American Smelting & Refining Co. was elected at the company's annual meeting held in Jersey City, N. J., on June 27. The number of directors holding no official position with the company was increased from eight, as nominated last year, to seventeen. Several days prior to the meeting the company announced that it had received proxies representing more than 700,000 shares of the 1,100,000 outstanding.

The new directors thus elected are: Bulkeley Wells, mine operator, Colorado; General George W. Goethals; Lewis L. Clarke, president, American Exchange National Bank; Charles D. Hilles, of Dwight & Hilles; Henry E. Cooper, vice-president, Equitable Trust Co.; E. C. Wagner, president, the Discount Corporation; Harvey D. Gibson, president, New York Trust Co.; Elihu Root, of Root, Clark, Buckner & Howland, and Harry L. Day, of Idaho.

The directors not holding official positions who were added to the board last year and were re-elected are: M. P. Callaway, Lyman Candee, Edwin C. Jameson, F. J. Leary, Fred W. Shibley, E. B. Schley; Wilfred Shore, and F. T. Walker.

The remaining members of the new board are: Daniel Guggenheim, formerly president; Simon Guggenheim, president; Edgar L. Newhouse, chairman of the board; F. H. Brownell, first vice-president and chairman of the finance committee; William Loeb, Jr., vice-president; H. A. Guess, vice-president in charge of metal mining operations; H. A. Prosser, vice-president in charge of Mexican operations; Walter T. Page, member of the advisory committee, Omaha; Roger W. Straus, assistant to the president; Hamilton M. Brush, manager, metal sales department, and C. A. H. de Saulles, president of the United States Zinc Co. The same board of directors was elected for the American Smelters Securities Co.

No contest was made by the proxy committee of the stockholders investigating committee, that recently reported its findings. Likewise, Henry S. Weller, E. D. Emerson, and Karl Eilers, who comprised an independent proxy committee, announced prior to the meeting that they would vote the management's ticket.

Premier's Third Dividend Totals $750,000

The Premier Gold Mining Co., of British Columbia, recently announced a dividend of 15c. per share, payable June 29, for the quarter ended June 30. The total is $750,000. This is the third dividend in the company's history. The first was for $400,000 and was declared at the end of 1921. The second was for $500,000, for the first quarter of 1922. The total to date is thus $1,650,000.

Utah Roads Reduce Intrastate Freight Rates

The Public Utilities Commission of Utah, in response to request, has granted to interstate railroads operating in Utah permission to reduce their intrastate rates to a parity with the interstate rates ordered reduced by the Interstate Commerce Commission, effective July 1.

Hollinger Buys Schumacher

Largest Price on Cash Basis Yet Paid for Canadian Gold Property

BY ALEXANDER GRAY

Official announcement that the Hollinger Consolidated Gold Mines, of Porcupine, Ont., had made a cash payment and taken an option on the Schumacher properties, which adjoin the Hollinger areas on the east, was not so much of a surprise as it was further testimony to the policy of expansion planned by the leading gold-mining corporation of Canada. The consideration entering into the agreement is that the price be $1,650,000, or 90c. a share for Schumacher shares. Of this amount 10 per cent was forthcoming upon execution of the document. After a short inspection period, $300,000 more is to be paid. Thereafter, the remainder of $1,185,000 will be due in four quarterly installments.

As 160 acres is involved, and as the Schumacher property was one of the debatable quantities in what is known as the Pearl section of Porcupine, the transaction in all its bearings is the subject of much discussion in mining circles. It is an open secret that the Hollinger management was prepared to pay more than it did for possession of the Schumacher. Negotiations were carried on without leakage. A Hollinger official fortuitously is also a member of the Schumacher board, and as he is a trustee of one of the estates that may be said to be part of the Hollinger control, he acted in a dual capacity. Neither side is dissatisfied with the outcome. The provision whereby the Hollinger management paid $165,000 for an examination period is merely precautionary.

The same is true of the purpose of

the purchasers, counseled by A. F. Brigham, general manager, who reported upon information and belief that certain orebodies now being developed in the Acme area of Hollinger territory at depth may exist within the Schumacher lines in quantity and quality that should not be ignored. One highly profitable series, of which vein No. 65 is the best, that can return the Schumacher purchase money if there was nothing else, is believed or presumed to be trending toward the Schumacher. In fact, for some time, it had been noted that the rake, the drag, was in that direction.

The geology of this locality in particular, created the supposition that there will be other orebodies. L. D. Huntoon, who reported on the McIntyre for New York interests, laid stress upon contact conditions without which McIntyre would not possess the speculative possibilities it does. McIntyre is banking upon the continuation of some of the Hollinger orebodies. If other extensions belong to the Schumacher, then the Hollinger management, being forwarned, desired to be forearmed, whether or not the eventuality of getting all there is in the Acme ground be somewhat remote.

Now Hollinger Consolidated will own seventeen full claims, the Schumacher acquisition adding 2,500 ft. or so on the strike. To most people, the impression has been that the Schumacher could not have more than a corner of the Acme fissuring. The Hollinger management ascertained to the contrary, and preferred to act rather than have other parties take the Schumacher.

Would Vary Gold in Dollar

A bill intended to stabilize the purchasing power of money by replacing the unstable dollar with a stable dollar has been introduced by Representative Goldsborough, of Maryland. He proposes that on Jan. 8, 1924, the gold dollar of the United States shall cease to be a constant quantity of gold of variable purchasing power, but thereafter shall be a variable quantity of standard gold bullion of approximately constant computed purchasing power. He proposes that the quantity of standard gold bullion that shall constitute a gold dollar at any time shall be ascertained and fixed from time to time by the computation and use of index numbers of wholesale prices. The gold dollar shall remain 25.8 grains of standard gold until some other quantity is fixed by the proposed bill.

Canadian Survey Plans Extensive Field Work

The field work of the Canadian Geological Survey this season will cover a wide area. One of the most important undertakings will be the surveying and mapping to completion of the region between Port Arthur and the Nipigon River, where silver, iron, zinc and other valuable minerals occur.

Broken Hill Cannot Meet Present Competition

Would Restart Steel Works at Port Waratah If Wages and Coal Prices Were Cut

By Reuters Agency

Twelve months ago approximately 6,000 men were employed by the Broken Hill Proprietary Co., at its Port Waratah steel works, near Newcastle, N. S. W. Today only 840 are at work. According to the company's head office, this has been caused solely by the inability of the company to secure orders at prices that will permit operation. Great Britain and the United States, it is stated, have been enabled to meet competition owing to adjustment made in prices of coal and wages, in neither of which have there been reductions in Australia.

The directors think that they will be justified in restarting the works if large coal is reduced by 4s. and small coal by 6s. per ton. Since the beginning of the industry at Newcastle prices of large coal have increased 100 per cent and small coal 153 per cent.

Regarding hours, the company is under great disability owing to the forty-four-hour week. It is considered necessary that a return to forty-eight hours be agreed upon before operations resume.

The company is unable to start at the latest New South Wales basic wage of £3 18s. per week. It claims that it could, however, start at £3 10s.

Canada to Seek New Markets for Mineral Products

Charles Stewart, Canadian Minister of Mines, announced on June 21 that the government had adopted a vigorous policy for the encouragement of the mining industry. A determined effort will be made to open up new markets abroad for Canadian mineral products, in connection with which Dr. C. C. Camsell, Deputy Minister of Mines, is leaving at once for England and the Continent. The Imperial Mineral Resources Bureau is interested in Canadian mineral products, and Dr. Camsell will confer with them as to the best means of opening up new avenues of trade. Among the minerals for which it is hoped to find additional markets are graphite, tar sands, feldspar, and bentonite. High-grade deposits of the latter have been discovered in Alberta and British Columbia and as it is a valuable factor in the manufacture of textiles it is hoped to create a demand for it among English manufacturers. As Germany has lost much of her mineral-producing territory it is believed that a market can be secured in that country for iron ore and other minerals. While in Germany Dr. Camsell will investigate the methods in operation there for briquetting coal, and will also give special attention to phosphates and other mineral fertilizers. During his stay in Europe he will represent Canada at the International Geological Congress to be held in Brussels.

Accounting in Dolly Varden Case Ordered at Vancouver

Said to Mean Practically That Property Goes to George Wingfield

In the Supreme Court of British Columbia Justice Morrisson has ordered an accounting in the case of George Wingfield v. Taylor Mining Co., which operates the Dolly Varden mine at Alice Arm, B. C. Mr. Wingfield is suing for the recovery of $200,000, being $150,000 and accrued interest loaned to the Dolly Varden Mines, Ltd., in 1919. Although papers were served on Taylor Mining Co., Taylor Engineering Co., Dolly Varden Mines, Ltd., C. M. Rolston, trustee for the bond holders, and H. C. Chiene, trustee for the creditors, none of the parties opposed the application for foreclosure of the property, consisting of the Dolly Varden and Wolf mines and the Dolly Varden-Alice Arm railway. The order practically means that the property goes to Mr. Wingfield, it is said, but a rumor is in circulation to the effect that he has entered into an agreement with the Taylor company, by which the latter may recover the property by complying with certain financial conditions within a specified period.

Importance of Colorado River Projects Pointed Out

Mining developments in the territory tributary to the power sites on the lower Colorado River can be stimulated greatly if this power should be developed. A formal statement to that effect by F. J. Bailey, the acting director of the Bureau of Mines, has been submitted to the committee now considering the Swing bill, which proposes the expenditure of $7,000,000 of Federal money for power development, flood control, and water supply in the lower Colorado River basin. In his letter, Mr. Bailey points out that mining is the dominant industry in Arizona, southwestern New Mexico, and southern Nevada, but that its development is being seriously hampered by the cost of power. "Cheap and dependable hydro-electric power," Mr. Bailey, said, "will stimulate prospecting and development. It will cheapen metal production in a large territory. It will put the small producer on equal terms with the large producer in the matter of power costs. It will open up possibilities of the electrometallurgical treatment of low-grade ores, which at present are unavailable on account of the high cost of steam or oil-generated electric power."

Funds for Helium Research Work Available

An appropriation of $400,000 for research work and for the production of helium will be available during the fiscal year beginning July 1. The effort of the Senate to reduce this amount to $300,000 was unsuccessful, as the conferees on the War Department bill accepted the House figure.

News from Washington

By PAUL WOOTON
Special Correspondent

Lawyers and Prospectors Oppose Mining Law Revision

Committee Hears H. G. Moulton, Representing Mining and Metallurgical Society

The hearings now in progress before the Committee on Mines and Mining of the House of Representatives have proceeded far enough to demonstrate that the opposition to the revision of the mining law comes largely from prospectors and from mining lawyers. The position of the lawyers is a natural one, it is contended, because their greatest asset is their knowledge of the rulings on and application of the existing law. As the proposed revision cannot be retroactive, some believe there is no ground for personal concern on the part of these attorneys, as the litigation certain to arise from the properties located under the present law will be ample to keep this generation of mining lawyers busy.

More illumination on the prospectors' situation was shed by Herbert G. Moulton, who appeared before the Mines and Mining Committee to indorse the bill on behalf of the Mining and Metallurgical Society of America and to give the members of that committee the benefit of some of his own experiences and observations. An extract from Mr. Moulton's statement and of his answers to some of the questions propounded by the committee, follows:

The CHAIRMAN. On that question of prospecting, do you mean it is practicable to pursue the old methods of looking for surface outcroppings of orebodies through individual efforts, or do you mean prospecting can be more successfully carried on by corporations looking in a scientific way for the larger bodies of low-grade ore?

Mr. MOULTON. The prospecting of the future must necessarily be carried on principally by large organizations, corporations, or groups of individuals, with adequate resources, in a scientific manner. There still remains a little room, and only a little, for the prospector whose rights and opportunities should be protected because of their value in developing American initiative.

The CHAIRMAN. In your opinion are their rights adequately protected under this bill?

Mr. MOULTON. Fully.

The CHAIRMAN. Have you, as a mining engineer, any definite idea as to whether the bulk of the mineral bearing ores of this country has been exhausted?

Mr. MOULTON. No, sir; I think there are many ores which await the development of new processes. I have had that question to answer with respect to a particular district within the last few months.

The CHAIRMAN. I am not alarmed, but I am concerned in the statement that Mr. Winchell made in connection with the proposition that the mining industry, great and important as it is, is languishing.

Mr. MOULTON. Yes, sir.

