

DEC 27 1922

ENGINEERING & MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

McGRAW-HILL CO., INC.

PRICE 15 CENTS



Surface plant of the Hecla Mine, Burke, Idaho, in the Coeur d' Alenes

Concentration of Rossland, B. C., Ores

By Douglas Lay

Sado Gold Mine, in Japan

By Chester Wells Purington

Marketing of Metalliferous Ores and Concentrates—I

By Arthur B. Parsons

Biography of Frederick Laist

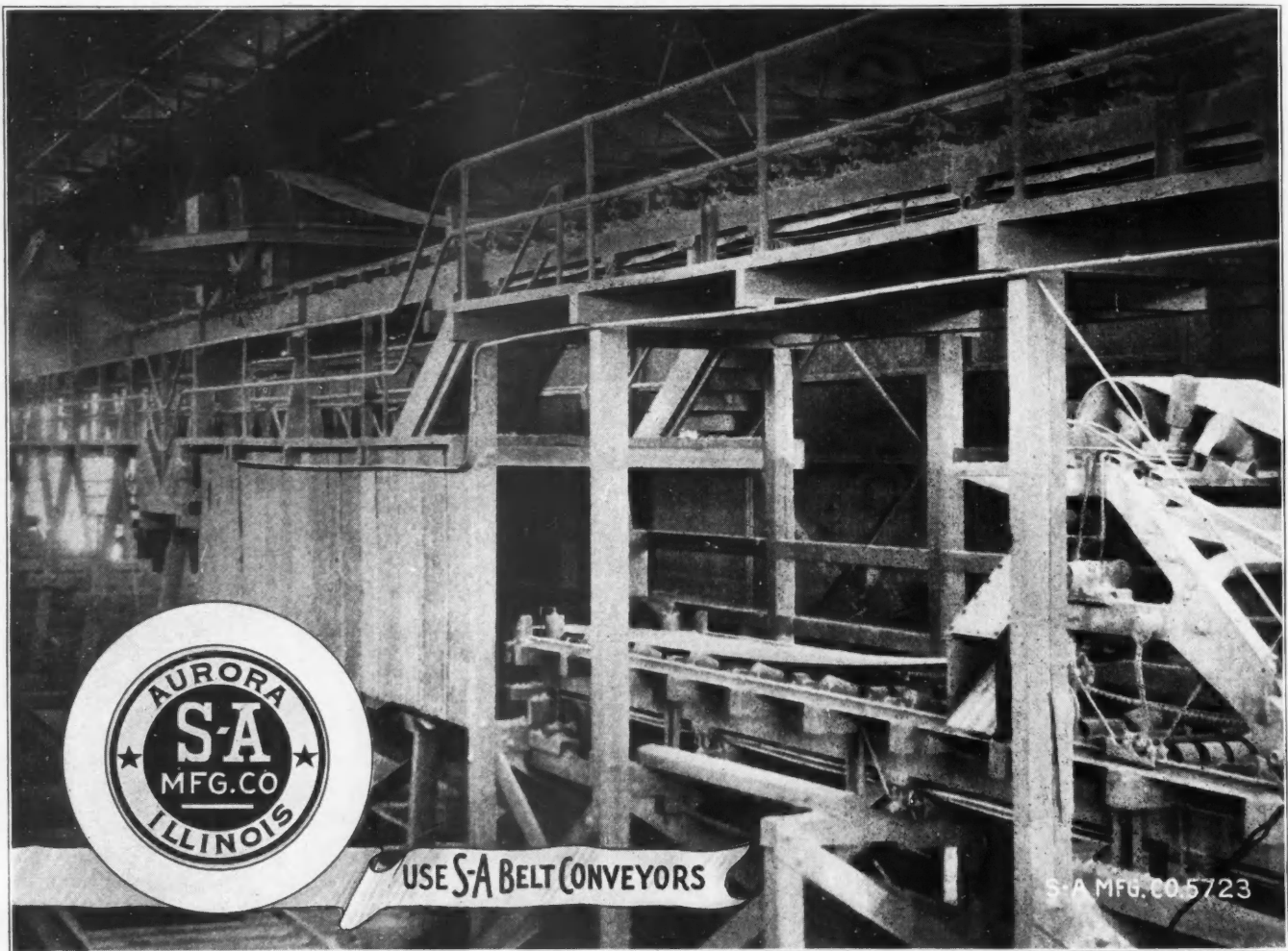
Engineering and Mining Journal-Press does not sell its front covers to advertisers. In uniting Engineering and Mining Journal with Mining and Scientific Press, however, the combined journal

has respected existing advertising contracts. Some of these made with the Mining and Scientific Press were for its front covers. Through the courtesy of these advertisers such obligations have

been released. The front cover this week has been released by the kindness of The Denver Rock Drill Manufacturing Company, whose advertisement will be found on page five.

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

December 23, 1922



To Keep Down Up-Keep Use S-A Belt Conveyors

S-A Machinery is correctly designed and well built. The experience and training of expert designing engineers coupled with the skill of expert mechanics and backed by a policy of keeping faith with the product is a strong combination. It is a combination of elements which is directly responsible for the success of S-A Labor Saving Machinery.

*Write for Copy of "S-A Belt Conveyors"
Catalog No. 26-E*

STEPHENS-ADAMSON MFG. CO.
AURORA, ILLINOIS

ENGINEERING & MINING JOURNAL-PRESS

T. A. RICKARD
Contributing Editor

G. J. YOUNG, Western Editor
A. H. HUBBELL, Managing Editor
E. H. ROBBIE, Metallurgical Editor
D. E. A. CHARLTON, Business Editor

J. E. SPURR, Editor

F. E. WORMSER
W. N. P. REED
A. W. ALLEN
A. B. PARSONS
Assistant Editors
BENJAMIN L. MILLER
ROBERT M. HAIG
Special Consulting Editors

Volume 114

New York, December 23, 1922

Number 26

The Work of a Bug

“WHAT is one man’s meat, signor, is another man’s poison” is an old expression that has a striking modern parallel in the unfortunate position of the southern cotton producer whose crops have been partly destroyed by boll weevils and the favorable outlook for the American arsenic producer whose product is highly desirable in combating the bugs. Crossing the Mexican border several years ago, the infamous boll weevil has spread over almost the entire cotton-producing area of the South. This pest is exceedingly difficult to exterminate and resists destruction to an unusual degree. State and governmental experimentation has disclosed the fact that one of the most effectual means of fighting the bug is by using liberal sprays of calcium arsenate in the proper season. Application of this chemical to infested districts has been so encouraging in its results that a demand for arsenic has arisen entirely out of proportion to the ability of the country’s resources, aided by imports, to supply.

From a price of 7c. per lb. last March, the value of white arsenic has climbed to about 14c.—and the end is not yet in sight. When arsenic was selling at low prices the producers had difficulty in persuading consumers—insecticide manufacturers—to fill their requirements for the future. Now the situation is completely reversed, and the demand is stronger than the ability of the producers to handle it. Peculiarly enough, and luckily for the producers, the advance in price cannot be attributed to a tariff. At the time when many industries were besieging Congress for tariff protection, the arsenic smelters asked for the same treatment accorded other commodities, and on the usual grounds. But owing to the fact that arsenic, like potash, is necessary in farming, the agricultural bloc had little difficulty in spiking the tariff guns of the arsenic producers. The poison was placed on the free list. The subsequent history of the arsenic market showed, however that not only is tariff protection unnecessary but that the absence of a duty did not prevent the price from increasing. Had the arsenic smelters been accorded their request, untold denunciation as gougers and what not would now be their fortune. They may well thank their stars they did not receive tariff benediction.

The rapid and steady advance in price has naturally alarmed the farmers, and the Department of Agriculture has been making an investigation into the situation. It is difficult to see exactly what this investigation may accomplish. The present arsenic market is responding to economic law. A sudden and continued strong demand from insecticide manufacturers has enabled the smelters not only to dispose of the large stocks with which they were burdened at the beginning of 1922, but has also enabled them to sell the stuff far into the future. If the price of arsenic is now too high or becomes too high, it will bring its own cor-

rective. Either more arsenic will be brought on the market and production stimulated, or the farmer will cease to buy the chemical, preferring to let the weevil ravage his fields rather than pay an excessive price to the chemical manufacturer. It stands to reason that beyond a certain price it would be more economical to sustain a loss by insect pests than to use expensive calcium arsenate. These corrective tendencies and elementary principles are well known to the producers. It is not to their advantage to have a runaway market. One of them with a view to stabilizing prices has sold his current output at prices a cent and more per pound below those asked by importers and brokers, but without producing the desired result.

It would be interesting for the investigators to ascertain the margin between the price of the raw arsenic and the finished calcium arsenate. The insecticide business is highly risky, so that it would not be strange to find a wide margin. One thing that will be discovered, if it isn’t apparent now, is the extremely interesting example of the law of supply and demand illustrated by the present arsenic market. The law works to the farmers’ advantage as well as the miners’, but this phase of its operation has been momentarily forgotten. The farmers’ attitude is easy to explain. It is a question to him as to whose ox is being gored.

Immigration and Revolution

IN ANOTHER COLUMN we review a book by David Chauncey Brewer, on the movement toward revolution in the United States. While Bolshevism has had a setback in Europe, and will never again reach its former extreme, its flood has left us here in the United States with a special aftermath of troubles. And this aftermath has precisely been due to the tremendous slop-over from the revolutionary and undesirable classes of Europe which we have experienced in the last forty years.

Since Mr. Brewer wrote, the truth of his conclusions has come to be generally recognized. In a recent editorial we referred to General Pershing’s speech in Chicago, warning the country as to the plots of Communists. At a recent meeting of the Chamber of Commerce of the State of New York, Elon H. Hooker, a prominent engineer, cited General Pershing’s speech and called attention to the activities of unassimilated aliens in the United States.

“Thirty million of the 105 million people in the United States are foreigners,” said Mr. Hooker. “We are drawing our immigrants today from the lowest class of southeastern Europe. If we are to safeguard this experiment in government, if we are to preserve the Republic and hand it down to our children, this influx of foreigners must be halted. The theory of government in this country is of assimilated peoples, while the theory of government abroad is a segregation of groups.”

There seems little doubt that our national health and even life is seriously threatened as a result of an undigested and unassimilated mass of undesirable aliens. It takes intelligence to be Americanized; without intelligence the obstinate mass degenerates the whole of the population and our common ideals. The present restriction on immigration therefore appears justified; but it is not sufficient, for still the quality of those we do let in, is, on the average, abominable. A recent writer in *Scribner's* proposes as a remedy that we base our quota on the proportions of immigrants which came from various countries when the desirable Nordic races were arriving, instead of being based, as at present, on a certain restricted proportion of acknowledgedly inferior populations.

This is a national illness that those who are smilingly going about their business and reading the sports page do not sense. But it calls for special thought from every patriotic and intelligent individual. The weakness of the situation is that the bandits are highly organized, while those on whom they expect to prey are not. No less cold-blooded an authority than William J. Burns has just sounded the alarm of danger, and pointed to the rapid growth of a vast revolutionary organization in this country. It should be stamped out. Meantime the door should be closed. And we should set to work cleaning our own house.

Metallurgy of Gold as a Profession

FOR A CONSIDERABLE TIME we have been impressed with the number of inquiries received from the public, from mine owners, from investors, and from mine officials who require information as to the merits of one or more of the numerous patented processes that achieve partial publicity and which are designed for the treatment of a gold ore, usually any type of gold ore. These requests emphasize a serious weakness in the prevailing professional structure; they point to the fact that the specialist in the metallurgy of gold is being ignored, although his experience and knowledge should entitle him to an adequate share of the recognition that is accorded to mining engineers as a body.

In spite of the importance of improvement in technical standards in the milling and treatment of a gold ore, there seem to be few, if any, engineers available in New York City to whom an inquiry could be referred. The cyanide process was responsible for doubling the output of the essential bulwark of currency within about twenty years; an extraordinary interest and advance in technical methods has been evident; gold ores are complex in many instances, and the problems involved in the selection of a suitable treatment are highly controversial; there is constant need for expert and impartial advice on subsidiary processes. Yet the professional directory of the *Journal-Press* contains no mention of any one engineer practicing in New York City who specializes in such work. As a reason for this we can only assume that there is no livelihood for the expert cyanide metallurgist who aspires to a position as consultant. It is also probable that serious inroads into professional service by disinterested cyanide engineers has been made by industrial firms who are willing to advise and report free of charge, or for a nominal fee, but whose viewpoint is biased by a desire that their clients adopt certain patented or manufactured equipment.

In many quarters it is considered that the metallurgy of gold and the preparation of a gold ore for hydrometallurgical treatment constitute an unimportant sideline in the qualifications of a mining engineer. Such a conclusion, however, is unfair to specialists and detrimental to technical progress in a highly complicated phase of professional work. At present the cyanide process should claim an increasing amount of study from specialists, but such men are likely to remain in touch with the work only if they are given the opportunity in due course to obtain recognition as consulting experts.

It is obvious, so far as the numerous patent processes are concerned, that expert advice is often needed to prevent waste of time and money by prospective licensees; and in many cases to divert the inventor's efforts along channels of greater promise. It is an exceedingly difficult matter for even a specialist to get at the bottom of the majority of such processes, to find out the nature of the secret chemical or procedure on which the inventor bases his promises. In the majority of cases the claims made are absurd, and this is sufficient to warrant caution.

Speaking broadly, however, the non-technical or unsophisticated individual who wants impartial opinion on the treatment of a gold ore is at a loss how to proceed. He turns to the technical press and finds recent practice exemplified in one new and extensive installation by the retention of amalgamation as a preliminary to cyanide treatment, whereas in another he discovers that it has been discarded; in one instance all-slimes is adopted; in another there is a characteristic reversion to gravity leaching. The general answer to this apparent want of agreement is that each ore has its own peculiarities. This is only partly true, however, for identical ores are being treated by fundamentally different methods. The disparity can best be explained as being the result of personal bias and due to the influence of the personal equation. But the point we would emphasize by italics, were they permitted, is this: How much of the prevailing practice is due to the opinions of specialists in the metallurgy of gold—men who have earned the distinction of being experts by reason of wide experience, varied responsibility, and professional achievement—men who are as unbiased in their views as they are impartial in their choice of equipment? For such we make a plea for recognition as consulting engineers in a branch of technology that deserves encouragement and demands the application of a high standard of specialized knowledge and a broad experience in engineering, chemistry, and metallurgy.

Tin Smelting in the United States

IN 1916 the American Smelting & Refining Co. built a tin smelter at Perth Amboy, in New Jersey. It had a capacity of 750 tons per month when it started. This plant was intended primarily to treat concentrate from the Bolivian mines, some of which were controlled by the American Smelting & Refining Co. or the Guggenheim interests. At the start the landslips in the Panama Canal interfered with the regular receipt of shipments of ore from South America, but at that time the principal danger seemed to be the possibility of the Bolivian Government imposing a differential tariff on *barilla*, or 60 per cent concentrate, and bars of metal. However, nothing unpleasant of

this kind appears to have happened. The smelting of tin ores at Perth Amboy has grown to considerable proportions, as the following figures testify:

	Tin Production	
	U. S., Lb.	A. S. & R., Lb.
1916	4,522,000	4,522,000
1917	12,130,000	12,130,000
1918	20,568,000	19,868,000
1919	24,472,000	15,340,000
1920	35,304,000	18,511,160
1921	23,084,000	11,915,954

It is apparent that whereas for two years the A. S. & R. had the monopoly of the business, since then its success has attracted others to participate, so that now the A. S. & R. has a capacity to smelt half of the total output. The chief competitor has been the Williams Harvey Corporation, which has a smelter on Jamaica Bay, in Brooklyn, N. Y. The United States imports annually about 150,000,000 lb. of tin, of which the major part comes from the Straits Settlements and another large part from Banka and Billiton, two islands in the Dutch East Indies. The Nigerian tin goes to England. Our country produces none—or at the most 40 or 50 tons of cassiterite per annum. This comes from Alaska and the Carolinas.

The tin-smelting industry of the United States is now almost completely shut down for want of an adequate supply of concentrates. Bolivian tin mines find it more profitable to ship their tin to Europe than to have it smelted in the United States, cheaper by at least \$10 per ton. It was this differential in smelting rates that led the American refiners to ask for a duty of two cents per lb. on imported metal, but they were denied the tariff protection. The future of tin smelting in the country is hardly bright.

Mining on the Bolshevnik Plan

IN AN EDITORIAL on April 22, 1922, we described the proposed Bolshevnik expedition from New York to work mines in Siberia on the communistic basis; and we warned our readers as to the inevitable outcome of the venture. Not much time has been lost in proving the failure of the enterprise, conducted under an organization called Kuzbas, whose central office is or was in New York City. Recent Associated Press dispatches convey the tale of two Americans who have left the Kuzbas colony and arrived at Riga, in Latvia. These men paid their \$300 entrance fee, and went to work in the Siberian coal mines on the mutual profit-sharing plan: but there were neither profits, decent food, nor better housing than a tent. Finally they escaped.

The latest news that reaches us from Russia is that communism is being abandoned with all possible speed. Shops have been opened, houses returned to owners, money allowed to circulate, trade resumed—even government warehouse receipts for grain next year sold for good gold and silver, which the inhabitants are bringing out of their hoarding places. The impression of our informant—a close observer—is that Russia is “coming back” and that she is doing so by abandoning the tenets of Bolshevism. Meanwhile, there is some joy in knowing that the I. W. W. are agitating in Russia, protesting their treatment by the Soviets.

The radicals have wrecked Russia and brought it to the depths of misery through attempting to put into effect their ideals. Prosperity, if it returns, will do so because their methods are being ditched.

On the Value of Repetition

CAPTIOUS CRITICS are inclined to cavil when they read something in the technical press that is neither new nor novel. Nevertheless, the repetition of an important fact or the reiteration of an irrefutable axiom is likely to do more good than the description of an unproved process or an incursion into the problematical. We are inclined nowadays to overstress the value of the undiscovered, meanwhile neglecting to take full advantage of the obvious. It is patent, to those who discriminate, that more failures are traceable to a neglect of fundamentals than to insuperable obstacles. It is easier and a good deal more exhilarating to seek for the spectacular method of overcoming difficulties than to reason a way to success by the employment of basic facts and the recognition of common-sense principles.

One of the chief duties of the editorial staff of a technical paper is to answer inquiries from those who recollect or have been told that an editorial or an article on a subject in which interest is awakened has at some indeterminate date appeared in print. Lucky indeed are those who are able to find the information needed; for the great majority lack the preliminary scent with which to justify a precise inquiry. Many of our correspondents candidly confess an ignorance of particular subjects, usually elemental, and for them we are inclined to bespeak the toleration of the other section of our subscribers who might criticize adversely a repetition of what to them would appear as the obvious.

Mining engineering covers such an immense field that he who boasts of knowledge and proficiency in all its branches must be ignorant of his own shortcomings. To be frank, how many of us, if questioned on some special subject outside our own experience, would be inclined to plead preoccupation with other matters, to give ourselves time and opportunity to consult an encyclopedia or a colleague? Part of an editor's time should be allocated to the segregation of the valueless from the essential and the emphasizing of the useful. It is not enough to say, for example, that a particular explanation of a phenomenon was made ten years ago, or that a certain method of treatment was in practice and was described in 1898. In these times of stress and bustle no one man has the time to keep apace with all that is published or practiced; neither can the ordinary individual be trusted to separate the wheat from the chaff, as it were, and to store only what is valuable, for future use. If technical journalism is to fulfill its high purpose it must step aside occasionally from an emphasis of the up to date, in order to impress on all and sundry the vast importance of those elementary facts and common-sense principles that, one must confess, are often overlooked. The mere recapitulation of such usually leads to a mental retrospection that is eminently stimulating. It is as easy to forget the essential as it is to remember the recent and the spectacular, because our heads are always cluttered with rubbish that is stored away in the hope that it may ultimately prove of value.

The frequent reiteration of what is worth while is necessary, even though it disturb the equanimity of those whose memories do not need jogging in at least one particular subject. Others are less fortunate; and, as they constitute the majority, we will strive to serve them, taking no heed of the captious critics who gave us the text for this digression from our technical domain.

The Prince and the Engineers

By T. A. RICKARD

ON NOVEMBER 17 the Prince of Wales attended a dinner held under the auspices of the Institution of Mining Engineers and the Institution of Mining and Metallurgy at the Guildhall in the city of London. The presence of the popular Prince caused the attendance to be unusually large and representative. Sir John Cadman presided. In response to the toast of the evening, the Prince made a charming speech, in the course of which he remarked: "Sir John probably has been down many more mines than I have, and I expect he will agree with me that it is much easier to talk to miners in the bowels of the earth than it is to address a gathering of mining experts in the Guildhall. But, both on my own property in the Duchy of Cornwall and elsewhere—especially when I came across them in tunneling companies in France—I have always found miners to be the best of good fellows, and I am sure mining experts are just the same." The Prince is Duke of Cornwall and draws a large part of his income from the 'old county', which Sir Arthur Quiller-Couch called "the delectable Duchy". His reference to his meeting with the Cornish and other miners on the battlefield must have touched a responsive chord. He proceeded to say: "Even if I cannot claim to be an expert, I can claim some right to speak at any meeting which concerns mining; for, from the earliest times, Cornwall has been the nursery and the school of mines. Richard Trevethick, perhaps the greatest of mining engineers, was born and bred in Cornwall, and educated at Camborne, and something of his skill and perseverance has always lived on in the Cornish miner, making him a sterling pioneer overseas, and enabling him to face with rare courage and optimism the depression through which, I am sorry to say, the Cornish mining industry is passing today. There are, happily, signs that the worse is over, but we in Cornwall look to the company assembled here tonight to help us, by improving the methods of dressing minerals and by devising more economical means of working, to bring back prosperity to the industry in the country". The reference to Trevethick reminds me that many years ago, when it was planned to inscribe the names of mining worthies on the facade of one of the exhibition buildings, at Chicago, I think, the question arose as to whose names should be so honored. Most of us thought of Agricola (George Bauer) and Rossiter Raymond, but stopped there. Undoubtedly Richard Trevethick, the inventor of the Cornish pump in 1798 and of the locomotive in 1801, is one of the worthies of mining; so is Schreiber, the great Saxon mining engineer whose name appears in connection with many important European mines at the close of the eighteenth century. He was the founder of the School of Mines at Moutiers in Savoy, and the director of it in 1808.

Among other interesting observations, the Prince remarked: "The first duty that we owe to all connected with the industry is to provide, so far as is humanly possible, for their safety. There must always, of course, be an element of danger in mining, as in seafaring; perhaps that is why these two typically British trades—the one working under the earth, the other on the face of the waters—have always attracted the right sort of man. An Australian poet has said: 'No game was ever yet worth a rap into which no acci-

dent, no mishap, could possibly find its way'; that is certainly true of games; and I think it is equally true of more important things than games. But the very fact that there are these inevitable risks in mining or seafaring, making them the fine professions they are, means that it is all the more necessary for us as a nation to reduce the risks to a minimum. Should we have made the most of our island situation unless we had constantly year after year devoted energy, brains, and money to trying to solve the problem of safety at sea? The problem of safety underground is just as urgent; and it is because your Institution has worked so hard for that end that I am particularly glad to come here and meet your members today". The reference to the risk inherent in games and in other things that are worth-while reminds one of the Prince's fondness for riding to hounds, polo, steeple-chasing, and other virile sports, and of his recent spill in the hunting-field. He makes a right comparison between those "who go down to the sea in ships and see the wonders of the great deep" and those, no less daring, who go down the mine in skips and see the wonders of the subterranean world of rock and ore.