The CHAIRMAN. He advanced the idea that we should look to foreign countries for minerals rights. Is that, in your opinion, necessary?

Mr. MOULTON. I believe it is, because I am advised that more of the mineral resources of the world have been taken from the ground since 1900 than were taken from the ground in the entire history of the world up to that date. That shows a very heavy consumption.

The CHAIRMAN. The fact is that men of your profession are much concerned about mineral reserves?

Mr. MOULTON. Yes, sir; we feel that, if possible, a stimulus should be given to large-scale operations, which implies expensive operations.

Road Improvement in Alaska Before Senate Committee

Strong arguments for improving roads in Alaska to provide tonnage for the Alaskan railroad, and to develop the mining industry of that territory, were advanced before the Senate Committee on Appropriations during consideration of the Army bill. Statements were submitted from the Alaskan Engineering Commission and the Alaskan railroad in support of the road projects, which made mention of various mining projects awaiting development in Alaska.

The Alaskan Engineering Commission referred to the need of road improvements in the mining district of Willow Creek which was termed a "permanent mining camp." Mining possibilities were mentioned on the proposed road from Wasilla to Knik, and the Iditarod mining district was referred to in connection with the need for road improvement from Nancy to Rainey Pass.

The report describes a vast mineral territory in the region which would be covered by a road from Talkeetna to Cache Creek. It is predicted that this territory will provide a feeder for the Government railroad.

It is further stated that a road going into Kantishna would open up "vast areas of apparently low-grade ore" and that the railroad should look to carrying ore for its largest tonnage, this district promising heavy shipments.

Improvement of the road from Dunbar to Fort Gibbon with a branch from Tofty to the rapids on the Yukon is also recommended, on the ground that it is a probable route to the Koyukuk mining region. Recommendation is made that a narrow-gage railroad be extended via the Chatanika River to low-grade mining districts in the territory between Chatanika and Miller House, but until the prospects show progress toward development wagon roads should answer the purpose.

As to the territory adjacent to Yukon and Circle, the reports state that it has been reported that there are frequent bodies of ore.

War Minerals Relief Staff Enlarged

Commissioner Robinson Recommends Two Additional Awards—Further Disallowances

Three additional mining engineers and two additional auditors are to be added to the staff of the War Minerals Relief Commissioner. The claims are being grouped geographically so that the work can be expedited.

Three engineers from the Bureau of Mines staff will be given leave of absence to accept this temporary service under the War Minerals Relief Commissioner. Karl Baumgarten, now at the Mississippi Valley Experiment station, and R. V. Ageton, now at the Houghton station, have been selected for this work. The third engineer is still to be selected.

Subject to the approval of the Secretary of the Interior, Commissioner Robinson has recommended an award of $32,404.50 to the Markstein-Dorn Mining Co. and the Carribee Mining Company, of Atlanta. These companies were awarded $15,705.54 by the former commission. The additional award is based on the longer period of stimulation and on the acceptance by Commissioner Robinson of evidence establishing commercial importance of a portion of the operation.

An award of $483.40 also was recommended for R. H. Walden, of Phillipsburg, Mont.

Disallowances and reasons therefor were recommended in the following cases: Edward E. Marshall, Philadelphia, not within the act; Johnson, Hale and Miller, Narrows, Va., stimulation not established; Loyalty Mining Association, Holdenville, Okla., stimulation not established; Anderson Manganese Co., Kansas City, commerical importance not established; Western Ores Co., Oakland, Cal., losses not incurred during the period of Government stimulation; E. C. Humphreys Co., Chicago, losses not established; Atlantic Ore Alloys Co., Philadelphia, not within the act; Pereira Bros., Jamestown, Cal., not within the act; Manganese Mining Development Co., Kansas City, stimulation not established; W. L. Marshall, Blackwell, Okla., stimulation not established.

Drill Steel Survey Work in Field Completed

Field work on the drill steel survey practically has been completed. As a result, F. P. Foley has returned to the Minneapolis experiment station of the Bureau of Mines to continue laboratory work. Prof. Charles Y. Clayton and H. S. Burnholz are now at the Rolla station writing up the results of their observations in the field.

News by Mining Districts

London Letter

Prestea Block "A"'s Future Depends on New Orebody—National Mining Corporation Cleans Slate

BY W. A. DOMAN

London, June 16—Prestea Block "A," of which so much was expected at one time, again disappoints its shareholders. During the past calendar year, 87,053 tons of ore was milled, for a recovery of 35s. per ton at the standard price of gold, though the excess price obtained raised the revenue to 43s. 7d. per ton. As working costs amounted to 61s. 7d. per ton, there was a debit on the year of £98,842. Development added only 4,512 tons to the ore reserves, and the expenditure on this account was no less than £40,136. At the beginning of the year the tonnage was 199,315, averaging 41.11s., and at the end 120,481, of a value of 42.2s. per ton, showing a heavy depletion. The reserves stand in the books at £89,084, which is equal to the high figure of 14s. 7d. per ton. The future of the mine depends upon what is known as the new lens. So far this gives encouragement, as here indicated:

Level	Sampled Feet	Average Value	Width Inches
14.	400	32s. 4d.	61
15.	110	45s.	62

The above figures were in the annual report. A message received from the mine for yesterday's meeting gave even better results: No. 15 level, 145 ft.; average reef width, 59 in. assaying 48s. 9d.; No. 14 level north drive, last 135 ft., 71 in., assaying 39s.; face of level solid reef is 99 in. wide, assaying 73s.; No. 14 level south, 160 ft.; average width 64 in., assaying 36s. 9d. per ton.

The "B" reef at the twelfth level south of Prestea shaft gives 38s. 6d. over 62 in. for 110 ft. To develop the property, further funds are required, and £50,000 is to be raised by the issue of 6 per cent debenture stock. Owing to the unsatisfactory condition of the balance sheet, the capital is to be reorganized, and 16s. per share is to be written off. Of the 100,124 shares unissued, 3,750 are to be divided into "B" shares of 1s., entitled to one-third of the divisible profits, and the rest into 4s. shares, to be held in reserve. If additional funds are not provided, the only alternative is to close down the mine, a course which the engineer does not recommend.

While Cornish mining has received a good deal of assistance, it is still in a bad way, owing to the continued low price of tin. There are now indications, say the directors of the Geevor Tin Mines, that the lowest prices have been recorded. Reductions have also taken place in the cost of fuel, timber, and other mine supplies, so that it is possible to employ additional labor. Apart from putting the mine and plant in order, little work has been done at the Geevor during the last year. The directors are looking ahead, and state that the completion of sinking the Victory shaft to the seventh level and the necessary equipment and crosscutting to the lodes are a prime necessity for the more economic working of the mine and increased output of ore.

At the annual meeting of the Modderfontein "B" Gold Mines, the chairman, Sir Evelyn Wallers, made special reference to development results. It appears that from the standpoint of payability, the area is divided into two parts, the northeastern and southwestern sections. The bulk of the payable ore is in the latter section. General conditions are said to be not very encouraging.

Herbert Guedalla, chairman of the National Mining Corporation, experienced no difficulty in proving to shareholders at yesterday's meeting that the troubles of the company were due to the low prices of metals. He was further able to state that the Burma Corporation was reporting satisfactory developments, and that matters are looking more hopeful at Santa Gertrudis and Fresnillo; and that there are also good possibilities in the South American Copper Syndicate and the Ayan Corporation, formed to work a promising gold mining area in Eastern Siberia. Shareholders, as a result, unanimously approved the writing down of the capital and the liability on the shares in order to wipe out the depreciation and go forward with a clean slate.

FRANCE

Iron Ore Output in the Republic Declines at Quarter's End

By Reuters Agency

The production of iron ore in France during the first four months of 1922 amounted to 1,298,712 tons in January; 1,308,104 tons in February; 1,553,900 tons in March, and 1,379,721 tons in April. As will be seen, the production, which had increased during the first quarter of the year, fell rather seriously in April. Stocks at the end of March showed a reduction compared with the January figure (3,911,401 tons against 4,199,272), and this decline continued in April, when the figure fell to 3,667,319 tons.

BURMA

Burma Corporation Reports Production for May

Namtu—During May the Burma Corporation milled 14,282 tous of ore in its treatment plant, producing 9,762 tons of lead concentrate. Also, 11,277 tons of lead-bearing material was smelted in the blast furnaces, producing 3,516 tons of hard lead for treatment in the refinery. The refinery products were 3,140 tons of refined lead and 296,392 ounces of refined silver.

KOREA

Unsankinko.—The Oriental Consolidated's cleanup for May was $89,000.

Johannesburg Letter

Currency Commission Against Further Inflation—Black Labor Requirements Estimated

BY JOHN WATSON

Johannesburg, May 23—The report of the Currency Commission was published on May 18 in Capetown. The commission is of the opinion that every endeavor should be made to revert as speedily as possible to the gold standard as it existed before the Great War, under which all notes were convertible on demand into gold, which could be freely exported, and that henceforth nothing be done which will in any way retard the achievement of this object.

The commissioners recommend that the South African Reserve Bank be authorized to take such steps as be deemed advisable, and as experience may show to be expedient, to prevent any further inflation of the currency of the Union, and that the policy of returning to specie payments on the gold basis at the earliest possible moment be steadfastly pursued.

The Government Department of Mines has just issued valuable statistics showing the purchases of the mines during 1921. The gold mines spent close on £14,500,000 last year, which was the largest amount on record. The figures for the past three years for all the union mines are as follows: 1921, £17,558,858; 1920, £17,843,310; and 1919, £15,901,276. The Central Mining & Investment Corporation has arranged the purchase from the Custodian of Enemy Property of the shares and debentures in his possession held by enemy subjects in the various companies which are administered by that group. This amounts to about 800,000 shares. The purchase price will be 2s. per share. These shares will be used to reduce the company's issued capital.

The question of native labor in the Union was discussed on May 18 before the Mining Industry Board. The total native male population of South Africa (excluding Rhodesia and all British country north of latitude 22 deg. south) is estimated as follows: Union of South Africa, 2,241,931; Basutoland, 260,169; Swaziland, 52,761; Bechuanaland Protectorate, 55,000; total, 2,609,891. William Brace asked how many natives the mines required and to how many white men would such native employment provide supervising positions. Mr. Gemmill replied that a figure of 40,000 had been mentioned as one to meet the industry's requirements. On the 10.5 ratio this indicated approximately 4,000 whites. It would be of no use in the present emergency, as in any case the absorption would take some time. The scales of pay were so fixed that the average earnings of all native workers underground could not exceed 2s. 3d. per shift.

BRITISH COLUMBIA

Providence Mining Co. Stockholders Hold Meeting at Greenwood

Greenwood—With the view to the re-starting of mining in this district, enterprising citizens have contributed funds and labor for the pumping out of the old Barbara and Helen mines, so that they may be examined by engineers, representing capitalists who are prepared to put money into the venture if the reports are satisfactory.

A meeting of shareholders of Providence Mining Co. is to be held here on June 28, according to permission of the provincial courts, given to a number of stockholders, following application for permit to call the meeting. Behind the application is alleged to be a dispute between the present directorate and the British Columbia shareholders. An action for foreclosure by the debenture holders was started recently, and it is alleged that the debentures are held largely by the directors, the majority of whom reside in Chicago.

Grand Forks—Work has been resumed at the Rock Candy mine and mill at Lynch Creek. The mine has been closed for about a year. In 1920, 7,500 tons of fluorspar concentrate was shipped from the mine, most of the product going to Gary, Ind. It is understood that the Consolidated company has negotiated a contract that will keep the mine in operation for at least twelve months.

Stewart—Much activity is being shown throughout this district, and development work is beginning in many places. S. G. Benson has stripped a 2-ft. vein for 250 ft. On the Lucky Boy claim, and samples from it average $126 per ton in silver and lead. The claim is only 100 yd. from the new Government trail up Fish Creek. Grant Mahood has returned from Vancouver, where he succeeded in organizing the American Mining & Milling Co. with an authorized capital of $1,500,000. Attention will be turned first to the Betty group, seven miles north of the Premier mine, and $100,000 is to be spent in its development, under the superintendence of W. M. Irwin. Promising ore has been exposed on the surface. Harry Hawson arrived recently to take charge of development work at the Big Missouri for A. M. Trites and associates.

Trail—Ore received by the Consolidated smelter June 8 to 14, inclusive, totaled 8,117 tons, of which 7,193 came from company mines. Other shippers were: Bell, Beaverdell, B. C., 42; Highland, Ainsworth, B. C., 87; Quilp, Republic, Wash., 106; Sally, Beaverdell, B. C., 37; Silver Standard, New Hazelton, B. C., 40; Silversmith, Sandon, B. C., 452; Surprise, Republic, Wash., 104; Silver Hoard, Ainsworth, B. C., 17, and Whitewater, Retallack, B. C., 39.

Ore shipments for the week ended June 15 to 21 totaled 9,708 tons, of which 8,889 was from company mines.

ONTARIO

Boston Creek Stockholders Authorize Capital Increase

Boston Creek—At a special meeting of the shareholders of the Boston Creek Mining Co. held in Toronto on June 2 a bylaw was adopted authorizing an increase in the capital from $2,000,000 to $4,000,000. The directors were also authorized to purchase several properties from E. U. Richardson for 580,000 shares and $180,000 cash.

Arrangements have been made for reopening the Patricia, which reverted to the original owners owing to the failure of the Patricia Syndicate.

West Shining Tree—A working option on the Herrick for one year has been secured by American interests. Work will be started immediately. The shaft, now down 140 ft., will be sunk to a depth of 400 ft., and at least 2,000 ft. of lateral work will be undertaken. The result of sampling is stated to indicate ore of a grade ranging from $10 to $12 per ton.

Cobalt—It has been definitely announced that the New York interests which recently acquired the Colonial, will sink a 900-ft. shaft to reach the diabase-Keewatin contact where the extension of the O'Brien main vein is looked for.

The old La Rose mine, which became flooded this spring, is being pumped out, and work will be resumed. The pumping out of the La Rose Extension, which has been under water for several years, is practically completed and considerable development will be undertaken at the 400 level.

With the tailings retreatment plant in operation the Mining Corporation is treating a total of 700 tons a day.

NEW BRUNSWICK

Provincial Government to Offer Bonus to Mining Operators

Under the direction of the Minister of Mines in the New Brunswick government, it is planned to offer bonuses to companies operating the mineral lands within the confines of New Brunswick. At present, although companies are operating soft-coal mines in the Grand Lake field, oil shales in Albert County, salt deposits and mineral waters of Kings County, and natural gas deposits of Albert County, there are extensive deposits of metal as yet undeveloped within New Brunswick.

It has been recently reported that a company will soon be organized to develop the Charlotte County areas, and also to investigate what possibilities are in the development of the iron-ore deposits of the same section of the province.

MEXICO

Sinaloa

Many Mining Scouts Reported in Eastern Section of State

Mocorito District—The Potrero, a gold property with a seventy-ton stamp mill and cyanide plant, is working on a slightly reduced scale on account of water shortage.

Badiraguato District—The Guajolote, a gold property in the Badiraguato district, is being worked with a Gibson mill by the owners. It is said that they have a considerable ore reserve. The ore is free milling, and is said to yield 75 per cent of the gold value by simple amalgamation.

The San Luis Gonzaga silver property, in the Badiraguato district, belonging to Fred Avery, of Columbus, Ohio, and associates, is closed at present, awaiting the arrival of machinery that has been purchased.

San Lorenzo District—The old Carmen mine is being unwatered by J. B. Hymes and associates, of San Francisco, Cal. This mine, together with others in this district, was a large silver producer in the days before the revolution.

Lem Shattuck, of Bisbee, Ariz., and J. T. Wallace are opening up a copper deposit in the San Lorenzo district. This is a new property and shows a general width of vein on the surface of over 40 ft., carrying about 4 oz. silver, 5 per cent copper, and a small quantity of gold per ton.

There are a great many scouts in the field, and it looks as though early recognition of the Obregon government was anticipated.

Nayarit

Cori Gold Mines to Build Camp—United Eastern Working Tigre Near By

Acaponeta — The properties of the Cori Gold Mines Co. situated near Acaponeta, Nayarit, Mexico, have recently been examined by Raymond Guyer, vice-president and consulting engineer of the company. Development work has been in progress for the last year, and has resulted in the exposure of two oreshoots running well in gold, according to the company.

The company is planning the installation of a permanent camp, compressor and milling machinery. The Cori vein is a continuation of the Tigre vein.

Work on the adjoining Tigre property, owned by the United Eastern Mining Co., of Oatman, Ariz., is being actively pushed. The company is sinking three shafts on the Tigre vein and has completed a wagon road to the property and installed a compressor.

Durango

Tamazula District—J. J. Nicholl and associates, of London, England, have installed a small Gibson mill on a property recently purchased from Primitivo Zazueta. This is a gold and silver mine said to contain platinum in commercial quantities.

The Zalate mine, also in the Tamazula district, is being worked by the Espinosas. Miguel Espinosa is in charge. This is a silver property, with a considerable record of production. Ore shipments are being made to Culiacan.

CALIFORNIA

Sixteen-to-One's Recent Strike Yields Over Half Million in Gold

San Francisco—The Sixteen-to-One mine, at Alleghany, is reported to have mined over $500,000 of gold ore from the recent strike within somewhat over two months.

The most important mining enterprise in northern California is that of the Shasta Zinc & Copper Co. at Winthrop. The smelting plant has been recently placed in operation and has about reached its smelting capacity. Many technical problems had to be solved before a commercial zinc oxide product was obtained. The zinc oxide product is up to commercial grade and will find a ready market in the manufacture of paint and commercial rubber products.

In the Rough and Ready district, Nevada County, the Osceola is being reopened; the Alta Combination is driving an adit to tap the Alta gravel channel; the Alta California is extending an adit into the Holbrooke ground. The Alaska mine at Pike City is to be reopened by the Sierra Alaska Mining Co. The Valentine mine, at Mohawk Valley, is to be reopened and equipped by G. H. Stephan, of Quincy. The Emigrant Hill mine, near Elizabethtown, in Plumas County, has been abandoned, the reported reopening resulting in little encouragement.

The twenty-five-mile railroad constructed by the Imperial Gypsum Co. to its gypsum deposit in Imperial Valley has been completed, and the gypsum plant is being constructed. Officers elected at a recent meeting are W. H. Coons, president; J. S. La Sha, and J. W. Kelley, vice-presidents; H. C. Hotchkiss, secretary; H. C. Peterson, treasurer; and S. W. Dunaway, manager. The headquarters of the company are at San Diego.

NEVADA

United Comstock Cuts High Grade in Yellow Jacket Mine—Tonopah's Production Increasing

Virginia City—It is reported that the United Comstock has cut a body of high-grade ore on an intermediate level of the Yellow Jacket mine. This is in a portion of the Comstock lode which has produced a large tonnage of bonanza ore.

There is an unconfirmed report that a new deal is on covering the Middle Mines group, which is being financed by Eastern interests.

The Comstock Silver has encountered pay ore in cleaning out old workings on the 260 level near the Overland shaft. This ore is in the Succor vein, and development is being continued as rapidly as possible.

Tonopah—According to figures compiled by the U. S. Geological Survey, total silver production of Nevada for 1921 was 7,083,782 oz., compared with 7,745,093 oz. for 1920. Production for Nye County, practically all of which came from Tonopah, was $6,042,036. At present rate of production, which has been maintained since Jan. 1, the Tonopah district will produce ore valued at over $7,000,000 in 1922.

The Tonopah Extension developments on the 1,880 level of the Victor shaft continue highly satisfactory. In one place at least the orebody has been proven to have a width of over 50 ft., and is of average milling grade.

The West End Consolidated's production in May was 10,000 tons, which is the largest monthly output ever made by this mine. Developments at the Halifax above the 900 level continue favorable and this company is shipping at the rate of 1,000 tons per month.

In the Midway mine the discovery made about the middle of April on the 1,200 level has so far proved disappointing. Good values are found, but the shoots are small.

Divide—Tonopah Divide's output during May was 1,690 tons, of an average value per ton of $34.10. Net returns to the company, after deducting metal losses and milling charges, were $41,809. This is slightly lower than the April figures, although tonnage is 126 tons greater.

The Gold Zone is shipping at the rate of 200 tons of ore monthly.

UTAH

Godiva Likely to Reopen—Park Nelson to Sink—Vipont Shipping Steadily

From Our Special Correspondent.

Eureka—Ore shipments from the Tintic district for the week ended June 16 amounted to 179 cars. Shippers were: Chief Consolidated, 50 cars; Tintic Standard, 48; Iron Blossom, 19; Victoria, 13; Eagle & Blue Bell, 13; Colorado, 10; Grand Central, 10; Swansea, 3; Sioux, 3; Mammoth, 3; Alaska, 2; Dragon, 2; Bullion Beck, 1; Gemini, 1; Tintic Drain Tunnel, 1.

Equipment is on hand at the Grand Central, and it is expected that the electrification of the hoist will be completed early in July.

There is prospect that the Godiva, controlled by the same interests as the Gemini and the Ridge & Valley, will be reopened during the summer, owing to the favorable prices for silver and lead, which would make it possible to exploit the lower-grade lead-silver ores.

Park City—Shipments for the week ended June 16 amounted to 4,523 tons. Shippers were: Ontario, 2,270 tons; Park-Utah, 873; Silver King Coalition, 785; Judge, Daly and Daly West, 595.

The Park Nelson Mining Co. is preparing to sink a shaft on its claims, which are about a mile and a half east of the Park-Utah, in the eastern section of the camp.

Oakley, Idaho—The Vipont Silver Mining Co., owning claims in Box Elder County, Utah, near the Idaho line, with Oakley the nearest shipping point, is working about 300 men in its mine and mill, and making steady shipments of concentrates.

MONTANA

Miners Scarce in Butte District—Great Falls Works at Capacity—Neihart Company Completes Lease Payments

Neihart—Final payment on $100,000 for the lease in the Neihart district owned by the William Mueller estate has been made by the Neihart Consolidated Silver Mining Co. The lease was made two and half years ago, since when the mine has paid for itself out of the 25 per cent royalty, more than $400,000 in silver having been produced. Ninety-five men are employed and the property is being developed. There is a mile and a half haul to the railway. Although the principal metal is silver the lead recovered has been sufficient to pay the hauling and smelting charges.

Stockholders of the Neihart Silver Mines have authorized the directors to dispose of any of the company's property without calling a special meeting. The property in the Neihart district adjoins some of the claims recently taken over by the American Smelting & Refining Co.

Butte—Lack of miners is still handicapping the big properties in the Butte district. Anaconda's Mountain View mine, employing between 500 and 600 men, has shut down, and the miners have been distributed to other mines.

East Butte's new Pittsmont shaft is now bottomed between the 2,000 and the 2,100 levels. It will be continued to the 2,200 level when two new levels will be opened.

Operations at the Richmond mine, on the Idaho-Montana line, have been resumed, starting from the St. Lawrence tunnel on the 600 level. Permanent use of the Montana-Idaho company's long tunnel has been secured.

Great Falls—The reductions works and mills of the Anaconda company are working practically at capacity for the first time since the war ended. The copper refinery is reported to be running at about 90 per cent of its capacity and the zinc plant, rod mill, and wire mill at capacity. About 1,200 men are employed.

WASHINGTON

Republic—Operations at the Knob Hill mine have been started by Balakala Consolidated Copper Co., a California concern, which purchased the property in the spring. Some new equipment is being installed. E. C. Blades, of Los Angeles, is superintendent.

OREGON

Durkee—The Delaware Mining Co. has a crew of eighteen men employed in development of the Lost Trail and Gallagher properties, twelve miles from here. Operations are being conducted under superintendency of P. J. and G. H. Jennings. The principal work in hand consists of the driving of a 1,200-ft. crosscut, which is expected to cut four ledges.

ARIZONA

Dispute Over State School Lands Likely—Oatman to Suppress False Reports Hurting Mines

Phoenix—Something of a clash is imminent between the United States of America and the sovereign State of Arizona. In the latter part of 1910, in the Statehood Enabling Act, Arizona was given all the school sections or other lands in lieu thereof, this land grant in addition to a number of others for specific purposes. The Federal Land Office asserts that it has the right to reject selections made by the Arizona Land Department whenever it shall have been established that mineral exists upon the land sought to be appropriated. Thus, there have been many rejections and at least sixteen sections have had rejection of filings within a short time. State Land Commissioner Rudolph Kuechler, of Phoenix, asserts, however, that the United States has no power to question the state's title to school lands already allotted to the state, and he will test this in the courts, if necessary. He now is leasing a tract of school land undoubtedly mineral in character, lying around Squaw Peak, in the Phoenix Mountains, about ten miles north of Phoenix. This particular section is rich in quicksilver and also has outcroppings of copper and gold, and shale found in the locality is valuable for building material.