One aspect of the Prince's presence at this affair and his expression of goodwill to the mining engineers must not be overlooked. This public dinner of the two Institutions is one of the few royal recognitions of the mining profession. In 1909 King Edward laid the foundation stone of a new Royal School of Mines building, but it is fair to say that the mining engineer has received but scant notice from those in high authority and has been regarded only too often as merely a pestiferous person whose prospecting activities in distant lands made trouble for the officials at the Foreign Office. This attitude is curious if one remembers that the expansion of the British empire has followed upon the explorations of the miner; trade has followed the flag, but the flag has followed the pick. Consider the history of Australia, New Zealand, Canada, and South Africa. It is not necessary to belabor the point. Nevertheless one may venture to express regret that Cecil Rhodes, who made his money out of mining, did not found a mining college at Oxford instead of establishing his grandiose scheme of international education. The profession in Great Britain needed the prestige that would have accrued from Oxford's recognition of mining engineering as a gentleman's vocation. The War helped to establish the profession in public esteem because many graduate mining engineers proved excellent officers in the artillery, and the tunneling operations, to which the Prince referred, brought both miners and mining engineers into honorable prominence. General Haig said of them: "In their special work they have demonstrated their complete superiority over the Germans". Whether in defensive mining or in the offensive "they have shown", he added, "the highest qualities both as military engineers and as fighting troops". Our own engineer units arrived at a time when movement had succeeded the long period of stationary fronts, so they missed this particular experience of mining on the battlefield, but we unite in congratulating our comrades overseas on their military record and on this latest recognition of their services to civilization in times of peace.

DISCUSSION

The Mining Game

THE EDITOR:

Sir—Today, in spite of the natural economic adjustments, there is less money invested or chanced in mining than ought to be invested. Investors have been so lied to, and so robbed, that they have struck. And even if your publication advocates and believes that blue laws will help the miner and mine machinery manufacturer, this does not make your belief fact, because the truth of the matter is that blue laws do not protect. If the mining profession is ever to be cleaned up, the cleaning must begin from the inside, and not from the outside; and the leading mining publication can be one of the great instruments to accomplish the proper kind of cleaning. The public must be given the opportunity to do business with honest promoters. Honest engineers must render honest work and honest reports. These things, and not law, represent the salvation of the mining industry.

The writer will explain his peculiar interest in mining and will ask kindly consideration for his very poor English. In his youth, which is not so greatly remote, he desired to become a mining engineer, and took the examinations necessary for an entrance into the well-known Massachusetts mining school. In spite of the fact he could throw mathematics and chemistry over his shoulder with an extra strong arm, and could use sufficient French and German, your writer miserably failed in his examinations. He could not pass the common English test, nor could he pass the re-examination so kindly allowed. Thus he failed to go to this mining school, and only the private study of geology and years of reading your publication have given him the very slight knowledge of mining he possesses. Presumably the examinations today call for perfect tests in psychology, and theology, and political economy, or ought to call for these tests; because as even the vital essentials of a common education have given way to frosted coatings and expensive flavorings, where the personality and salary and half-year vacations of the instructors take the place of providing useful profitable education, one obtains a very clear impression, from your mining journal, that properly wearing a white collar and immaculate diamond-studded cuffs is more important to a mining engineer than finding dirty pay dirt.

The writer will ask further consideration, not for himself, but for his home town, Newbury, in Massachusetts, which town he will timidly assert is in a mineralized country where volcanic action has been made plainly evident and which town has many times been well rocked by earthquakes. Since 1880 several small companies have attempted to locate high-grade ore without finding much ore or spending much money. The latest attempt made in 1919-1921 did result in spending over \$160,000, when the Merrimac Development Co. attempted to mine ore at the old Chipman-Merrimac mine. This Merrimac mine was reopened in August, 1919. It was closed down the first of March, 1921, when the miners, receiving no pay for some time, and

little pay for a longer time, went on strike, and left the plant with the steam up and the fires undrawn.

There stands a wreck, with its deserted mine buildings, to prove conclusively that blue laws do not protect. Laws! What do they amount to? There are laws against lotteries; but for the last ten years there has never been a time I could not go out to the nearest barber shop or pool room, and buy lottery tickets, and buy them openly. They have even been sold on the church door steps. Any time I could call for a list of the monthly or weekly winners, and receive a printed card giving the real names and addresses. There are laws against manufacturing or drinking liquor, but every other house, in these eastern states anyhow, is better supplied with liquor now than was the case when liquor was free; although now it is doubly the dishonest liquor, and most of it very costly and exceedingly abominable in character.

Finance as applied to mining is different from other finance. Mining is a game of gambling, although the products of mining form the frame timbers of empires. The majority of those who gamble on the stock exchange or invest in lotteries lose their money, and its loss benefits no one. Though mining is also gambling, it is gambling with certain known chances; and in honest mining the per cent of chance is not more than in many ordinary manufacturing businesses when losses are considered, while the possible winnings are far beyond the profits of usual manufacturing. Moreover, in honest mining, the miners, mine-machinery manufacturers, and the public are all benefited, even where losses take place. But mining, being a gamble, follows in the footsteps of all gambling.

A great magnitude of capital is ready to swamp the mining industry with all the capital it can use; and more than it can use, as safe interest rates go to a low level. Yet your mining journal does not see any of this capital in evidence or see any of this capital coming the mining way. Also, your mining journal is very sensitive because many people look with contempt upon a mining engineer. So today you stand ready to back blue laws, although these laws help the large crook, and breed blackmail and hypocrisy. Yet blue laws will not deceive the high-class investing public into believing it is now a good thing to invest money with men you could not trust without the laws to curb them.

An ideal method of providing money for mining purposes would be by a unit of banker and engineer; capital and experience. A banker with independent capital himself, joining perhaps with other men of capital, some of them mining-machinery manufacturers, would associate himself directly with an engineer of mature years of age and mining experience, and an engineer possessed of excellent judgment rather than one of excessive learning. This unit firm would then establish its business and engineering offices—with salesmen, clerks, messengers, geologists, and engineers—for the sole business of handling the money of investors, for the purpose of providing money for prospecting, ex-

till death, but is so aloof from the body that even physicians do not know in full what their corporal organization is doing. This growth of the mind is but a tangled mass of mundane stress that may well be left behind on parting with its terrestrial habitation. Can anyone say there has been alteration in the texture of the human mind during its existence? Knowledge increases. Anything more?

Beginning as we know, with forms that cannot be classified as between organic and inorganic, animal or vegetable, development leads along divergent routes to such contrasting terminals as the Andes condor and the deep-sea fish of the Norwegian fiords. The next step may be forms which will traverse interplanetary space, impelled by known or unknown powers.

Following Henri Bergson, and this editorial, in their faith of great ultimate development of the human intellect, none hope for a further mental victory than to understand what has already been accomplished. We have one timepiece, the earth. Its records start one thousand million years ago; even then, everything we yearn to know for we do not yet aspire to be creators) had been thought out and done. By whom? By something, anyhow, existent then and before, and assuredly today.

JOHN B. HASTINGS.

Los Angeles, Calif.

Prospectors and Prospecting

THE EDITOR:

Sir—The field of the prospector in the United States is certainly more limited than it was fifty or even twenty-five years ago, and most of the so-called "grass-root" mines have been discovered. But these are not the only difficulties with which the old-time prospector or his successor must contend.

Assume that the prospector has been grubstaked, and has been successful in finding a promising outcrop: unless it is a grass-root mine with enough ore easily available to make it pay from the start, his troubles have only begun. Nobody wants to develop a prospect these days. Many prospectors of my acquaintance bear witness to this. They come in from the hills hopefully, with good specimens and alluring descriptions, to be met with cold and fishy stares from the men with money whom they approach; or they are referred to engineers who ask them questions as to the amount of work done, the number of samples taken (with assays at \$1.50 each and upwards), the average value of the ore, width of vein, length of payshoot and similar details.

These the "old-timer" answers with increasing doubt, until at last he wraps his specimens up in the tattered newspapers, and says, sadly or angrily, as the case may be: "I guess maybe you don't want a prospect. I never claimed this was a developed mine."

Those questions are tiresome and useless and discouraging to the prospector. But they must be asked, because the men who have the spending of the money will not spend it on generalities.

But somehow, the practical prospector cannot be persuaded to do even the simplest things to meet the conditions which he encounters when he comes to town to sell an interest in a prospect. There is nothing difficult in taking proper samples at intervals along a vein, measuring the width sampled, and taking a piece big enough to look at and representative of each sort of material sampled. It is easy enough to get samples

assayed, also, if the man to be interested is convinced that they were properly taken.

When Sam, or Bill, or Tom comes down from the hills with a story of a likely looking "strike" and some specimens to back it up, the impulse is to roll the old blankets and go out to see. It would mean at least some bully days in the hills, and some interesting looking around with a good scout. But the Man Who Pays says: "Hold on here! How do you know that this old galoot has got a damn thing? Where are his maps and sample returns?" Then the prospector tramps away to the next office, and you turn to the perusal of Report No. 973, which has been thumbed by the engineers of so many so-called exploration companies that it is almost illegible. You know that there is not one chance in a thousand of its telling anything of interest.

If I had my way about it, I would spend most of my time in the hills looking over what the prospector has to offer. That is where the mines are to be found. Also, I would make it a point to grubstake a few good prospectors in such a way that they could really prospect, and not spend most of their time rounding up burros, or the modern equivalent thereof, which is tying up a broken-down car of well-known make with baling wire. I would want to have something to say as to where they did their work, and what things they picked to dig on, and how much digging was to be done. And there would certainly be quite a lot of digging, for that is the way mines are to be made in the future.

The day of the prospector is not over by any means, but the day is past when, without adequate financial assistance, the prospector can expect to find a mine and bring it to a productive stage. If mines are to be found to take the places of those which are being exhausted, they will be found by a combination of prospecting and *development of prospects*.

Without intelligent and aggressive development work, following the initial activities of the prospector there will be few new mines. There is also a field for prospecting which does not appeal to the "old-timer." He wants to find something that he can see shine in his pan, or make a nice precipitate in a test tube. He is not interested in the surficial signs of a disseminated copper deposit, for instance. And while his patience is great, it is still too little to enable him to divide a large area into imaginary squares, and classify and reclassify rock specimens from each square, and draw curves representing the inefficiency of results, and so decide whether there has been the necessary amount of secondary enrichment.

In this it must be confessed that one's sympathy is with the prospector whose patience is too little, or whose common sense is too great. Personally, in doubtful cases, I prefer a churn drill to the use of the gessometer, no matter how highly educated.

At the same time, there are many things that we have learned about outcrops, and the conditions controlling the formation of ore deposits, which are valuable guides in carrying on the development of prospects. Consequently, we sometimes feel justified in recommending development chances which would not appeal to the practical prospector. We can even take chances on things which he tried and gave up. There are mines to be found in the United States, and a great many will be found when necessity forces activity in development of prospects.

J. H. FARRELL.

San Francisco, Calif.

ploration, and development of mines and oil lands. The products of this unit firm would be mining stock, but mining stock greatly differing from ordinary mining stock, for this firm would manufacture mines and sell the manufactured product, similar to the manner a shoe manufacturer manufactures shoes and sells them. This firm would make a large, safe, reasonable profit from a manufactured product, mines, represented by shares, and would only retain such stock in the mines as did not immediately sell when offered to the public. The idea is that this unit firm gives up the chances of making big money in fortunate holdings, and as a reward for real service given to the investing public the firm receives a fairly large legitimate profit through the sale of stock in mines this firm has established and financed.

There is another side of the mining question. Your publication holds up its hands in horror at the thought of synthetic gold. Yet at the same time your publication advocates and lauds the manufacture of mental gold.

The relative number of men with real brains in this world is small indeed, but the world and your publication, while deprecating synthetic gold, manufacture or attempt to manufacture brains. Millions upon millions of dollars, running into the billions, have been invested in something worse than poor mines. This wasted money has been invested in schools and colleges which vainly attempt, under the religiously sacred name of education, to turn ordinary clay into brains. It can't be done. It never has been done. It never will be done. One of the most laughable factors connected with this manufacture of gold-plated synthetic brains is the science of personality, which in plain language means to cheat by fraud. Personality is the science of assuming something that has no existence in fact, and acting just the opposite of the natural way to act. In actual life we are testing a man's ability and fitness to make or ruin a mine, or a man's ability to cut up the human body for good or for death, by the caliber of his smile. Personality gives an E.M. to a nonentity, an M.D. to a quack. Our systems of education, even technical education, are creating abominations that may well be likened to Victor Hugo's man who laughed, only education has operated on the head rather than on the face. We use our colleges to instruct a multitude of ordinary men, and we tattoo their brains with images of power and greatness as a sailor tattoos his arms and breast. Efficiency of human material would empty the colleges and fill the trenches with better men or fill the poorhouses. It is economic waste to operate the colleges and schools as they are now being operated.

When a man, by nature and training, is fitted for the profession of a mining engineer, and experience in the trenches has given this mining engineer the necessary mental judgment so he can play the mining game to the limit, then when this man engages in the mining game to the limit of his ability he is playing a man's game, fighting nature in a great and grand fight. Roosevelt only followed in the footsteps of great men when he left the ignoble crowds of eating and drinking Americans and sought the lonely places and the deserts of earth, to face wild animals. Since the foundation of the world, the greatest men, and their imitators, have always longed to get into the wilderness and fight nature and the animals of nature.

In his natural element, this cosmopolitan citizen, the mining engineer, is a peer of men. He has the entire earth for his feet to travel, and the entire broad eternal

heavens for his thoughts to roam. To fight against nature in the wilderness and on the desert, beneath caverns of rock, against heat and cold, against thirst and deluge, against barricade of mountains of snow, and over paths of reptiles and robbers—this is a man's game. To win gold, and silver, and copper, and precious metal from its lair is a man's game. It is not the loss of money that has brought the game into disrepute: men who risk money on mines expect oftentimes to lose. It is not the bad judgment of badly educated, incompetent engineers, who ought not to be engineers, that has brought the game into disrepute: when it is so necessary to take some chances, guesses may even be good guesses and go wrong. It is plain downright robbery that has queered the mining game.

Newburyport, Mass.

FREDERICK E. GREEN.

Another Optimist

THE EDITOR:

Sir—It is seldom indeed that one has the pleasure of reading an article so full of real good common sense and worth as that by F. C. Smith, on page 933 of the issue of Nov. 25, entitled "Prospectors." While it may be true that the total number of prospectors at work in this country is less than, say, ten years ago, it is also true that the average intelligence and metallurgical knowledge possessed by those who are at work is at least double what the early prospector had.

So far from the mines of this country and Canada having all been found, it is an actual fact that a good start toward locating all the orebodies has not even been made. The first group of men who will option a number of promising claims, under the best geological advice to be obtained, systematically prospect them with skilled men and with a complete outfit of diamond drills and enough capital to keep at it, will surely be rewarded with one real great mine.

Think of the vast area that has never been touched, that may perhaps not show any mineral indications on the surface, but that may at depth be the very richest of ore-bearing ground. Here in this camp commercial copper ore is being found at 2,500 ft., and no sign that the final depth has been explored.

I feel that I can view both sides of this question fairly. Have been a burro and bean prospector—dog train, canoe and snowshoe in Alaska and Canada, pack train in Mexico and on the West Coast; was in the early development of the Joplin field, placer and dredge in Guatemala, and have been field engineer for a number of large undertakings. I believe that the mining business in future tonnage extraction, market value, technically trained expert men, low treatment costs, improved metallurgical processes, and attractive possibilities for the employment of large capital is far and away better this moment than it has ever been.

Toward the coming of this good time, the prospector will always be found in the front of the fight.

Miami, Ariz.

C. E. HART.

Religion and Science

THE EDITOR:

Sir—Referring to the editorial on "Religion and Science," in your issue of Oct. 14, it was a relief to have the author bring us back again into the port of "Common Sense." Einstein can be followed with interest in relativity, and "Nothing has quality except by comparison" expresses the equation.

Mind is real and apparently grows from babyhood

Marketing of Metalliferous Ores and Concentrates—I

Miners Should Study the Ore-Purchasing Business—Better Contracts Might Be Made—Failure to Realize Expense Involved in Extracting and Refining Metals in Ore—Reasons for Deductions and Charges

BY ARTHUR B. PARSONS

Assistant Editor, *Engineering and Mining Journal-Press*

ONE TROUBLE with a great many sellers of metalliferous ore (concentrate is merely ore, usually crushed, from which some of the detrimental or less valuable pieces or particles have been culled) is that they make too little effort to understand the somewhat complicated business of the *buyer* of ore. The marketing of anything involves a transaction between a seller, who wants to get every cent he can for the thing sold, and a buyer, who, assuming that the thing in question is valuable to him, wants to get it for just as little as he possibly can. It is probably well to qualify this statement by pointing out that the buyer of ore always should be looking ahead for future tonnage—which is the very essence of his business—and accordingly he does not necessarily negotiate the purchase of a single lot of ore strictly on the basis of the value of that specific lot.

To get the best price for anything you have to sell you must know how badly the man you are dealing with wants the thing; in other words, you must be able to form some idea of how much he is willing to pay. To do that intelligently, you must have an accurate general knowledge of his business.

MANY STEPS BETWEEN ORE AND FINISHED METAL

Before considering the details of ore-buying contracts and schedules, it will be well to discuss sundry general conditions. The process of preparing copper, lead, or zinc for sale to a manufacturer usually entails four distinct operations: (1) Mining, or getting the metal-bearing rock out of the ground; (2) concentrating, or separating the profitable portions of the run-of-mine rock from the unprofitable; (3) smelting, or isolating the metallic constituents—as impure bullion—from the remainder—as slag—after melting the whole of the concentrate with appropriate fluxes in a suitable furnace; and (4) refining or separating the different metals from each other. Zinc metallurgy is singular; (3) and (4) do not apply to it in detail. Theoretically, the net value of any ore to the miner is the difference between the market value of the economically recoverable metals in the unmined ore and the cost of doing the things just enumerated, plus the cost of transporting ore and metal, marketing the metal, and financing the successive operations, and the paying of a reasonable profit to everybody but himself. If this "difference" is not a negative quantity the miner should then make appropriate deductions for the development and equipment of the mine and set up the necessary reserves for depreciation and depletion; if there is still something left he can inscribe a few figures on the right side of his own profit-and-loss account. Far be it from me to discourage the miner!

Now, as a rule the second of the operations mentioned is performed at or near the mine by the miner (I will use the words miner and smelter to represent respectively the mining company and the smelting company for the sake of simplicity). The concentrating

process may consist of an elaborate treatment in an expensive mill, or it may be simply sorting by hand to remove a small portion of the best material for shipment, or to remove a small proportion of the waste material so as to increase the per-ton value of the remainder. Often the ore is shipped just as it comes from the mine—frequently, indeed, when it ought not be. I shall allude to this later.

POSSIBLE WAYS TO ELIMINATE THE SMELTER

Progress is continually being made in the development of processes which will make it possible for step (3) in the series of four to be done at the mine, even though it be a small one. For example, chloride volatilization and leaching processes of sundry kinds, whereby operation (2) may be practically eliminated, offer prospects of obviating the necessity for shipment to a smelter. The product of such treatment, instead of concentrate, is impure bullion that may go directly to the refinery. This is a step in the right direction from the standpoint of ultimate economic efficiency, particularly on account of the prevailing high cost of transportation.

However, the customary procedure today is to ship either crude ore or concentrate, of comparatively high grade, to a custom smelter; and it is with the transaction in which the miner disposes of his ore to the smelter that this article is particularly concerned. There are a few mills in the country that take ores on a custom basis, and later I shall mention briefly the buying practice of two of them.

THE "WHY" OF A CUSTOM SMELTER

The reasons why ore and concentrate are shipped, often hundreds of miles, to a custom smelter are not obscure, but it will be well to enumerate some of them, as they have a bearing on the subject of marketing. In the first place, a satisfactory smelter charge requires various constituents—essentially lime, iron, and silica. If one or two of these constituents must be supplied by adding barren rock, the process is not economical. The ideal ore would contain these elements in proper proportions to be self-fluxing—but such ores are seldom found. The next best thing would be to have a mine producing two or more kinds of ore that would afford the proper mixture. Then that mine might build a small smelter of its own. The practical procedure, however, is for a company, operating for the specific purpose, to accumulate and mix the ore from various mines of various districts, at custom plants built at industrial and railroad centers. A second reason is the fact that an efficient smeltery must be a very large plant; it must have large stocks of ore to insure constant and uniform operation; it must run for decades, and, unfortunately, few mines have ore in sight for many years ahead.

Perhaps the greatest service that the custom smelter does the mining industry is in supplying a market at

Metallurgists of Note

FREDERICK LAIST

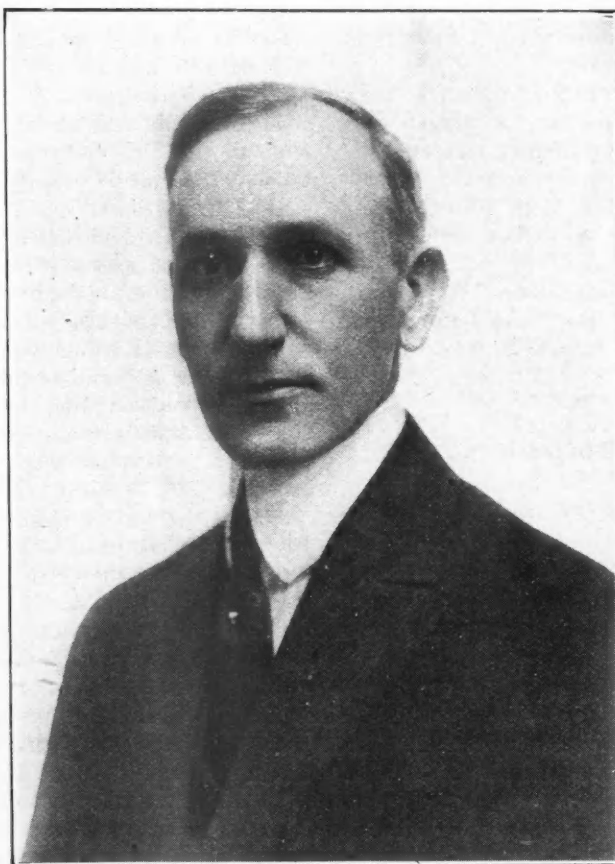
SOME engineers achieve success by getting wide experience in different parts of the world. They may not stay more than a few months with any one company, but after five or ten years of this sort of experience they feel qualified to hold down a position

of importance. The difficulty comes in finding a suitable opening. Others feel it more advisable to stick to one company, and, granted the necessary ability, gradually work up to the top. This method is not so attractive to the young man with a leaning to adventure, but it is productive of results, particularly if the company is a large one, like Anaconda, with diversified interests, and, also, if it is a company, again like Anaconda, which makes a practice of training and advancing its own men rather than bringing in outsiders for its more important positions. Frederick Laist has made his way by the one-company route, and therefore, when we asked him for some of the high-lights of his life, he said "I am afraid my life has been very uneventful and does not furnish very exciting material for a biographical sketch." We know however, that a man

who has spent twenty years with the great Anaconda company, from the bottom to the top, must have been intimately concerned with some interesting happenings. Frederick Laist was born in that Ohio town made famous by the "The Prince of Pilsen"—Cincinnati—on Oct. 30, 1878. Thirteen years later the family moved to California, where advantage was taken of the facilities offered by the college of chemistry in the University of California. Graduating in 1901, Mr. Laist accepted an appointment on the chemical faculty of the University of Utah, and in his one and a half years there made a study of the treatment of oxidized ores by leaching. Then he entered that famous stamping ground of metallurgical neophytes—the testing department of the Anaconda Copper Mining Co. This is the first step of the Anaconda ladder. Graduates of the testing department go next to the chemical laboratory, through the position of chief chemist, then superintendent of one of the subsidiary departments, and finally, if they have the requisite ability and personality,

are promoted to executive positions. This is exactly the course that Mr. Laist followed. After four years in the testing department and laboratory, he was made superintendent of blast furnaces, and a year later, assistant general superintendent of the smelter. When Mr.