Recently the managers of some of the larger Arizona mines have appeared before the Arizona Tax Commission at Phoenix, seeking reduction of taxation on their properties. The ordinary method of assessing taxes on the basis of five-year production periods, may be modified this year, to raise needed state revenues. It is understood that such return to arbitrary assessment is being opposed by the mining corporations, which pay over half the state's taxes.

Oatman—The Oatman Mining and Business Men's Association has made announcement that summary punishment will be inflicted upon anyone who, for the purpose of depressing stock values or for any other reason circulates false and derogatory reports concerning any local mine. It is charged that lying telegrams have been sent abroad, much to the injury of the mines under development.

Superior—The Magma Copper Co. is preparing for production of copper at a profit even under such price conditions as those at present. The big item of transportation is to be decreased by the local handling of all ores and by construction of the company's new broad-gage branch railroad, avoiding the present necessity for breaking carloads and reloading. The new road, too, will have a maximum 2-per cent grade and 12½-per cent curves, compared with 4-per cent grade and 50-per cent curves on the present inadequate narrow-gage.

Some doubt is expressed whether the overhead of the new smelter in the way of interest, depreciation, and maintenance will not bring the gross cost up to that which would be incurred in sending the ores and concentrates to the Hayden smelter, forty miles east of Magma Junction, but it is said that the added transportation cost would more than cover these items.

COLORADO

Buel Mine at Central City Leased to C. A. Linderman

Central City—C. A. Linderman, representing Iowa interests, has leased the Buel mine and is preparing to unwater it. Installation of the power line to the Wayne mine, in Chase Gulch, has been completed, and as soon as the transformer is in place the company will start unwatering.

After ten years' idleness work has been resumed at the Sherman tunnel in Silver Creek.

Blake & Co. has taken a lease on the Palace group and is retimbering the lower tunnel from which a large tonnage was taken in the early days of the camp. Work in the Snowden tunnel has recently been resumed, and a strike of good ore has been reported.

JOPLIN-MIAMI DISTRICT

Standard Mine Near Picher, Once Abandoned, Yielding Much Ore

BY P. R. COLDREN

Joplin—The Blue Ribbon Mining Co., owned by Harry Hawkins, of Miami, has just started a new concentrator at work on its lease south of Hockerville, Okla. It is a small mill of about 200 tons capacity, though the ore is so rich that it is doubtful whether this tonnage can be handled. Oil engines transformed to use gas furnish the power. The company is sinking a new mill shaft, and has it down to 130 ft. but will go to about 155. A large percentage of the production is lead. H. Bryan is superintendent.

The Right Good Co., which recently started a new concentrator southwest of Hockerville, is sinking a new shaft southwest of the mill, which will give three shafts. Equipment at plant includes four Boylan cones. The mill was designed for four Boylan rougher slimers, which are to be installed a little later.

J. W. Creech, L. C. Doke, Roy Cook, and William Lowe, practical miners are successfully operating the Standard mine, west of Picher, that was abandoned about a year ago. The miners could have bought the lease and mill for $3,000, but they leased it instead and already have paid the owners more than $5,000 in royalties and are just getting into a lead cave where they estimate there is more than $400,000 worth of lead. The cave is about 150 ft. long, and similar to those caves discovered some time ago at the Laclede mine. The company has sold $40,000 worth of ore since the first of the year, working only a small crew.

MICHIGAN

The Copper Country Production Falling Somewhat on Account of Labor Shortage

BY M. W. YOUNGS

Houghton—Labor has become an important factor in the mining situation in the Lake district, and were the mines called upon at this time to increase production largely some would have difficulty in meeting the demand. Production for June will be under that of May. The district normally produces about 22,000,000 lb. of copper a month. The May output, refined, was approximately only half of that. Current metal sales are a little under production in volume.

Copper Range is devoting more attention to actual mining at present than opening work, due to a labor shortage. It can afford to do this as its mines are opened well ahead, a vigorous program of development having been carried out last year. Emphasis then was placed on development rather than production, owing to the limited demand for the metal. Physically, all three properties of the company are in good condition. Champion and Baltic continue in ground of average quality for these properties and Trimountain continues to show improvement at depth. All of the lower levels in Trimountain are better than those above.

Like Copper Range, Quincy will show a reduction in production this month, due to loss of underground men. It should, however, produce in excess of 1,000,000 lb. Quincy is using loading scrapers successfully, these helping to solve the labor problems.

With the sinking of another 150 ft. in the New Baltic shaft, which has been decided upon by New Arcadian, it will be possible to test the lode at depth both as to mineral content and physical character. The vein has shown up so promisingly at the bottom level, the 1,100, both south and north, with no faulting, that the management is eager to cut it at greater depth. The south drift at the 942 level has cut through the fault recently met, and is again in vein matter. This drift will continue south toward the New Arcadian shaft.

Mohawk has been hit by a labor exodus from the district, but probably to a less extent than the mines in the south end. Production continues around 1,000,000 lb. a month.

There is little change in Calumet and Hecla's operations. Nos. 9 and 10 shafts, South Hecla, are producing regularly, and sinking is under way in Nos. 6 and 7, Hecla. At the smelter, nine furnaces are in operation. The plant treats the mineral of its subsidiaries as well as that from the Calumet mill. At the mill eight heads are stamping rock and two more are being prepared.

At Mayflower-Old Colony, developments continue encouraging. On the 1,700 level, the drift has been alternately in vein and trap matter, with occasional rich stretches. At the 1,450

level, drifts will be started both north and south from the crosscut. More attention will be paid to the ground to the north because of the opening work in that direction on the lower level.

Gogebic Range

Wakefield Pit Shipping—Heavy Rain Causes Delay

Ironwood—At Wakefield the Plymouth pit has been working two steam shovels, one in ore and the other in rock, and has been shipping about 3,000 tons per day to Ashland. The Wakefield pit has had two shovels stripping and preparing approaches, and has had its 300-ton shovel working in ore but not shipping. The company is starting to ship. Heavy rain on June 15 filled the pits to a depth of seven feet besides washing out tracks and covering others with mud. This caused considerable delay.

Practically all of the underground iron mines on the Gogebic Range are working full time. Several of them are not yet employing their usual number of men because, having been shut down, their workings need repairs. The open pits are ready for production and the Plymouth has shipped two cargoes, but no regular schedule of shipping has yet been received. It is understood that the Wakefield pit some time ago received orders for 100,000 tons of ore, but as yet no shipments have been made.

The mines of the U. S. Steel Corporation, which include the Nome-Aurora-Pabst group, the Davis-Geneva, the Royal-Puritan and the Tilden mines, were able to resume full-time operations immediately the order was received, as they have not been shut down and their crews were intact. They have, however, not yet started shipping ore; all hoisted (about 5,500 tons per day) is being placed on stockpiles which now amounts to 1,250,000.

The Newport Mine (Steel & Tube Co. of America) is hoisting and shipping about 2,000 tons per day. Some ore is also being shipped from stockpiles, where there is about 500,000 tons. The Anvil-Palms-Keweenaw mine (Steel & Tube) is getting back to a production of 2,500 tons daily, and is shipping some from stockpiles of about 240,000 tons.

Of the Oglebay-Norton Co. mines the Montreal is working full time, hoisting about 1,300 tons daily, and making no shipments. It is employing about 500 men. The Ottawa is also working full time, but chiefly on development work. The Eureka at Ramsay is working full time and shipping its hoist. The Asteroid is sinking a shaft, and the Castile is shut down completely, with no prospect of reopening soon.

Besides the Plymouth pit, Pickands-Mather & Co. is working the Cary mine.

The Republic Iron & Steel is shipping the hoist from the Townsite mine and also from the Plummer, both small mines now.

The Charcoal Iron Co. of America has 300 men working full time at the Yale mine.

The McKinney Steel Co. is hoisting and shipping about 1,000 tons per day at its Ironton mine. The Colby is shut down.

Thus no more than half the ore being hoisted on this range is being shipped to docks and furnaces, and very little is being loaded from stockpiles. However, the mines are resuming their normal rates of production as rapidly as possible and employing more men as soon as they get working places for them.

Most mines have now come up to the wage scale established by the U. S. Steel Corporation, or only a little lower. Their rate for contract miners is about $4.06. Some of the independent companies paid as low as $2.95 the past months.

It is reported that an attempt will be made to ship ore from the Morgan mine this summer. The property is operated by the Thomas Furnace Co., of Milwaukee, and is situated at the eastern end of the range, several miles east of any producing mine. A considerable quantity of bessemer ore has been developed, but none has been shipped.

Montreal, Wis.—The Montreal Mining Co.'s No. 5 shaft is now down 700 ft. It is 11 ft. 4 in. x 18 ft. outside of timbers, has one large cage compartment, two skip compartments, and two ladder and pipe compartments beside the skip compartments. The shaft will be a duplicate of the "H" Pabst shaft of the Oliver Iron Mining Co. at Ironwood, lined with steel sets built up of "H" sections, but will have creosoted wood lath in stead of reinforced concrete as at "H" Pabst. Work has been started on the new engine house.

Menominee Range

Building Houses at Rogers Mine

Iron River—Fourteen dwellings are being erected at the Rogers mine location. Most of the mines in the district are now being operated, and steady shipments are being maintained. Some of the operators report a shortage of labor.

Marquette Range

Cleveland-Cliffs Resumes at Cliffs Shaft Mine

Gwinn—Operations have been resumed at the Austin mine, closed since last summer.

Negaunee—The South Jackson pit has closed down after being in operation but a few weeks. A small tonnage was sold and shipped for the manganese which it contained.

Ishpeming—The Cleveland-Cliffs Iron Co. is to resume operations at its Cliffs Shaft mine, following a year's idleness. This is one of the largest producers of hard hematites in the Lake district, and there is considerable ore in stock, of which part has been sold for delivery this year. Shipments from the Marquette Range have improved since the reduction in freight rates.

ALABAMA

District Furnaces Taking Half Million Tons of Ore Weekly—Labor Scarce

BY GEORGE HUNTINGTON CLARK

Birmingham—Mining activities in Alabama have shown gratifying increases thus far during June. An iron-making output of 200,000 tons for the month by the twenty-one active stacks is now indicated, which will call for something over a half million tons of ore mined, with corresponding relative percentage increases in coal mining and in coke production.

On June 1 there were nineteen active stacks in the state and on June 5 two more were added, the Sloss-Sheffield bringing in the Philadelphia furnace, and the Shelby Iron Co. resuming activities on charcoal iron at its Shelby stack, blown out for repairs March 3, making a present total of twenty active stacks on coke and one on charcoal iron.

Operations of the other companies remain about as previously noted, the Tennessee Coal, Iron & R.R. Co. having eight of its total of nine, and the Gulf States Steel Co. three of its six open-hearth furnaces under production.

In steel production, the Tennessee Coal, Iron and R.R. Co. has been at 100 per cent capacity for three months, and as far back as March broke all previous high records in ingot making and in the rail and blooming mills.

With furnace stocks stated as reduced to about 60,000 tons of all grades, and less than 40,000 tons of merchant iron on hand at the beginning of the month, the Birmingham Iron market may be said to be approaching one of the strongest statistical positions in its history.

Coal mining has finally begun to receive a marked impetus from outside buying, which is confined to western railroads and districts. Kentucky and Tennessee coal mines are meeting all demands for coal from the strike-affected sections in the north.

Outside demands are estimated to be approximately 50 000 tons weekly, which if correct indicates a normal weekly coal output that approaches 330,000 tons.

Should the strike continue, the limit of production of the state, which is estimated at not over 375,000 tons per week, may soon be reached.

Employment conditions have been materially benefited by the increase in furnace operations.

Following a first and second voluntary increase in wage scale recently made by both the Tennessee and Woodward companies, it has been found expedient to open labor employment offices, which is marked evidence of renewed industrial activity.

The supply of common labor is becoming severely limited, and an acute shortage is so strongly indicated that efforts to remove labor from the district are being opposed by every possible means.