Wraith resigned as general superintendent of the Anaconda works to become general manager of the International works at Salt Lake, Mr. Laist succeeded to his position, in January, 1913. About a year later, technical supervision of the Anaconda and Great Falls plants was combined, and he was made metallurgical manager of both plants, succeeding to the general management of both in 1917, soon after Mr. Mathewson's resignation. Mr. Laist is, in addition, chief metallurgist, and has charge of the designing of the plants for the Anaconda company's South American properties at Potrerillos and Santiago. Most of the improvements which have been made in the Anaconda plants since 1913 have been initiated and carried on under Mr. Laist's immediate supervision. These included the application of the flotation process; the enlargement of the Ana-



FREDERICK LAIST

conda plant from a capacity of 18,000,000 to 28,000,000 lb. of copper per month; increasing the recovery from 78 to 91 per cent; equipping the reverberatories with coal-dust firing; remodeling the converter plant; building and remodeling the roaster and concentrator plants; construction of a Cottrell plant of new design, with arrangements to treat the arsenical dust thereby caught; construction of a leaching and acid plant; and, perhaps most important of all, the construction of a zinc concentrator and an electrolytic zinc plant, now producing 10,000,000 lb. of high-grade zinc per month. Mr. Laist has given full publicity in the technical press to all of these improvements as made, a policy that has evidently redounded to the advantage of the company, and to which the management of less important companies may well give heed. Many a visitor to the Anaconda company's plant can testify as to Mr. Laist's courtesy and hospitality.

In 1907 Mr. Laist was married to Rosalba Murphy, and they have one boy and two girls.

which the miner who is developing a prospect can sell small lots of ore and thereby assist in defraying his expenses as he goes along. Otherwise he would have to find new money for all his development work, and accumulate ore on his dump until such time as the blocked-out reserves warranted the erection of a small smelter. Moreover, a small smelting plant is costly, and few mines even of medium size can afford to finance expensive plants. Big mines always start from little ones, so let the custom smelter have full credit for having been a most potent factor in the development of our mineral resources.

As it is of course impracticable to treat small lots of ore separately and pay the miner for the actual metal recovered, the only alternative method is for the custom smelter to purchase the ore outright and settle for it on the basis of the analysis as determined by sampling and assaying. Except for some zinc ores, these settlements are calculated on the current quotations for refined metals, as published in the *Engineering and Mining Journal-Press*. The purpose of this last is to allow the producer to benefit, or suffer, from price fluctuations. Otherwise, the smelter would be assuming an added risk for which he necessarily would provide by increasing his treatment charge on each lot of ore.

ORE BUYING A COMPLEX BUSINESS

The producer of ore or concentrate has but one object in selling: that is to get the most he can for the product of his mine or mill. For the custom smelter the problem of ore buying is more complex. Just as a railroad company must have traffic, so a smelter must have ore to continue in business. As a result of distributing overhead expense he can afford to pay more for ore (which is merely another way of saying to make the smelting charges less) if his plant is working at full capacity. Accordingly, he makes low rates for low-grade ore, or ore on which the mining costs are high, and usually he charges "what the traffic will bear" for high-grade or cheaply mined ores. Like the railroad company, also, he finds, not strangely, that he can afford to make lower rates where there is competition than he can where there is none. That is why the smelting charges in Salt Lake valley are low; the A. S. & R., United States, and International companies are all in the market for ores, and rivalry is strong. If you must have a mine, other things being equal, select one in the neighborhood of Salt Lake City!

The smelter should always look ahead. He can afford to make, and often does make, rates that means little or no profit to him, in the expectation that, as a mine is developed, richer and therefore more profitable ore will be mined, which will come to him by virtue of the contract that at the start did not appear to be advantageous. Broadly speaking, a custom smelting enterprise depends for its success on the prosperity of the mining industry in the region tributary to it. Mining in this region must be active if the smelter is to prosper, and it cannot long be active unless it is prosperous. This seems to be a self-evident fact, even though the policy of one large smelting company, that has enjoyed a virtual monopoly in a certain territory, until a few years ago was apparently established without regard for the principle. A change in that policy appears to have been made, however.

An ore buyer often finds that his company will need regularly an additional supply of a particular kind of ore. Tonnages shipped from sundry properties are con-

tinually fluctuating, and the "balance" may be short of one class of ore. He can afford to make a contract for that particular kind of ore on better terms than he otherwise might. It is to the advantage of the prospective seller to know as much as he can of such conditions.

MISTAKEN ATTITUDE OF "SMALL" MINER

The big mining company knows the ins and outs of the smelting business as well as the smelter himself; the smelter knows that it knows, and the consequence is the arrangement of a contract on fair and equitable terms without any great ado. Many small mine owners, on the other hand, could get more favorable terms if they would pay more attention to the making of their ore-selling contract. Although some fail to realize it, this may be as big a factor in the success of their enterprise as the intelligent development of the mine or the efficient extraction of the ore.

Too frequently the question of arranging a smelter contract is dismissed with the feeling that the schedule is a document too "complicated" to understand and that the smelter is going to get the best of it anyway. If one must be robbed, why not accept it cheerfully? This attitude is wrong for several reasons. In the first place, the miner who feels this way probably believes that he is being treated a great deal worse than he really is. He knows the assay value of his ore and he notes the big difference between that and the return from the smelter; but he does not always take into account the fact that the railroad takes a large toll for hauling the ore to the smelting plant; that the smelter does not recover and market all the contained metal; that his ore must help pay the cost of running the big plant; and that the pig lead or blister copper must be hauled a long distance to the refinery and there be subjected to an expensive treatment; all of these are rightly charged to his ore. He must help pay interest on the capital invested in all the plants in which these processes are carried out and he must pay interest on the money advanced by the smelter to let him have cash on the delivery of the ore. All this is fair, and it is fair, also, that both the smelter and the refiner, if they happen to be separate companies instead of one organization, make a reasonable profit on the business.

ORE SCHEDULES NOT MYSTERIOUS

When the average miner says the smelter schedule is "complicated" he generally means that it is also "mysterious." Most ore-buying contracts are complicated—some unnecessarily so—but they are not mysterious. There is a specific reason for each of the provisions. These are largely standardized and are virtually the same for the most favorable contract and the most exorbitant one.

The figures that are typed in to fill the occasional blanks are the meat of the contract. The miner owes it to himself to make some study of ore buying before he attempts to sell his ore. Even if a producer is at the mercy, so to speak, of the smelter, on account of the location of his mine and the consequent absence of any competition in buying, he will usually fare much better than he otherwise might if he understands something about the ore-buying business. Smelting plants are built and operated for the sole purpose of making money, and the miner should not expect to rely upon the liberality or generosity of the ore buyer.

There is another phase of the question from the miners' point of view that is frequently overlooked.

After the contract is made, it is often put in the safe at the mine and forgotten. Many mine managers fail to appreciate the possibilities of increasing profits by so preparing the ore as to secure maximum returns under the contract. The prevailing high freight rates make this opportunity particularly promising. I shall give some interesting figures to demonstrate this point in the concluding part of this article.

OPEN RATES LESS FAVORABLE

Most ore is sold under the terms of a formal contract usually of several years' duration. These, of course, vary somewhat in their general provisions and widely in the specific terms to be used in the actual calculation of settlement. The part of the contract that deals with factors to be used in ascertaining the money due the vendor is called the schedule. In form, the schedule is practically the same whether the transaction is controlled by a special contract or is simply made on the "open" rates offered by the smelter for any one who desires to ship. The figures in the schedule of a specific contract ought to be, and usually are, more favorable to the shipper than those specified under the open contract; unless, as has been suggested, the vendor is not sufficiently well informed to obtain concessions.

The difference between the gross value of the marketable constituents of the ore as determined by assay, on the date of settlement, and the return to the miner, is made up of two elements: (1) smelting charges (in which are included unavoidable metallurgical losses) and (2) what may be termed marketing charges. The latter are definite charges against the ore that for convenience are paid by the smelter in behalf of the miner and charged on the settlement sheet. They may include (a) freight on ore from mine to smelter, (b) demurrage, (c) extra sampling costs and umpire assaying, (d) freight on lead or copper to the refinery, and (e) duties and customs charged if the ore is of foreign origin. The freight on metal to New York or to other eastern refinery point may be calculated as a separate item or it may be provided for in the deduction from the metal quotation used for settlement. Under the first arrangement the seller gains or loses by changes in the freight rate. The cost of refining and of the marketing of refined metals, whether done by the smelter himself or by a separate company, is generally covered by an arbitrary deduction from the metal quotation and virtually becomes part of the smelting charge.

Smelting charges may be classified under three heads:

1. Nominal treatment charge (called by some working charge), which often fluctuates with the value of the ore, with the content of some constituent, or with the market quotation for some constituent.

2. Deductions from assay content (metallurgical losses are usually covered here), or from market price, of the various marketed metals for calculating the amount to be credited to the shipper.

3. The various penalties imposed because of the presence of undesirable constituents that are presumed to make the treatment more costly. Iron is sometimes paid for, although it is of course not recovered. It simply is the antithesis of one of the penalized constituents.

This seems to be complex. However, as I have said, there is a theoretical reason for each provision. The ideal end in view is to adjust the smelting charge so that each lot of ore is credited with exactly what it returns to the smelter and is debited in an amount proportional to the expense entailed in the treatment of it

and in the marketing of the resulting metal. It is also intended to diminish the profit to the smelter on ores of low grade, and on all ores during periods when market quotations are low; and, obversely, to increase the profit on rich lots, and during periods of high quotations. It is manifestly desirable that as between the two lots of ore the one that is more costly to treat should pay the higher charge.

In actual practice, unfortunately, this ideal principle is applicable as between different lots shipped by the same miner, rather than as between the shipments from different miners. The proportional part of the smelting expense borne by ore shipped by one company, as compared with another, depends upon how shrewdly and how successfully the smelter contract has been negotiated rather than upon the character and mineral content of the ore. Selling ore is primarily a business transaction; in negotiating a contract the ore buyer does not care particularly where he gets his "margin" so long as he gets it. He uses the technical phases of smelter operations as convenient arguments to convince the miner. This is not to say, of course, that he must not guide his purchases by the requirements of the metallurgists.

Typical ores may be divided into several classes, for each of which different schedules may apply. The following classification can be made:

- (a) Lead ore, rich in lead, low in copper.
- (b) Copper ore, rich in copper, low in lead.
- (c) Dry siliceous ore, low in lead, low in copper, valuable for gold and silver.
- (d) Zinc ores.

I shall now discuss the charges, deductions, and penalties mentioned in paragraphs 1, 2, and 3 above, giving the reasons assigned for the deductions from the "full value" as determined from assays and market quotations. Zinc ores are subject to peculiar provisions, and may best be discussed separately.

Nominal Treatment Charge—This is an arbitrary charge that theoretically represents the normal operating expense entailed in treating a ton of smelted material. Sometimes this charge is made low to delude shippers into thinking they are getting a good contract, when the difference is made up in some of the other charges. For dry ores, the treatment charge frequently, and reasonably, fluctuates in proportion to the gross value of the metal content. The following is taken from one schedule:

\$5 per ton for ores with gross metal content less than \$25.
 \$6 per ton for ores with gross metal content \$25 to \$40.
 \$8 per ton for ores with gross metal content over \$40.

One schedule for lead ores provides a base of \$2.50 per ton for 30 per cent lead content, with a debit of 10c. for each unit (20 lb.) of lead under 30 per cent and a credit for each in excess. This smelter desires rich lead ores. On the other hand, another smelter bases the charge on 50 per cent lead content, on open contract, at \$15 per ton, debits the shipper 10c. per ton for each unit above, and credits him for each unit below. This plant has a surplus of high-lead ores and varies the treatment charge in proportion to the grade of the ore.

ORES VARY IN VALUE TO DIFFERENT SMELTERS

To illustrate the fact that one smelter may well afford to make more favorable terms than another for a particular class of ore, presume an oxidized ore containing 6 per cent copper and 50 per cent iron. A smelter who was accustomed to buying iron ore con-

taining no marketable metals to flux his copper-furnace charge would be justified in making a nominal smelting charge, whereas a competitor, whose ore supply was balanced so far as iron was concerned, would charge for the oxidized copper-iron ore because the high iron content would have the effect of increasing the iron in his slag, thereby making a dirtier slag—i.e., one containing more copper. In Colorado there has always been an excess of dry siliceous ore. To collect the precious metals efficiently there should be 8 or 10 per cent of lead on the charge; accordingly, high lead ores have always been at a premium. These are only examples of dozens of problems that enter the business of buying ore and fixing treatment charges.

Deductions on Content and Quotation—I shall not attempt to go into a technical discussion of the arguments used to justify the amount of the deductions that come under this head, but will enumerate the usual figures and give the reasons briefly.

The minimum amount of gold settled for varies from 0.01 oz. up to 0.05 oz.; the entire assay content is usually paid for, and the price varies between \$19 and \$20 per oz., as against the standard mint value of \$20.67. The non-payment for minute quantities is based on the theory that a certain amount goes into the slag. However, this is rather inconsistent with the payment for 100 per cent of the assay content. In practice, the smelter always sells much more gold than he pays for, one reason being that the furnace recovery is higher than the assay recovery. The deductions for gold may therefore be categorized among the "margins" that go to make up the smelter's profit.

The minimum amount of silver recognized is usually 1 oz. per ton. Generally 95, though sometimes 90 or 100, per cent of the content is paid for; and frequently 3 or 3½c. per oz. is deducted from the market price in figuring settlement. The "minimum" and "95 per cent" provisions cover metallurgical losses. These used to be much greater than they are now, on account of volatilized silver which was lost before the days of fume cleaning in baghouses and Cottrell treaters. Silver differs from gold in that gold does not volatilize appreciably. Moreover, there is always enough lead or copper as a collector to get practically all the gold, whereas the silver, being present in greater bulk, is likely to be forced in greater quantity into the slag if the percentage of collecting metal on the charge is not sufficiently high. The deduction of 3c. or 3½c. from the market price of the metal is designed to cover refining and marketing charges and interest on the capital involved, and to protect the smelter against depreciation of the price between the time of settlement and the time that the actual metal finally gets on the market. This may be from 50 to 120 days. Of course the Pittman Act eliminates this element of uncertainty, temporarily, for silver produced in the United States, but the principle is sound.

INFLUENCE OF MARKET FLUCTUATIONS

A word of explanation here will apply likewise to similar deductions in the quotations for lead and copper based on possible losses consequent to fluctuations in the market. Theoretically, as soon as he has his plant running regularly, a smelter should be able to sell each day at the prevailing market quotations, which control his settlements for ore purchased, the exact quantity of metal that that ore contains. If he does not do this, in so far as his operations will permit, he is deliberately

speculating on the market and has no right to expect protection from the miners whose ore he is buying. As a matter of fact, however, there are certain practical limitations to his ability to synchronize sales and purchases, for the reason that high prices stimulate production and swell the stockpiles at the smelting plant with high-priced ore which must be worked off when the market is depressed and mine shipments are at the minimum. Furthermore, the metal market on large movements almost invariably declines more rapidly than it climbs. On the whole, it is fair to assume that the non-speculating smelter does not realize as much on his metal as the settlement quotations would indicate that he should.

The loss of silver in the assay cupel is more appreciable than that of gold, so that, as a matter of fact, the smelter doubtless sells more silver than he pays for.

The settlement for lead varies widely. The minimum content for settlement on a "lead ore" schedule is generally 5 per cent "dry assay," the analysis being based on the wet assay with an arbitrary deduction of 1½ units to convert to a theoretical "dry." Or, as an alternative, the lead contents may be determined by a wet analysis of the button obtained in a fire assay. In either event, the purpose is to compensate for a metallurgical loss of approximately 30 lb. per ton of ore that is commonly accepted as being an average, although the actual loss is probably more for high-grade ores. A typical contract specifies the payment for 90 per cent of the lead content (fire assay) "at the average New York quotation for the *E. & M. J.-P.* week previous to the date of receipt, less 1.65c. per lb." The freight on lead bullion from many intermountain points to the Atlantic seaboard is \$16.50 per ton. This takes half of the 1.65c. deducted, and the remainder more than covers refining and marketing. The 10 per cent deduction on the dry-assay content consequently goes into the smelter's margin of profit.

If the lead content of an ore is under 5 per cent, it becomes in effect a dry ore. That is, it does not supply its proportion of the lead required on the charge, and although some of the lead may be recovered, it seems reasonable that it be not paid for. The lead in ores that are smelted in copper furnaces is not paid for either, although some is recovered from the fume.

Two deductions are usually made on copper ore purchased by a copper smelter. From the wet assay, 0.5 to 1.3 units is deducted to cover assumed metallurgical losses; in the best modern reverberatory practice the copper actually lost is approximately 10 lb. per ton, or 0.5 units on ore assaying from 10 to 20 per cent copper. The loss incurred in converting is almost negligible.

The second is a deduction from the *Journal-Press* quotations for the refined metal of from 2½ to 3½c. per lb., to cover "freight, refining, selling and delivery charges." Three cents per lb. is \$60 per ton of metal. The maximum freight rate from Western smelters to the Atlantic seaboard refineries is \$16.50, even at the prevailing high railroad tariffs. Refining once was estimated at about \$14 per ton, but during the war it cost about twice that, and \$14 is less than actual cost now, although on old contracts a great deal of the metal is now being refined at a figure little above that. The metal loss in refining is about 7 lb. per ton of blister. The selling charge at most is not more than \$3 per ton, and the delivery charge is fictitious, because the price quoted in the *Journal-Press* is f.o.b. refinery. Clearly, a large part of the smelter's "margin" comes in this item.

In addition to the four metals already mentioned, several others are recovered in part in most modern lead- and copper-smelting operations. Zinc in "zinc" ores is of course paid for, but it will be most convenient to deal with them separately. Arsenic, antimony, and bismuth are frequently recovered, but are seldom if ever paid for, although the future is likely to bring about a change in this regard. Sulphur, arsenic, and bismuth are a source of profit to some smelting companies, but, generally speaking, all of these elements are either penalized or ignored in settling for copper, lead, and dry ores. Just at present antimonial lead is a drug on the market.

Cobalt and nickel are penalized at the rate of from \$2 to \$3 per unit. Although these metals may be recovered, generally speaking, they add more to the expense of refining the other metals than can be realized from their sale.

Penalties for Undesirable Constituents—Silica has always been one of the principal constituents penalized, for the simple reason that there usually has been a greater supply of siliceous ore than is required to form a suitable furnace charge, thereby necessitating the smelting of iron and lime for flux. The penalty used frequently to be fixed on the basis of the excess of silica over iron, or over combined iron and lime.

The development of flotation concentration, with the production of a large tonnage of concentrate that is high in pyrite and low in silica, has had the effect of altering these conditions in most smelting localities. Low-grade siliceous tailings are being shipped as flux to a number of smelters. One large lead smelter simply provides in his open contract that there shall be no penalty for silica or "insoluble" and no payment or credit for iron. More frequently, however, a penalty of 10 or 12c. per unit for the total content of silica or insoluble is imposed, and a credit for iron of 5 or 6c. per unit is allowed. In one contract available lime is paid for at 6c. per unit if the amount present exceeds 3 per cent. "Insoluble" is not synonymous with silica, for it includes, in addition to silica, such constituents as alumina, calcium fluoride, barite, and garnet. However, the determination of silica is tedious and costly, and "insoluble" is frequently specified to determine the deduction.

Sulphur, especially where the charge is high in zinc, is a source of great trouble in the lead blast furnace. The lead smelter penalizes the content above a certain maximum, whereas the copper smelter likely ignores it. The following shows a number of typical provisions for sulphur in lead ore:

Contract	Free Maximum, Per Cent	Rate per Unit for Excess	Maximum Penalty per Ton
A	4	\$0.25	\$2.00
B	2	0.25	2.50
C	1	0.25	3.00

In the first of the above there is no sulphur penalty on ore containing more than 20 per cent lead. As an alternative to a penalty on sulphur a roasting charge of about \$3 per ton is sometimes imposed.

Penalties for zinc likewise are of more importance with respect to lead ores than to copper ores, for the reason that lead and zinc seem to have a greater affinity for each other in nature than have copper and zinc. As a consequence, copper ores are not often contaminated with an excessive quantity of zinc. The zinc penalties, corresponding to those just quoted for sulphur, are:

Contract	Free Maximum, Per Cent	Penalty per Unit for Excess
A	5	\$0.50
B	10	.25
C	8	.30

Similar deductions may apply to dry and copper ores, as there is no question that an excessive zinc content increases both operating costs and metallurgical losses.

Arsenic unquestionably is another bad constituent in the smelting charge. It has an affinity for iron, with which it forms speiss, a substance that has a very high fusing point and which accumulates in the furnace. Frequently the deduction is designated as a penalty on speiss. One contract calls for 30c. per unit; another for 20c. per unit, with 10 per cent allowed free. Nevertheless, the arsenic can be recovered, and with the prospect of a rising market and large consumption it will be an asset of increasing importance to the smelter. One miner pays \$2 per unit on combined arsenic and antimony in excess of 1 per cent. This seems unreasonable.

Many schedules provide for a penalty on moisture. One contract for lead ore allows 6 per cent free and charges 20c. per ton for each per cent in excess of that up to a maximum of \$2 per ton. This charge manifestly seldom applies to anything but flotation concentrate. To justify it the smelter argues that the sticky concentrate is bothersome to handle. In addition, of course, fuel is required to evaporate the water. Taking into consideration the freight on the contained water, it is not unlikely that the miner frequently can save money by partly drying his concentrate before shipment.

RETURN ON ZINC ORES LESS THAN ON OTHERS

The marketing of zinc ores is a development of the Joplin (Mo.) practice, where the smelter representatives buy concentrate outright at the mill, much as they might purchase grain at an elevator. This is practicable, because the character of the concentrate does not vary greatly, as does that of Western ores, and precious metals are negligible. For oxidized concentrate the standard zinc content is 40 per cent; for sphalerite it is 60 per cent. The "base" price is determined by the keenness of competition among the buyers, and of course fluctuates with the condition of the market for slab zinc. Usually the price for any lot is increased or decreased above or below the base by \$1 for each per cent variation in the zinc content from the standard. For each unit of iron above an allowable maximum of 1 per cent, a penalty of \$1 is imposed. Lead is undesirable, and if a lot contains above 0.5 per cent, for illustration, a lower base rate is fixed.