THE MARKET REPORT

Daily Prices of Metals

June	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
22	13.45@13.50	30.375	31.125	5.75	5.50@5.60	5.30
23	13.50	30.25	31.125	5.75	5.50@5.55	5.30
24	13.50@13.60	30.25	31.125	5.75	5.50@5.55	5.30
26	13.50@13.60	30.375	31.00	5.75	5.50@5.55	5.275@5.30
27	13.50@13.625	30.25	31.00	5.75	5.50@5.55	5.275
28	13.50@13.625	30.125	30.75	5.75	5.50@5.55	5.275

*These prices correspond to the following quotations for copper delivered: June 22d, 13.70@13.75c.; 23d, 13.75c.; 24th and 26th, 13.75@13.85c.; 27th and 28th, 13.75@13.875c.

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

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

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

June	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
22	61¾	62⅛	69	152¼	153¼	24¾	23⅝	27⅝	27¾
23	61½	62	69	152¾	153¾	24½	23½	27½	27½
26	61⅝	62⅛	69½	152⅝	153¼	24⅜	23½	27⅝	27½
27	61½	62	69½	152⅜	153½	24⅜	23½	27¾	27⅝
28	61¼	61¾	69½	152⅜	153½	24⅝	23⅝	27⅝	27½

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

Silver and Sterling Exchange

June	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	June	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
22	442½	99⅝	70⅜	35⅜	26	438	99⅝	70	35⅞
23	441	99⅝	70¼	35⅞	27	441	99⅝	70¾	36⅛
24	439	99⅝	70⅛	35⅞	28	440¼	99⅝	70¾	36⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, June 28, 1922

The week has been generally quiet in the metal markets. This is partly attributable to the usual lull at this time of the year, and partly to the continuance of the coal strike and the unsettled condition of railway labor. The coal strike is not causing any serious trouble as yet, but if conditions do not improve some Middle Western plants may be forced to close down in another month. There is more of an indication that the Government will make a serious attempt to settle the dispute. The projected strike of railway shopmen and maintenance of way employees is not considered seriously, and no important tie-up of traffic is likely at this writing. Transpacific freight rates are reported by wire from San Francisco to be $5 per gross ton.

Copper

Demand for copper has improved somewhat. The small lots which were available at the close of last week for less than 13.75c., delivered, were quickly absorbed, and beginning with Friday practically all copper sold netted producers at least 13.50c., f.o.b. refinery. Several producers held all week at 13⅞c. delivered, but did little business at that level, though they report that they had several offers at ⅛c. under this price. Today there is no diffculty in getting copper at 13.75c. where the freight rate is not too high. Some producers report that they were enabled to get orders because they were in such position that a railway strike would not seriously embarrass them, and that they were therefore in little danger of not being able to make deliveries. Some consumers report that their spring orders have been pretty well filled and that they expect to curtail slightly for the next month or two. September requirements of crude copper have not yet been booked on any large scale; in fact, many buyers have not yet placed their orders for all that they will need in August.

Foreign demand for copper was very weak, though the prices obtained generally netted producers about one-quarter cent over the domestic business. The Far East is buying nothing now, and what little copper is being sold in England is sold by English dealers.

Lead

The official contract price of the American Smelting & Refining Co. continues at 5.75c., New York.

Lead is perceptibly easier, both here and in the Middle West. Though some good orders have been placed, the aggregate tonnage is much below that of recent weeks. Lead has been easily available at 5.75c., New York, all the week, and it is not likely that any producer has been able to get more than 5.775c. Today it is even possible to obtain good corroding lead at 5.75c. The 2,000 tons of Penarroya lead which was imported to this country over a year ago has been actively offered this week at 5.85c., but none has been sold so far as we learn. This lead is reported to be of the best corroding quality, but the pigs are cast a little longer than usual here.

In St. Louis, lead has been freely offered practically all week at 5.55c., with the indication that this price might have been shaded on inquiry. The interest selling at 5.50c. last Wednesday continued quoting at that level throughout the week for near-by deliveries. One large producer remains at the 5.60c. level, but sales at that price have not been active, to say the least.

Much of the Mexican lead continues to come into this country, and lead is available for shipment from Tampico at current prices, duty paid. This Mexican lead is helping greatly to prevent a runaway market here; in fact, without this supply 6c. lead would probably have been reached before this, domestic production probably not being much more than 10 per cent greater than a year ago.

Lead for forward delivery is obtainable from those interests willing to sell it at about 2½ points advance over July prices.

Zinc

The zinc market has been exceptionally quiet, brass makers seeming well provided for the present with Prime Western zinc, and galvanizers holding off pending settlement of the coal strike. Most producers are unwilling to sell at present levels and the market price is being set by dealers. The prices quoted are for June and July deliveries. August and September could be obtained at from 2½ to 5 points premium. High-grade zinc continues in good demand at 6.25c., with 30c. per 100 lb. freight allowance.

Tin

Practically no consumers have been in the market. A little business has been done among dealers, but the volume of trading is the smallest for weeks. Forward tin was quoted at the same prices as spot, for the most part.

Arrivals of tin, in long tons: June 17th, Liverpool, 25; 23d, Liverpool, 50; London, 25; 24th, Straits, 60; Batavia, 380; 26th, London, 50; Straits, 950.

Gold

Gold in London: June 22d, 93s. 3d.; 23d, 93s. 4d.; 26th, 94s.; 27th, 93s. 4d.; 28th, 93s. 8d.

Foreign Exchange

Most of the more important foreign exchanges have shown a tendency to decline during the last week. On Tuesday, June 27th, francs were 8.40c.; lire, 4.75c.; marks, 0.29675c.; and Canadian dollars exhibited a marked decline from last week to 98.19c.

Silver

Silver prices in London have advanced slightly on China buying, although the market is limited. China has also been a buyer in New York for Frisco delivery, but prices here have been affected by the rate of sterling exchange. The market closes quiet, but steady, with higher prices probable if the China demand improves.

Mexican Dollars—June 22d, 53⅞; 23d, 53¾; 24th, 53¾; 26th, 53½; 27th, 54⅛; 28th, 54⅛.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum — 20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.25@18.25c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, weak at 4.95@5c. W.C.C., 5.75c. Cookson's "C" grade, 7@7.50c.

Bismuth—$2@$2.10 per lb.

Cadmium—$1.20@$1.25 per lb.

Iridium—$170@$175 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market somewhat firmer at 31@33c. per lb.

Palladium—$55@$60 per oz.

Platinum—$87.50 per oz. Strong.

Quicksilver—$55 per 75-lb. flask. San Francisco wires $54.70.

Selenium—$1.75@$1.85 per lb.

The prices of **Cobalt, Magnesium, Molybdenum, Monel Metal, Osmium, Rhodium, Thallium** and **Tungsten** are unchanged from prices given June 3.

Metallic Ores

Lake Superior Iron Ore—Mesabi nonbessemer, $5.05, f.o.b. Lake Erie docks.

Chrome, Magnetite, Manganese, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, and Zircon ore are unchanged from the quotations published June 3.

Zinc and Lead Ore Markets

Joplin, Mo., June 24—Zinc blende, per ton, high, $34.10; basis 60 per cent zinc, premium, $33; Prime Western, $32.50@$31.50; fines and slimes, $31@$30; average settling price, all grades of blende, $31.72.

Lead, high, $78.25; basis 80 per cent lead, $80; average settling price, all grades of lead, $78 per ton.

Shipments for the week: Blende, 14,322; lead, 2,319 tons. Value, all ores the week, $635,240.

Shipments for six months: Blende, 225,581; calamine, 631; lead, 45,608 tons. Value, all ores six months, $9,454,310.

Demand for blende slackened two thousand tons or so this week, and prices eased off $1 per ton on all grades.

The tonnage requirements of Eagle Picher Lead Co. to supply the demand of its manufacturing plant make it practically imperative for the company to secure a large amount of the tonnage of ore produced, and outside competition has forced prices to $80 basis.

Platteville, Wis., June 26—Blende basis 60 per cent zinc, $33 per ton. Lead ore basis 80 per cent lead, $80 per ton. Shipments for the week: Blende, 375 tons; lead ore, 37 tons. Shipments for the year: Blende, 7,645 tons; lead ore, 1,014 tons. Shipped during the week to separating plants, 1,114 tons blende.

Non-Metallic Minerals

Feldspar—Canadian feldspar, 13 per cent K_2O and 65 per cent SiO_2 continues at $10 per net ton, f.o.b. Quebec quarry.

Graphite—Ceylon lump, first quality, 5@5½c. per lb., f.o.b. N. Y.; chip, 4@4½c. per lb.; dust, 3½@3¾c. per lb.; amorphous crude, 75 to 78 per cent carbon, $39 per ton; 80 per cent, $46; 81 to 84 per cent, $50. Market dull and weak.

Talc—High-grade foundry talc, $20 per ton, or $18 in carload lots, f. o. b. Virginia mills; 200 to 300 mesh, in good demand at $13.50@$14.75, f.o.b. New York mills.

Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites. Silica, and **Sulphur** are unchanged from the prices published June 3.

Mineral Products

Arsenious Oxide (White Arsenic)—7.25@7.50c. per lb.

Copper Sulphate — 6.25c. for large crystals. Demand now at peak.

Sodium Nitrate—$2.50 per 100 lb. ex vessel, Atlantic ports.

Potassium Sulphate and **Sodium Sulphate** are unchanged from quotations of June 3.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $67.50 per gross ton, f.o.b. furnace. English, $67.50, c.i.f. Atlantic seaports. Spiegeleisen 19@21 per cent, $36, f.o.b. furnace; 16@19 per cent, $35.

Ferrosilicon—10 to 15 per cent, $38@$40 per gross ton, f.o.b. works; 50 per cent, $58@$60; 75 per cent, $115@$120.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrotitanium, Ferrotungsten, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published June 3.

Metal Products

Copper Sheets—New York base, 20.50c. per lb.; wire, 15.75c.

Nickel Silver—26.75c. per lb, for 18 per cent nickel Grade "A" sheets.

Yellow Metal—Dimension sheets, 17.75c.; rods, 14.75c. per lb.

Lead Sheets and **Zinc Sheets** are unchanged from the quotations published in the June 3 issue.

Refractories

Chrome Cement—$24@$35 per net ton, f.o.b. Eastern shipping points.

Magnesite Brick—$56 per net ton.

Magnesite Cement — $35@$40 per ton.

Silica Brick—$33@$41 per 1,000, f.o.b. shipping points.

Bauxite Brick, Chrome Brick, Firebrick, and **Zirkite** are unchanged from the prices appearing in the issue of June 3.

The Iron Trade

Pittsburgh, June 27, 1922

There has been a further decrease in the turnover in the finished steel market, but mills assert that this is due chiefly to their unwillingness to commit themselves farther ahead. Considerable buying pressure for early deliveries is noted, and in the majority of lines delivery premiums, generally $2 or $3 a ton, are being paid for early deliveries. This is particularly true of bars, shapes, plates and sheets. Bars, shapes, and plates are 1.60c. to 1.70c. and black sheets 3.15c to 3.30c.

Steel ingot production continues at a rate of fully 39,000,000 gross tons a year, against a rate of 35,000,000 tons April 1, when the coal strike started, and production is slightly increasing.

Pig Iron—The market remains stagnant. Prices are largely nominal, at $25 for bessemer and basic and $24 to $25 for foundry, f.o.b. Valley furnaces.

Coke

Connellsville Coke — Furnace, $8; foundry, $8@$8.50.