All zinc until quite recently was extracted from its ore by a smelting process, in which the essential part is retorting, after a preliminary calcining or roasting, depending upon whether the ore is oxide or sulphide in character. The recovery varies inversely with the zinc tenor of the ore and usually ranges between 80 and 85 per cent of the total content. The treatment cost is variously given as \$16.50 to \$22.50 per ton of ore, but the process is admittedly more expensive than the smelting of lead and copper, so that the comparative percentage return to the miner of zinc ore is even lower than that realized by the producer of ores of the other metals.

Where electric power is available at reasonable cost, and a large tonnage of zinc ore can be obtained, leaching and electro-deposition have proved more efficient with sulphide ore containing in addition to zinc 5 to 20 per cent lead and 5 oz. or more of silver. It is desirable that the iron content of the ore be low. A preparatory roasting is essential. Whichever process is used, most of the lead, silver, copper, and gold remain in a residue that must be smelted by the usual methods.

One scheme of settlement that still survives for these complex ores is based on the old Joplin practice. The ore-purchasing contract specifies a base price fixed according to an arbitrary analysis and at arbitrary metal quotations. The settlement for any lot of ore is calcu-

going below them and (2) by specifying a minimum content for combined lead and zinc content.

In one contract of this type the base price f.o.b. St. Louis for an ore containing zinc, 30 per cent; lead, 15 per cent; silver, 8 oz.; and silica, 7 per cent, at quotations of 6c., 5c., and \$1 respectively, for zinc, lead, and silver, is \$19.50, or only 30.7 per cent of the gross value of the metal contained. Later in this discussion I shall present the details of a settlement based on this contract.

In recent years many contracts have been written with a schedule quite similar in form to the schedules used for lead and copper ores. These usually provide for the payment of from 75 to 85 per cent of the zinc in the ore at the St. Louis quotation for Prime Western spelter, and from 65 to 80 per cent of the silver and lead.

By way of comparison, the following payments in two schedules, A and B, by different smelting companies, are shown:

LEAD-SMELTING PLANTS IN THE UNITED STATES

Company	Situation of Plant
American Smelting & Refining Co.	Denver, Colo.
American Smelting & Refining Co.	Durango, Colo.
American Smelting & Refining Co.	East Helena, Mont.
American Smelting & Refining Co.	El Paso, Texas.
American Smelting & Refining Co.	Leadville, Colo.
American Smelting & Refining Co.	Murray, Utah.
American Smelting & Refining Co.	Omaha, Neb.
American Smelting & Refining Co.	Perth Amboy, N. J.
American Smelting & Refining Co.	Pueblo, Colo.
American Smelting & Refining Co.	Selby, Calif.
Bunker Hill Smelter	Kellogg, Idaho.
International Smelting Co.	Tooele, Utah.
Pennsylvania Smelting Co.	Carnegie, Pa.
U. S. Smelting, Refining & Mining Co.	Midvale, Utah.
St. Louis Lead Co.	Herculanum, Mo.
Federal Lead Co.	Federal, Ill.
St. Louis Smelting & Refining Co.	C. Illinois, Ill.
American Zinc, Lead & Smelting Co.	Granby, Mo.
Eagle-Picher Lead Co.	Joplin, Mo.
Consolidated Mining & Smelting Co. of Canada.	Trail, B. C., Canada.

COPPER SMELTING PLANTS IN THE UNITED STATES

Company	Situation of Plant
American Smelting & Refining Co.	El Paso, Tex.
American Smelting & Refining Co.	Garfield, Utah
American Smelting & Refining Co.	Hayden, Ariz.
American Smelting & Refining Co.	Omaha, Neb.
American Smelting & Refining Co.	Perth Amboy, N. J.
American Smelting & Refining Co.	Tacoma, Wash.
Anaconda Copper Mining Co.	Anaconda, Mont.
Anaconda Copper Mining Co.	Great Falls, Mont.
Southwest Metals Corporation	Humboldt, Ariz.
Calumet & Arizona Mining Co.	Douglas, Ariz.
Ducktown Sulphur, Copper & Iron Co.	Isabella, Tenn.
East Butte Copper Mining Co.	Butte, Mont.
International Smelting Co.	Miami, Ariz.
International Smelting Co.	Tooele, Utah
Nevada Consolidated Copper Co.	McGill, Nev.
Nichols Copper Co.	Laurel Hill, N. Y.
Norfolk Smelting Co.	West Norfolk, Va.
Old Dominion Co.	Globe, Ariz.
Phelps Dodge Corporation, Copper Queen Branch	Douglas, Ariz.
Tennessee Copper Co.	Copperhill, Tenn.
U. S. Metals Refining Co.	Chrome, N. J.
United Verde Extension Mining Co.	Clemenceau, Ariz.
United Verde Copper Co.	Clarkdale, Ariz.
Calumet & Hecla Mining Co.	Hubbell, Mich.
Lake Superior Smelting Co.	Dollar Bay, Mich.
Michigan Smelting Co.	Houghton, Mich.
Quincy Smelting Works	Hancock, Mich.
Consolidated Mining & Smelting Co.	Trail, B. C., Canada
Granby Consolidated M. S. & P. Co.	Anox, B. C., Canada

ZINC SMELTING PLANTS IN THE UNITED STATES

Company	Situation of Plant
American Steel & Wire Co.	Donora, Pa.
American Zinc Co. of Illinois	Hillsboro, Ill.
American Zinc & Chemical Co.	Langeloth, Pa.
American Zinc, Lead & Smelting Co.	East St. Louis, Ill.
Eagle-Picher Lead Co.	Hillsboro, Ill.
Grasselli Chemical Co.	Terre Haute, Ind.
Grasselli Chemical Co.	Meadowbrook, W. Va.
Hegeler Zinc Co.	Danville, Ill.
Illinois Zinc Co.	Peru, Ill.
Matthiessen & Hegeler Zinc Co.	La Salle, Ill.
National Zinc Co.	Springfield, Ill.
New Jersey Zinc Co. of Pa.	Palmerton, Pa.
United Zinc Smelting Corporation	Moundville, W. Va.
Grasselli Chemical Co.	Cleveland, Ohio
Arkansas Zinc & Smelting Co.	Van Buren, Ark.
Athletic Mining & Smelting Co.	Fort Smith, Ark.
Bartlesville Zinc Co.	Blackwell, Okla.
Eagle-Picher Lead Co.	Henryetta, Okla.
Edgar Zinc Co.	Cherryvale, Kan.
Fort Smith Spelter Co.	Fort Smith, Ark.
Grasselli Chemical Co.	Clarksburg, W. Va.
National Zinc Co.	Bartlesville, Okla.
Quinton Spelter Co.	Quinton, Okla.
U. S. Zinc Co.	Henryetta, Okla.
U. S. Zinc Co.	Kusa, Okla.
U. S. Zinc Co.	Sand Springs, Okla.
Utah Zinc Co.	Salt Lake, Utah
Anaconda Copper Mining Co.	Great Falls, Mont.
Park City Mining & Smelting Co.	Park City, Utah
The Empire Zinc Co.	Canon City, Colo.
Shasta Zinc & Copper Co.	Winthrop, Calif.
Consolidated Mining & Smelting Co. of Canada	Trail, B. C., Canada

	Zinc	Silver, Per Cent	Lead	Nominal Treatment Charge
A	82 per cent at St. Louis quotation	65	65 per cent of wet assay, less 1 1/2 units at N. Y. quotation, less 1 1/2 cents	\$17.50
B	75 per cent at St. Louis quotation	80	80 per cent of wet assay, less 4 units at N. Y. quotation, less 2 cents	\$19.50

These figures indicate that the method of making deductions or charges is by no means based on metallurgical recovery, for there is no such wide divergence in the work done at different smelting plants as would be necessary to account for the figures just quoted.

The purchase of siliceous gold and silver ores by companies operating cyanide plants is usually arranged on a simple schedule based on the precious-metal assays. A typical contract provides payment for 90 per cent of the assay content of gold and silver at \$20 and \$0.9986 per ounce respectively. The 10 per cent is the nominal loss in tailing; the actual loss is probably somewhat less. In this same contract the treatment charge varies in proportion to the value of the ore. This is justified partly by the additional expense for refining the precipitate, but principally on the theory that the richer ore can reasonably bear a higher treatment charge. The schedule provides:

Valuation per Ton	Treatment Charge per Ton
Up to \$20	\$4.50
\$20 to \$25	5.00
Over \$25	\$5.00 plus 10 per cent of additional value

A plant in another district that treats gold ores only pays for the full gold content as determined by assay at \$20 per ounce, with a sliding treatment charge based on the assay value of the ore. The schedule, which includes freight from the district that supplies all its ore, follows:

Value of Ore	Freight and Treatment Charge
Under \$4.50	\$3.00
\$4.50 to 8.00	3.25
8.00 to 10.00	4.00
10.00 to 15.00	5.25
15.00 to 20.00	6.25
20.00 to 25.00	6.60
25.00 to 30.00	6.90
30.00 to 40.00	7.50
40.00 to 100.00	8.60

lated by adding to or subtracting from the base price premiums or penalties for variations in metal contents and in market quotations. The variations usually give the miner the benefit of only a small percentage of the "increases." The smelter, on the other hand, protects himself from decreases (1) by making the base quotations so low that there is little likelihood of the market

In the concluding article next week I shall outline the provisions of typical contracts and give the detailed figures of thirteen different smelter settlements.

To be concluded

The Sado Gold Mine, in Japan

A Property That Has Produced Since the Year 1601—Gross Output \$12,000,000—Ore Deposits Are Below Sea Level—Amalgamation and Cyanidation Recover Fair Proportion of Gold and Silver—Operating Cost \$5 Per Ton

BY CHESTER WELLS PURINGTON

DURING APRIL, 1922, I visited the Sado gold mine, which is situated on the western side of the large Island of Sado, off the west coast of the main island of Japan at latitude 38 deg N., in the Inland Sea. The point of departure for Sado Island is Niigata, a prosperous city of 62,000 inhabitants. Communication with Ebisu, the main port of Sado, is by

of the *Transactions* of the A.I.M.E. John R. Black, in "Young Japan" (Yokohama, 1881), states that in 1870 the Japanese Government engaged E. J. Gower to run the Sado mine, and that the first foreign-type stamp mill was then erected. It is said that previous to this about twenty-nine different openings were being worked in the Sado valley, the quartz

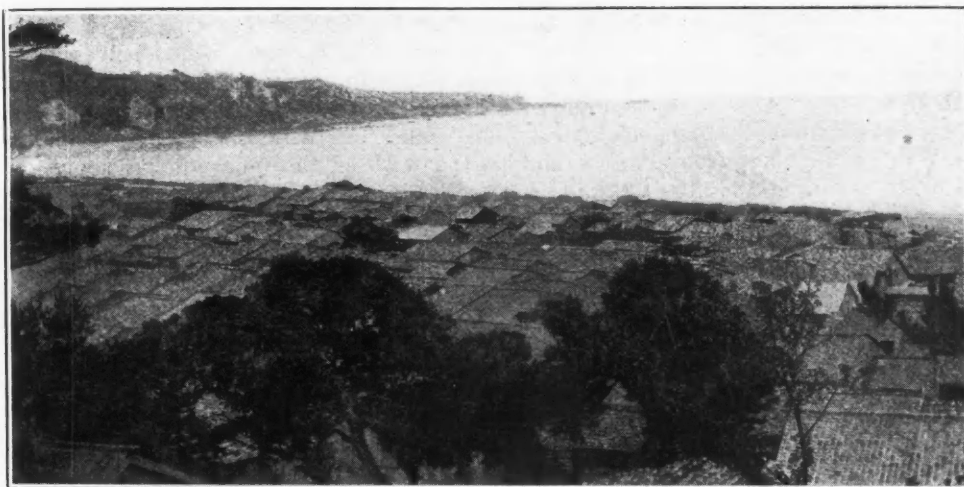
being crushed by hand, to the extent of only six to eight tons per day. This seems rather incredible, since in Kyushu, the south island of Japan, stamp mills of Korean type have been operating for many decades. It is interesting to note, also, that the gold used in the early seventeenth century for the decoration of the temples and mausolea at Nikko and Kyoto was obtained by Iyeyasu, the famous chieftain, from the Sado valley mines.