COMPANY REPORTS

Kennecott Copper Corporation

Assets and liabilities as of Dec. 31, 1921, follow:

ASSETS

Property accounts		
Mining property—net book value after depletion deduction		$6,821,247.45
Construction and equipment	$2,846,488.35	
Less depreciation	1,821,637.45	1,024,850.90
Investments		
616,504 shares Utah Copper Co. stock	$43,295,209.06	
2,566,416 shares Braden stock	39,483,945.18	
23,854⅛ shares Alaska Steamship stock	2,385,412.50	
500 shares Alaska Development & Mineral Co. stock	62,480.03	
1 share Copper Export Association stock	1.00	
48,174 shares C. R. & N. W. Ry. Co. stock	1.00	
$23,020,000 par value C. R. & N. W. Ry. bonds	14,408,608.34	99,635,657.11
Current and working assets		
Metals sold for future delivery, at sales price	$1,551,994.50	
Copper on hand and in transit, at cost	1,737,802.45	
Ore and concentrates on hand and in transit	36,327.27	
Materials on hand and in transit	793,928.25	
Accounts collectible	984,257.98	
Loans to affiliated companies	15,488,984.68	
Deferred accounts	746,430.47	
Marketable securities	3,289,622.05	
Cash	2,436,159.92	27,065,507.57
		$134,547,263.57

LIABILITIES

Capital stock, no par value		
Authorized	3,000,000 shares	
Unissued	211,786⅞	
Outstanding	2,788,213⅛	
Stated capital	$15,000,000.00	
Capital surplus less capital distributions	87,523,156.45	$102,523,156.45
Ten-year 7 per cent secured gold bonds		15,000,000.00
Accounts payable	$248,728.22	
Accrued interest and taxes	489,248.59	
Deferred accounts	11,717.69	
Copper Export Association—suspense	38,933.90	
Treatment, refining, and delivery charges, not due	501,660.44	1,290,288.84
Undivided profits (after deducting depletion)		15,733,817.74
		$134,547,263.03

The income account for the year is as follows:

Operating revenue		
Copper sold—32,404,985 lb. @ 13.102c		$4,245,686.61
Silver sold—390,012 oz. @ 99.438c		387,816.95
		$4,633,503.56
Operating cost		
Mining and milling	$1,545,812.87	
Treatment, refining and freight	1,481,603.21	
Selling and delivery charges	211,936.84	
General expense	119,719.06	3,359,071.98
		$1,274,431.58
Miscellaneous income at mines		19,301.56
		$1,293,733.14
Other income		
Alaska Steamship Co. dividends	$143,124.72	
Interest, discount, and miscellaneous	2,342,534.40	2,485,659.12
Total income for year		$3,779,392.26
Deduct		
Interest on ten-year 7 per cent secured bonds	$1,050,000.00	
Amortization of discount on bonds	75,000.00	
Taxes	131,010.40	1,256,010.40
Balance to undivided profits		$2,523,381.86

UNDIVIDED PROFITS

Balance, Dec. 31, 1920		$16,094,692.95
Income for year		2,523,381.86
Adjustment of 1920 depreciation charges		28,982.80
		$18,647,057.61
Depreciation of construction and equipment	$223,177.54	
Depletion for year	2,690,062.33	2,913,239.87
Balance of undivided profits, Dec. 31, 1921		$15,733,817.74

Kennecott ores milled totaled 212,723 tons, assaying 5.62 per cent copper. A total of 168,108 tons of Latouche ore, assaying 1.83 per cent copper, was also milled. The operations in Alaska were curtailed throughout 1921.

Braden Copper Co.

The seventh annual report of the Braden Copper Co., with mine, mill, smelter, and other properties in Chile, gives the following assets and liabilities of the Braden Copper Mines Co. and the Braden Copper Co., combined, for the year ended Dec. 31, 1921:

ASSETS

Property		$6,350,379.86
Construction and equipment	$37,696,822.22	
Less—depreciation and reserve	8,576,784.94	29,120,037.28
Deferred charges for mine development		5,425,419.22
Total for property, construction, equipment, and development		$40,895,836.36
Investment—Sherman Steamship Co.		575,480.13
Copper Export Association, suspense		695,142.33
Current and working assets:		
Materials, supplies and merchandise		4,022,689.21
Undistributed items in transit		15,031.07
Deferred accounts		178,183.48
Accounts collectible		787,582.70
Ore and copper in process, at cost		315,015.27
Copper on hand and in transit, at cost		2,650,672.89
Cash		629,009.39
Cash balance in sinking fund		384.91
Cash deposited with trustee of bond issue		2,090.12
		$50,767,117.86

LIABILITIES

Capital stock issue, Braden Copper Mines Co.		$12,953,530.00
Bonds issued, fifteen-year 6 per cent sinking fund gold bonds		13,416,000.00
Kennecott Copper Corporation, loan account		14,913,926.70
Notes payable		1,500,000.00
Loan from subsidiary company		140,000.00
Accounts payable, not due		850,671.73
Unpaid expenses on copper, not due		67,500.69
Drafts payable, not due		857,191.63
Accrued bond interest		335,400.00
Deferred credits in suspense		74,181.36
Reserve for insurance		51,584.87
Sinking-fund accruals	$555,555.56	
Less corresponding reduction to be made from outstanding bonds when retired through sinking fund	555,555.56	
Net deficit from operations	$1,527,369.68	
Depletion reserve	8,290,654.34	
	$6,763,284.66	
Less—unamortized discount on bonds	1,156,153.78	5,607,130.88
		$50,767,117.86

The combined statement of income and surplus accounts for the year ended Dec. 31, 1921, is given in the report as follows:

Operating revenue:		
Copper sold and delivered—40,552,312 lb. @ 13.803c		$5,597,453.20
Gold and silver		35,232.80
		$5,632,686.00
Operating cost:		
Plant cost	$4,410,621.09	
Freight to seaboard	164,928.18	
Embarking	29,006.18	
Ocean freight	223,977.85	
Insurance	25,291.28	
Refining	444,689.37	
Delivery and selling expenses	197,575.45	5,496,089.40
Operating profit		$136,596.60
Other income:		
Miscellaneous		75,975.09
Total income		$212,571.69
Charges against income:		
Taxes and miscellaneous charges	$478,218.10	
Interest on bonds of Braden Copper Mines Co.	842,013.83	
Other interest (net)	1,333,449.75	2,653,681.68
Net loss for year, carried to surplus account		$2,441,109.99

COMBINED STATEMENT OF SURPLUS ACCOUNTS

Balance as stated, Dec. 31, 1920	$3,339,713.77	
Add adjustment of steamship investment account	181,140.72	
	$3,520,854.49	
Less adjustment of copper sales account of prior years	34,503.82	
Net balance Dec. 31, 1920, as adjusted		$3,486,350.67
Net loss for year, as above		2,441,109.99
		$1,045,240.68
Charges against surplus:		
Depletion of ore reserves	$915,671.22	
Depreciation of construction and equipment	1,670,028.20	
Loss on plant and equipment superseded or abandoned	114,478.03	
Amortization of discount on bonds	128,461.56	
	$2,828,639.01	
Less discount on bonds purchased for retirement	256,028.65	
		2,572,610.36
Deficit Dec. 31, 1921		$1,527,369.68
Depletion reserve Dec. 31, 1921		8,290,654.34
		$6,763,284.66
Less unamortized discount on bonds, Dec. 31, 1921		1,156,153.78
Net combined surplus and depletion reserve Dec. 31, 1921		5,607,130.88

The plants operated throughout the year at greatly reduced capacity, only 27,461,691 lb. of blister copper being produced, the lowest production during the last eight years. The total tonnage shipped from the mines during the year was 735,681, 732,069 dry tons being milled, and 65,609 tons smelted. The construction program to increase the plant capacity to 10,000 tons daily has been practically completed.

Positive ore reserves amount to 184,510,000 tons, averaging 2.44 per cent copper, and probable ore an additional 80,000,000 tons, averaging 1.83 per cent copper.

Davis-Daly Copper Co.

The quarterly report of the Davis-Daly Copper Co., operating at Butte, gives the following data:

RECEIPTS

	Ore Returns	Miscellaneous Revenues
January	$6,170.10	$4,738.92
February	3,378.65	802.61
March	24,957.64	1,098.17
	$34,506.40	$6,639.70

Total receipts, $41,146.10

DISBURSEMENTS

	Colorado Shutdown Expense	Hibernia Operating Expense
January	$22,576.46	$9,377.12
February	18,650.81	9,187.46
March	20,854.61	23,048.58
	$62,081.88	$41,613.16

Total disbursements, $103,695.04

Tonnage for the quarter from the Hibernia mine amounted to 5,703 tons, producing 86,268 oz. of silver and 207 oz. of gold. The average assay of ore shipped was 30.49 oz. of silver to the ton. Quarterly reports are hereafter to be suspended until such time as conditions warrant.

Unity Gold Mines Co.

The balance sheet of the Unity Gold Mines Co., operating at Warren, Idaho, on Dec. 31, 1921, was as follows:

Capital stock: 500,000 $5 shares		$2,500,000.00
Treasury stock: 127,000 $5 shares		635,000.00
Property: Little Giant group, Charity groups, Banner and Gunmetal claims, S. Giant group, and Eagle claims	$2,002,173.65	
Unity tunnel and Charity tunnel	83,022.71	
Millsite, buildings, and improvements	80,544.35	
Water rights, power plant, and ditches	75,769.75	
Mine developments	104,959.00	
Machinery and personal property	17,136.89	
Ore development	126,231.35	
Bullion produced		11,540.52
Bullion on hand and in transit	6,794.23	
Cash, bonds, and accounts receivable	14,908.59	
Treasury stock donation	635,000.00	
	$3,146,540.52	$3,146,540.52

The principal receipts during the year were $32,500 from sales of treasury stock at par, and $27,371.21 from the sale of Liberty bonds. Expenses included $34,695.62 for labor and $8,288.62 for materials and supplies. Milling operations were started in March, 1922. Insufficient power is given as the reason for failure to get to production during 1921.

American Metal Co. Shares To Be Listed

Plans have been completed by the American Metal Co. whereby shares in that important mining, smelting, and trading organization are to be offered to the public. According to the *Boston News Bureau*, when necessary steps have been taken in the re-adjustment of capital, American Metal Co. will have $5,000,000 new 7 per cent preferred stock of $100 par value and 536,000 shares of common without par. This will replace the present issue of $14,000,000, or 140,000 shares par value, stock of one class. Application to list both classes will be made to the New York Stock Exchange. A special stockholders' meeting is called for June 28.

Proceeds from sale of the new $5,000,000 preferred at par will be used to liquidate current indebtedness and provide additional working capital.

For each share of old stock there will issue three and one-third shares of new stock of no par value. The new preferred may be exchanged at rate of one share for at least two shares of the new common during the next five years.

On completion of present financing the capitalization of American Metal Co. will be as follows:

	Authorized	To be Issued
7 per cent cumulative preferred	$5,000,000	$5,000,000
Common stock, no par (shares)	1,000,000	536,000

On the old stock there has been declared a dividend of $4 a share, or at rate of 8 per cent for the year. The new preferred will pay 7 per cent, while the common stock of no par value will go on a $3 dividend basis, it being provided that profit sharing for executives and employees will not be effective until after these rates have been paid. On the common the new dividend will be equivalent to $10 a year on the old stock.

For the first four months of 1922, after depreciation, net earnings were $762,708, while the company's interest in affiliated concerns' undistributed earnings amounted to $325,844 more in the same period.

American Metal Co. has been a consistent dividend payer since organization in 1887, the total distribution to the first of January having been $24,337,800. Its original capital was $200,000, which was increased by easy stages to $14,000,000 in 1920, when the business and assets of L. Vogelstein & Co. were absorbed. This amalgamation necessitated a cash outlay of more than $10,000,000, which was financed in part by an issue of $7,000,000 stock.

Mining Dividends in June, 1922

The following dividends were paid by mining and metallurgical companies of the United States, Canada and Mexico during June:

Companies in the United States	Situation	Per Share	Totals
American Smelting & Refining, pfd	U. S.	$1.75 Q	$875,000
Calumet & Arizona, c	Ariz.	0.50 Q	321,261
Federal Mining & Smelting, pfd. s. l	Idaho	1.25 Q	150,000
Hecla Mining, s. l	Idaho	0.15 Q	150,000
Homestake Mining, g	S. D.	0.25 M	62,790
Mother Lode Coalition, c	Alaska	0.50	1,250,000
National Lead	U. S.	1.50 Q	309,831
National Lead, pfd	U. S.	1.75 Q	426,433
North Star Mines, g	Cal.	0.20	50,000
St. Joseph Lead	Mo.	0.25 Q	387,342
Texas Gulf Sulphur	Texas	1.00 Q	635,000
Utah Copper	Utah	0.50 Q	812,245
West End Condolidated, s	Nev.	0.05	89,425
Companies in Canada and Mexico			
Lucky Tiger Combination, g	Sonora	0.07	50,074
Hollinger Consolidated Gold	Ont.	0.05 (4 wks.)	246,000
Premier Mining, g.s	B.C.	0.15 Q	750,000

Q, quarterly; M, monthly; g, gold; s, silver; l, lead; c, copper.

The Mother Lode Coalition Mines Co. declared an initial dividend of 50c. a share. It is understood that dividends will be paid semi-annually when the earnings justify. The North Star Mines paid its first dividend since March, 1921, when the same disbursement was made. The West End Consolidated had not paid a dividend since December, 1919, and the last payment of the Lucky Tiger Combination was in December, 1921. Dividends of this last company have been paid regularly. Premier paid $400,000 in December, $500,000 in March, and its third dividend in June.

MINING STOCKS

Week Ended June 24, 1922

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	63	61	61	Sept. '20, Q	$0.50
Alaska-Br. Col. new.	N. Y. Curb	4⅛	3⅞	3⅞	.....	....
Allouez	Boston	26½	25	25	Mar. '19	1.00
Anaconda	New York	52	50	51⅞	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3⅞	3½	3⅞	.....	....
Ariz. Com'l	Boston	9½	9¼	9¼	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*18	*13	*13	.....	....
Bingham Mines	Boston	15½	15½	15½	Sept. '19, Q	0.25
Calumet & Arizona	Boston	....	....	65½	June '22, Q	0.50
Calumet & Hecla	Boston	275	270	274	June '20, Q	5.00
Canada Copper	N. Y. Curb	*37	*32	*36	.....	....
Centennial	Boston	†11	†10	10	Dec. '18, SA	1.00
Cerro de Pasco	New York	36⅜	35½	36	Mar. '21, Q	0.50
Chile Copper	New York	21½	19½	21½	.....	....
Chino	New York	29⅜	28¼	28½	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*26½	*26½	*26½	.....	....
Con. Arizona	N. Y. Curb	*5	*5	*5	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	*68	*50	*64	.....	....
Copper Range	Boston	44¼	43⅝	43⅝	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1⅛	1⅛	1⅛	.....	....
Davis-Daly	Boston	8	7½	7⅝	Mar. '20, Q	0.25
East Butte	Boston	11¼	10⅛	10½	Dec. '19, A	0.50
First National	Boston Curb	*70	*65	*70	Feb. '19, SA	0.15
Franklin	Boston	2⅜	2	2	.....	....
Gadsden Copper	Boston Curb	†*90	†*80	*81	.....	....
Granby Consol.	New York	29½	28¼	28¼	May '19, Q	1.25
Greene-Cananea	New York	32	30	30	Nov. '20, Q	0.50
Hancock	Boston	2⅜	2⅜	2⅜	.....	....
Howe Sound	N. Y. Curb	3¼	3	3	Jan. '21, Q	0.05
Inspiration Consol.	New York	40⅜	39¼	40⅛	Oct. '20, Q	1.00
Iron Cap	Boston Curb	†8½	†7½	8	Sept. '20, K	0.25
Isle Royale	Boston	23	23	23	Sept. '19, SA	0.50
Kennecott	New York	34⅜	32½	34	Dec. '20, Q	0.50
Keweenaw	Boston	2¼	2¼	2¼	.....	....
Lake Copper	Boston	4⅞	4½	4½	.....	....
La Salle	Boston	1½	1½	1½	.....	....
Magma Copper	N. Y. Curb	29⅜	29	29⅛	Jan. '19, Q	0.50
Majestic	Boston Curb	*11	*8	*10	.....	....
Mason Valley	Boston	†3	†1⅞	1⅞	.....	....
Mass. Consolidated	Boston	3⅛	3	3⅛	Nov. '17, Q	1.00
Miami Copper	New York	28⅛	28⅛	28⅛	May '22 Q	0.50
Michigan	Boston	3⅞	2⅞	2⅞	.....	....
Mohawk	Boston	63	61	62	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	9⅛	9	9⅛	June '22, I	0.50
Nevada Consol.	New York	17⅛	16½	16½	Sept. '20, Q	0.25
New Cornelia	Boston	18⅛	18	18	May '22, K	0.25
North Butte	Boston	13	12½	12⅝	Oct. '18, Q	0.25
North Lake	Boston	....	....	⅛	.....	....
Ohio Copper	N. Y. Curb	*10	*10	*10	.....	....
Old Dominion	Boston	26½	26	26½	Dec. '18, Q	1.00
Osceola	Boston	33	33	33	June '20, Q	0.50
Phelps Dodge	Open Mar.	†185	†175	...	Apr. '22, Q	1.00
Quincy	Boston	45	43	44	Mar. '20, Q	1.00
Ray Consolidated	New York	16⅛	16⅛	16⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅜	1⅛	1⅜	.....	....
St. Mary's Min. Ld.	Boston	45½	45	45	Apr. '22, K	2.00
Seneca Copper	Boston	....	....	14	.....	....
Shannon	Boston	1	*80	*95	Nov. '17, Q	0.25
Shattuck Arizona	New York	10½	9⅜	9⅜	Jan. '20, Q	0.25
South Lake	Boston	†1½	†*95	1½	.....	....
Superior & Boston	Boston	1⅜	1⅜	1½	.....	....
Tenn. C. & C. cfs.	New York	11	10½	10⅝	May '18, I	1.00
Tuolumne	Boston	*65	*65	*65	May '13,	0.10
United Verde Ex.	Boston Curb	28	22	27	May '22, Q	0.25
Utah Consol.	Boston	3	3	3	Sept. '18,	0.25
Utah Copper	New York	64½	62½	63⅜	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1¼	1⅛	1⅛	Dec. '17,	0.30
Victoria	Boston	†2	†1½	1⅜	.....	....
Winona	Boston	2	1⅜	1⅜	.....	....
Wolverine	Boston	11⅜	11⅜	11⅜	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	16⅞	16½	16⅜	Mar. '19,	0.50
Internat. Nickel, pfd	New York	†84	†77	81	May. '22, Q	1.50
LEAD						
National Lead	New York	93⅜	92½	93⅛	Mar. '22, Q	1.50
National Lead, pfd	New York	112	111	112	June '22 Q.	1.75
St. Joseph Lead	New York	14⅛	14⅛	14⅛	June '22, Q	0.25
QUICKSILVER						
New Idria	Boston	*25	*25	*25	.....	....
ZINC						
Am. Z. L. & S.	New York	17⅛	16⅞	16⅞	May '20,	1.00
Am. Z. L. & S. pfd.	New York	44⅛	42⅛	44⅛	Nov. '20, Q	1.50
Butte C. & Z.	New York	7⅛	6⅛	6⅛	June '18,	0.50
Butte & Superior	New York	28⅛	27	28	Sept. '20,	1.25
Callahan Zn-Ld.	New York	8⅛	8⅛	8⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	142	142	142	May '22, Q	2.00
Yellow Pine	Los Angeles	*56	*55	*55	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

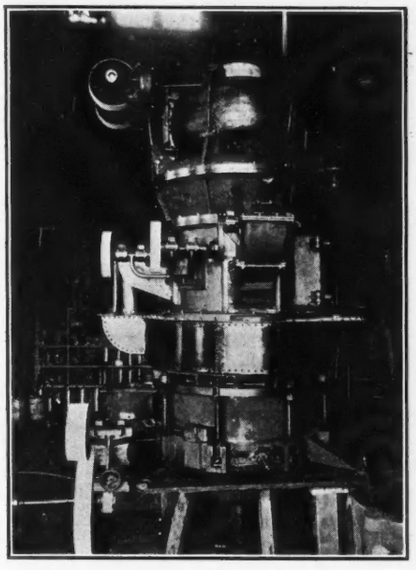
Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅜	⅜	⅜	.....	....
Alaska Juneau	New York	1⅛	1⅛	1⅛	.....	....
Atlas	Toronto	*25½	*24½	*24½	.....	....
Carson Hill	New York	....	....	12	.....	....
Cresson Consol. G.	N. Y. Curb	2 1/16	2⅛	2⅛	Apr. '22, Q, X	$0.10
Dome Mines	New York	30⅜	28⅛	30⅛	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*17	*17	*17	.....	....
Golden Cycle	Colo. Springs	*81	*81	*81	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*7	*6	*6	Dec. '19,	0.05
Gordon Murray	Toronto	*31	*29	*31	.....	....
Hollinger Consol.	Toronto	9.25	9.05	9.21	June '22,	0.05
Homestake Mining	New York	†71	†68	69⅛	May '22, M	0.25
Keora	Toronto	*12	*8⅛	*11⅛	.....	....
Kirkland Lake	Toronto	*40	*37	*40	.....	....
Lake Shore	Toronto	2.35	2.15	2.32	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	16.50	16.00	16.50	May '22, K	0.05
Porcupine Crown	Toronto	*19½	*17	*18	July '17,	0.03
Porcupine V. N. T.	Toronto	*21	*19½	*19½	.....	....
Portland	Colo. Springs	†*30	†*23	*25	Oct. '20, Q	0.01
Schumacher	Toronto	*77	*73½	*74	.....	....
Silver Pick	N. Y. Curb	*17	*16	*16	.....	....
Teck Hughes	Toronto	*46	*45	*45½	.....	....
Tom Reed	Los Angeles	48	45	48	Dec. '19,	0.02
United Eastern	N. Y. Curb	1⅛	1⅛	1⅛	Apr. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*7	*7	*7	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*7	*7	*7	.....	....
Wright-Hargreaves	Toronto	2.75	2.45	2.50	Apr. '22,	0.02½
Yukon Gold	N. Y. Curb	*92	*88	*92	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1⅛	1⅛	1⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*31	*25	*30	May '20, K	0.03
Coniagas	Toronto	1.27	1.25	1.27	May '21, Q	0.12½
Crown Reserve	Toronto	*15	*12	*13	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3⅛	3⅛	3⅛	Apr. '22, Q	0.12½
La Rose	Toronto	*32	*30	*31	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	....	....	*25	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.05	1.02	1.04	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6½	6	6½	Apr. '22, Q, X	0.30
Ontario Silver	New York	8⅛	7⅛	8⅛	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	....	....	*12	Jan. '12,	0.10
Temiskaming	Toronto	*29½	*25	*27½	Jan. '20, K	0.04
Trethewey	Toronto	*4	*3½	*4	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*17	*14	*16	.....	....
Cash Boy	N. Y. Curb	....	....	*6	.....	....
Dolores Esperanza	N. Y. Curb	2⅛	1⅞	2	.....	....
El Salvador	N. Y. Curb	*4	*3	*4	.....	....
Jim Butler	N. Y. Curb	*5	*5	*5	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	....	....	*5	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*8	*7	*7	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1 1/16	1⅛	1⅛	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*83	*77	*83	.....	....
Tonopah Extension	N. Y. Curb	1 1/16	1 1/16	1 1/16	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1 1/16	1⅛	1⅛	Apr. 22, SA, X	0.07½
West End Consol.	N. Y. Curb	1⅛	1 1/16	1⅛	June '22, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*7	*7	*7	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*96	*94	*94	Dec. '20,	0.15
Chief Consol.	Boston Curb	5	4⅞	4⅞	May '22, Q	0.05
Consol. M. & S.	Montreal	23½	22¼	22½	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†2.00	†1.40	...	July '20, Q	0.10
Daly-West	Boston	....	....	1⅜	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	2⅜	2⅛	2⅛	Apr. '21, K	0.05
Electric Point	Spokane	7⅞	6	7	May '20, SA	0.03
Federal M. & S.	New York	11	11	11	Jan. '09,	1.50
Federal M. & S. pfd.	New York	48½	46½	48½	June '22, Q	1.25
Florence Silver	Spokane	*22½	*21½	*22½	Apr. '19,	0.01½
Grand Central	Salt Lake	4¼	4¼	4¼	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6½	6¼	6½	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*29	*27	*29	Apr. '22, Q	0.02½
Judge M. & S.	Salt Lake	†2.60	†2.45	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*23	*19	*20	June '21, I	0.02
Prince Consol.	Salt Lake	5	4½	4½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	4¼	4¼	4¼	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*9	*8	*8	.....	....
Standard Silver-Ld.	N. Y. Curb	....	....	*20	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*9	*8	*9	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.72	2.55	2.70	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.10	2.00	2.10	Dec. '21, Q	0.05
Utah Apex	Boston	2⅛	2⅛	2⅛	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	47⅛	44	46⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	57⅛	56	57⅛	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	76	75½	75½	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	24	22	22⅜	Nov. '19, Q	1.00
Texas Gulf	New York	48⅛	45	47½	June '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	60⅜	57⅛	59⅜	Mar. '21, Q	1.00
Amer. Sm.& Ref. pf.	New York	98⅜	97½	97½	June '22 Q	1.75
Am. Sm. Sec. pf. A.	New York	92	92	92	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	41⅛	40⅜	40⅜	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf.	New York	47½	47½	47½	Apr. '22, Q	1.75

NEW MACHINERY AND INVENTIONS

Air-Separating Mill Which Produces a 200-Mesh Product

A unit pulverizer and air separating mill has recently been developed to meet the demand for an air-separating machine capable of producing a finely pulverized product which will pass a 200-mesh sieve, and in which the separating element is an integral part of the mill itself, making it possible to operate the unit mill and separator from one motor or one actuating belt drive.

An exhaust fan is mounted directly on top of the separating chamber of



Air-separating mill and pulverizer

the mill and is driven by belt direct from the pinion shaft of the mill. This arrangement gives it a speed constant with the speed of the mill itself, and an unvarying exhaust suction from the separating chamber without loss by frictional resistance to the passage of air through pipes is obtained. The exhaust fan discharges vertically to a "cyclone," or other collecting medium which separates the fine products from the air, for discharge into bins or conveyors serving any portion of the installation. Most of the exhaust air from the separator is again returned to the pulverizer mill, where it encircles the port section spirally, with a constant pressure through all of the ports into the internal part of the mill, where it again goes through the process of separating the fine material from all that is elevated by the inclined fan blades mounted above the grinding element.

From an overhead bin, the material to be reduced is fed to the mill by a reciprocating feeder mounted on the side of the mill. The feeder is driven direct from the mill countershaft and the operator can easily control the amount of material entering. The feeder is arranged to oppose the tendency of the exhaust fan to draw air into the mill with the material. As the material leaves the feeder it enters the pulverizing zone of the mill.

The pulverizing element consists of unattached steel balls which roll in a stationary, horizontal, concave-shaped grinding ring. The material falls between the balls and the grinding ring in a uniform and continuous stream, and is reduced to the desired fineness in one operation. Between the inner circumference of the concave-shaped grinding ring and the base of the main bearing is an annular space, leading downward to four equally spaced discharge channels, which are closed at their outer ends with quick opening cover plates. This annular space permits the deposit of any tramp iron which may pass the magnetic separator, obviating possible damage to the grinding element, and also providing for the easy elimination of the foreign body or a possible overload of material in the mill. The mill is manufactured by the Fuller-Lehigh Co., Fullerton, Pa.

The Wilfley Centrifugal Sand Pump

The Wilfley centrifugal sand pump has been developed by Arthur R. Wilfley, inventor of the Wilfley concentrating table. Among the features of this new device is the elimination of the stuffing box which is generally used in centrifugal pump design to prevent the material handled from leaking out. When pumping hot solutions or gritty materials the stuffing box design causes considerable wear on the shaft and requires frequent replacements of shaft and packing.

The patented seal on Wilfley centrifugal pumps consists of a revolving member having radiating wings called an "expeller," which prevents the material from leaking out by centrifugal action. A patented automatic check-valve seals around the shaft while the pump is not in operation. The operation of the pump prevents air being trapped in the runner and enables it to deliver a continuous uniform stream, which is a desirable feature when delivering feed to flotation machines, classifiers, and other milling machinery.

Another important feature of the Wilfley pump is the slippage seal adjustment. One of the greatest losses in a centrifugal pump is the slippage of the material handled from the discharge back to the intake of the runner. This causes a reduction in capacity and efficiency and depends upon the clearance between the runner and side plate. The wearing action of sand and grit causes the clearance to be so increased that, unless an adjustment is provided, frequent renewals of the wearing parts are necessary in order to maintain the capacity and efficiency of the pump. The Wilfley is provided with a simple take-up adjustment which may be made in a few minutes while the pump is in operation. The single-inlet inclosed type runner is used because of the high efficiency and adaptability to high heads. It is entirely closed on one side, limiting the slippage to one side only as compared with slippage on both sides where balance port holes are used or in the case of an open runner. When wear causes the clearance between the runner and follower plate to become enlarged, the bearing unit and runner are moved endwise by means of a draw-bolt until the runner is felt to rub the follower plate and then slightly relieved.

This makes practically a ground joint and reduces the slippage and side wear to a minimum. The slippage seal adjustment in combination with the use of ball bearings and no rubbing contact while in operation, makes for an exceptionally high pump efficiency. It also makes possible the use of heavy long-life parts, pumping sand and grit against high heads, easy adjustment and installation of wearing parts, and eliminates the necessity of overspeeding.

With the new Wilfley pumps the wearing parts are easily replaced in a few minutes. This quick change feature is particularly valuable where a spare pump is not available or when the nature of the material handled requires frequent clearing out of the pump. The bearing assembly is of unit construction and is independent of the frame. Two sets of large non-adjustable ball bearings are mounted on a heavy shaft and inclosed in a cylindrical housing. The frame is of one-piece construction and is sufficiently heavy to make a rigid support for the bearing unit and wearing parts.

The Wilfley centrifugal pumps are being quite extensively used to handle various kinds of gritty materials, such as sand, tailing, concentrate, and slime. Also water and solutions which are hot, muddy, or subject to occasional grit. They are operating against both low and unusually high heads. A complete description and catalogue may be had by addressing A. R. Wilfley & Sons, Denver, Col.

New Wire Rope Plant To Be Built at St. Louis

As soon as a suitable site is definitely decided upon, construction work will be started on a new plant for the Broderick & Bascom Rope Co., St. Louis, Mo. Plans have been drawn for what promises to be one of the most modern wire-rope plants in the country. The buildings, of fire-proof construction throughout, will cost about a quarter-million dollars, exclusive of equipment.

The plant will consist of two great building units—the factory proper, and, parallel to this building and separated by an open space, another unit, including the office building, warehouses for raw and finished materials, spooling and testing departments, machine shop, blacksmith shop, engine room, and

boiler house. All excepting the boiler house are under one roof.

Each of the two units will be 600 ft. long. The factory will be 143 ft. wide, the other group 83 ft. in width. Both units will have brick walls and concrete roofs and floors. The roofs will be supported by steel trusses. In addition, the factory will have concrete foundations to support the great weight of the "laying up" and "stranding" machinery.

The buildings have been designed by E. P. Frederick, general superintendent and wire rope engineer of the Broderick & Bascom Rope Co. Mr. Frederick will also supervise construction.

TRADE CATALOGS

Distribution Transformers—The Allis-Chalmers Mfg. Co., Milwaukee, Wis., has issued Bulletin 1109 (superseding 1088), which covers distribution transformers having ratings of 200 kva. and smaller, suitable for lighting and power purposes, and of the oil-immersed, self-cooled out-door type.

Cycloidal Pumps—The Connersville Blower Co., Connersville, Ind., has recently issued Catalog No. 20, which describes Connersville cycloidal pumps. The principles of operation of these pumps are mentioned, as are a number of the features of the design. Several installations in various kinds of industry are shown.

Chain Furnace Screens—The E. J. Codd Co., 700 Caroline St., Baltimore, Md., has issued an eight-page pamphlet which describes and illustrates the Wiegand patent chain furnace screens for furnaces and ovens. These doors have found a wide application not only in America but also abroad, on metallurgical, glass, chemical, and boiler furnaces. The screen consists of a multitude of individual strands of steel chain, forming a penetrable, transparent sheet of chain, which does not interfere with the view of the interior of the furnace or with the passage of the charge, or the tools necessary for manipulation of the same, yet "keeps the heat in and the cold out of the furnace."

Velocity Stage Turbines—A line of velocity stage turbines especially designed for high pressure and high temperature steam is described in a twenty-eight-page catalog issued by the De Laval Steam Turbine Co., Trenton, N. J. The cast steel steam chest is located in the casing cover to avoid the conduction of heat to the bearings. In addition to the speed governor and governor valve, there is an independent valve controlled by an automatic overspeed trip. The turbines are built in sizes up to 1,200 hp., and are designed to be directly coupled to high-speed centrifugal pumps and blowers, small a.c. and d.c. generators, and, by means of double helical speed reducing gears, to large pumps and blowers, medium-size generators, belt pulleys, rope sheaves, and slow and moderate speed machinery.

Portable Conveyors — The Jeffrey Manufacturing Co., Columbus, Ohio, has issued Bulletin No. 369, which illustrates and describes the Jeffrey Portable belt conveyor. This conveyor was built to meet the demand for a light, durable, and inexpensive conveyor for loading and unloading coal, coke, cinders, sand, gravel, crushed stone, and similar materials, and may also be used for handling bricks, tile, small boxes and bags. Two or more of the conveyors may be used together to extend storage piles, or the conveyor may be used as an extension conveyor to storage pile in connection with the Jeffrey portable car unloader. It is operated either by electric motor or gasoline engine. Capacity varies from twenty to fifty tons per hour, depending upon the kind of material handled and the methods used in loading the conveyor.

CONSTRUCTION NEWS

Montreal Co. Begins Erection of Engine House

The Montreal Mining Co., Montreal, Wis., has started work on the engine house for its No. 5 shaft, which is being sunk and has now reached a depth of about 700 ft. The building will be 50 x 214 ft. and of brick and steel construction on a concrete foundation. Excavation has been completed and a contract let to the Worden-Allen Co. for the erection of the building. It will be equipped with a forty ton crane, and in addition to the hoists will house two Ingersoll-Rand 28 x 17 x 27-in. electrically-driven air compressors, which were recently purchased at Hog Island from the U. S. Navy Dept. Delivery of the hoists is not expected until next year.

New Mill Under Construction Near Baxter Springs, Kan.

George Meese and J. C. Nichols, of Kansas City, are erecting a new concentrator on the Charles Opperman land, west of Baxter Springs, Kan. It is to be a 200-ton plant and is being erected under contract by Ben. F. Hoskins, of Baxter. It is expected that it will be ready for operation about August 1.

Tom Reed Building Sampling Mill

The Tom Reed Gold Mining Co., of Oatman, Ariz., is placing foundations for a sampling mill, machinery for which is expected to arrive July 15.

The Black Range Mining Co., of Oatman, is considering the erection of a mill for its own ores and for handling the product of a number of properties southwest of Oatman, beyond Boundary Cone.

Federal M. & S. Co. Will Install Power Equipment at Wallace

Electric power will be generated in the Coeur d'Alenes, northern Idaho, by the Federal Mining & Smelting Co., and sold to the Montana Power Co. The latter company distributes power from its Montana plant to the Federal company properties, the Day mines, and to others in the district. Two flumes, each about two and a half miles long, formerly furnished power for the two concentrators on Canyon Creek once operated by the Federal company. The concentrators have not been in use for a long time, and the flumes are in disrepair. These flumes are now being repaired and will be used to furnish power for an electric plant which the Federal will install in the old Standard mill near Wallace. About 300 hp. will be generated. The Washington Power Co. and the Montana Power Co. furnish most of the electric power used in the Coer d'Alenes. The consumption in the district is heavy.

Joplin-Miami District Has Two New Plants

Two new concentrators have recently been started in the Joplin-Miami zinc lead district. One is operated by the Blue Ribbon Mining Co., controlled by Harry Hawkins, of Miami, Okla., and is situated on the company's lease south of Hockerville, Okla. Its capacity is 200 tons daily.

The second concentrator is that of the Right Good Co. and is near Hockerville, Okla. Its equipment includes four Boylan cones. Four Boylan roughers slimers are to be installed a later.

Auxer Gold Mines to Repair Plant Burned

Examination of the power plant of the Auxer Gold Mines, of Hope, Idaho, has resulted in a decision to overhaul and repair the equipment thoroughly, with a view to putting it in active operation again. The buildings housing the plant were destroyed by fire in the latter part of the winter, and it was thought at first that the damage to the mechanical equipment, including boiler, engine, and compressor, was such as to prevent its further use. With the overhauling of the plant completed, driving of the main crosscut tunnel will be resumed.

South Park Dredging Co. Spending Large Sum

The South Park Dredging Co., owned by the Hammon dredging interests of California, is expending approximately one million dollars in equipment and preliminary operations in the vicinity of Bear and Elk Creeks, Idaho, where the company has acquired a large acreage with a view to extensive dredging operations. Included in the work now in hand is construction of a fifty-mile power line. Dredging operations are scheduled to start soon.