The "koban" and "oban," Japanese oval gold coins, of about \$12 and \$70 value respectively, are said to have

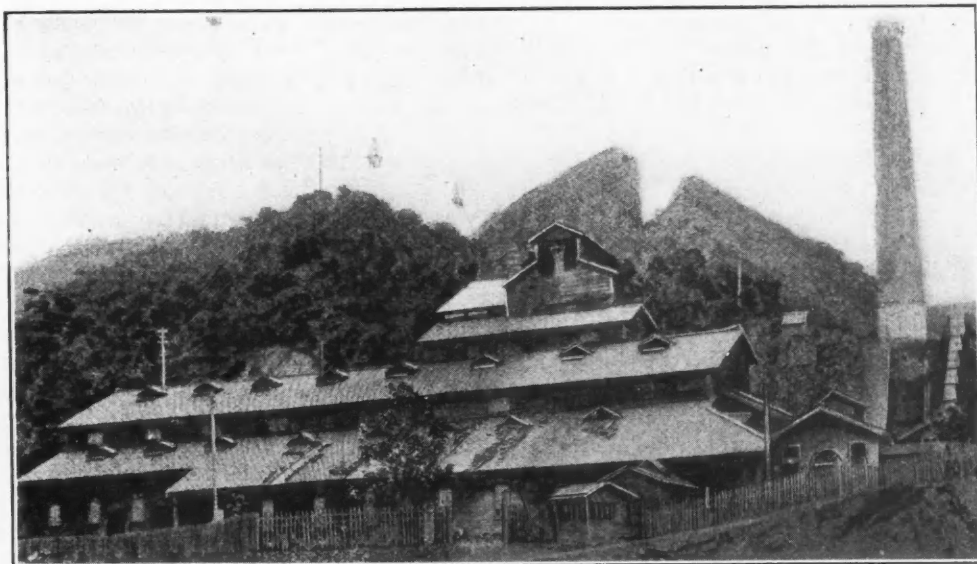
been first mined at Sado. No record of production of gold and silver at Sado previous to 1869 is available, but I saw a sheet showing the detailed production since then at the mine office. From this it appears that a total of about \$12,000,000 (23,000,000 yen) in gold and silver has been produced to date, in little over half a century. About 20 per cent of the value

small steamer; the distance is 32 miles. From Ebisu, on the east coast of Sado, a jitney bus runs to Aikawo-Machi, the mining community, in one and a half hours, crossing the island by a fairly good country road.

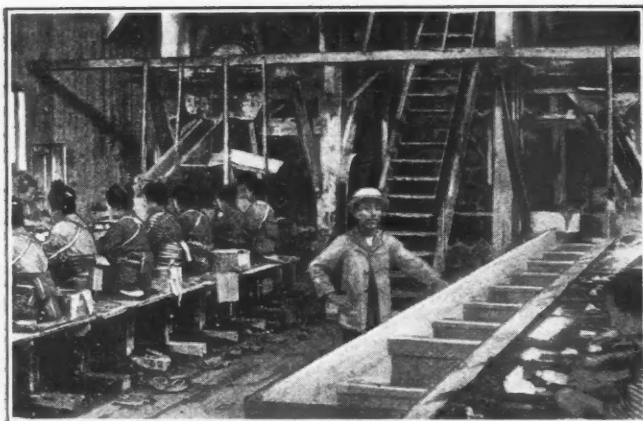
The Sado mine is owned and operated by the Mitsubishi Company, one of the great subsidized industrial companies of Japan. It was formerly a government property, and was taken over by the present company in 1896. The mine has a long history, having been opened in the year 1601. It was operated for over two and a half centuries by convict labor. Originally belonging to the Tokugawa Shogunate, it passed to the Imperial Court on the fall of that dynasty, and was finally sold to the Mitsubishi Company. The present mine and treatment plants are entirely modern and are under the able direction of S. Yasukawa, general manager, and S. Matsuoka, assistant manager. A description of the Sado mine was given in one of the early volumes



Aikawo-Machi village, on Sado Island



Mill at the Sado mine, in Japan



Sorting ore at the Sado gold mine

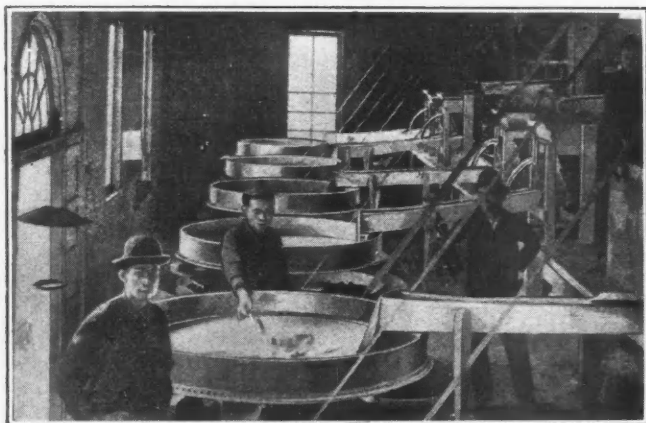
appears to have been in silver. Copper is produced in insignificant quantity (about twelve to twenty tons per year) from a cross vein, but most of the gold and silver came from the "south vein."

In 1912, the output was 12,574 oz. of gold and 123,660 of silver. The peak output was in 1915, when from 24,648 short tons of ore 20,556 oz. of gold and 186,116 oz. of silver, with an aggregate value of \$536,500, was extracted.

In 1920 the output is said to have been \$440,000 in gold and silver, with about \$3,000 worth of copper. The present output is said to be about \$320,000 in gold and \$115,000 in silver (reckoning silver at 60c. per ounce annually).

In 1915 the ore stoped must have come from bonanza shoots, as the recovery is calculated to be \$17.23 in gold and \$4.12 in silver per ton. At present, it is said, the recovery averages only \$4.24 in gold and \$2.10 in silver (0.205 oz. gold and 3.5 oz. silver). At the same time it is stated that 8,000 metric tons per month, say 8,800 short tons, is being sent to the crusher, so that, apparently, nearly 50 per cent of the ore must be sorted out on the picking belts below the crusher instead of only 20 per cent, as I have been informed. The lowest grade of ore that can be made to pay is about \$5.70. About twelve metric tons of copper is being produced annually.

Sado Island is about 32 miles long by 17 wide. It is mainly important for agricultural and dairy products, and has a population of 120,000. There are two mountain ranges, extending north of northeast, said to be of limestone; the highest peak, Kimpoku-san, rises to



Amalgamating pans below the stamps in the Sado mill

3,900 ft. The andesite in which the veins of Sado mine lie appears only on the west side of the island.

A 500-ft. divide, about three miles from the west coast, separates the eastern plain from the cirque-like valley of Aikawo. Here thin-bedded tufts are to be seen, with a generally north strike and west dip, steeply inclined. Outcrops of fresh blue andesite may be noted along the road; this is in fact the country rock of the Sado veins. The andesite at Sado is almost identical in appearance with the andesite which forms the country rock of the gold-bearing veins at the Taio Gold Mining Co.'s property, 560 miles to the southwest, in the Island of Kyushu.

Two principal veins have been worked, both having a northeasterly strike and dipping steeply south. They are about 300 ft. apart. By far the greater part of the work has been done on the south vein, which has been worked over a length of 7,000 ft. and to a depth below the outcrop of 1,650 ft. The outcrop is 800 ft. above sea level and is 80 ft. wide. Curiously enough, it is still mined, although apparently it must have been worked with a fair degree of continuity for over three centuries. The collar of the main shaft is 400 ft. below and to the west of the outcrop and about one and one-half miles from the beach at Aikawo. The collar is 400 ft. above sea level, and the bottom level is 1,250 ft. below, so that it is evident that the mine bottom is now 850 ft. below the level of the sea.

The north vein is understood to be of similar character to the south vein, so that the description of the ore given below will serve for both. A cross vein which produces mainly chalcopyrite, affording the small output in copper, I did not have an opportunity to visit.

The south vein is said to have averaged 15 ft. in width in the main oreshoots already stoped, and a measurement taken at the seventh level showed 15 ft. of what was said to be ore of milling grade, and the foot wall had not been reached. As will be inferred from a statement set forth above, however, a considerable proportion of the quartz between walls profitably could be left in the mine as waste filling, although in hard specimens is it difficult to distinguish low-grade ore from that running several ounces per ton. All headings are sampled regularly.

ORE IS PRINCIPALLY QUARTZ

The walls are good, and little timbering is required, even in the widest stopes. The ore itself is white milky quartz, the richer portions being marked by ribbon structure with interspersed fine black lines. These lines are, in part at least, composed of pyrite in an extremely fine state of division. A piece of unusually rich ore from the lowest level exhibits both white and black quartz, intermingled, with some carbonate inclosed in vugs. Free gold in flakes interspersed with very fine pyrite is found in the black quartz, and also flakes of what appears to be a black silver sulphide. Certainly the fact that ore of this character occurs in any quantity at 855 ft. below sea level, and over 1,600 ft. below the outcrop, suggests that secondary enrichment has played little part in the Sado deposit. Shoots of ore occur with a fair degree of regularity and average 100 ft. in length.

There are employed underground 200 men at an average wage of \$1 gold per eight- to ten-hour shift. Machine drills are used in driving, and apparently machine runners get less pay than ordinary miners. The figures given are 70c. per shift of twelve hours.

The ore is hoisted in a double-compartment shaft in one-half-ton cars. All tramming underground is by hand. Below the 400 level the mine makes considerable water, but apparently no difficulty has been experienced in dealing with it, as it is said that an average quantity of 300 tons of ore per day is hoisted.

The miners are nearly all Japanese, although a few Koreans are employed. The small wage earned by the men is to a certain extent offset by special prices for food, especially for rice, a very cheap commodity in the island. Since my visit a strike for increase in wages has occurred. It is said that the cost for running main

Treatment of the sand is continued four to five days; of slime, fifty hours. Consumption of cyanide is 1.4 lb. per ton of ore; of zinc shavings, 1/2 lb. per ton. Lime consumed is 20 lb. per ton. The entire plant, including the cyanide plant, was constructed about ten years ago, and is essentially modern, although it would appear that economies might have been effected in the original laying out, and certain details of the practice are doubtless subject to improvement. The cost of treatment is given as under \$1.50 per ton.

COST IS GIVEN AS \$5 PER TON

The entire working cost of mining and milling is said to be \$4 per ton, while \$5 per ton covers the entire cost of production.

The copper ore, said to run 4 per cent and consisting of chalcopyrite in quartz, is doubtless sorted at the mine. There is a small smelter and copper matte plant. All of the machinery at the mine appears to have been made locally, even to the principal parts of the wire-rope tramways, of which there are many, serving various purposes.

Power is supplied mainly by sundry hydro-electric installations, and is transmitted from a mountain gulch, six miles away. Plants Ia and Ib are both of 600-kw. capacity with a head of 1,000 ft. Plant II is of 450-kw. capacity and 350-ft. head. The electric plants are supplemented by a 500-kw. steam turbine. Much difficulty is experienced with the water-power plant, as in the slack season of three months during the summer only 200 kw. is furnished by the entire plant, while in the slack season of two months in the winter, only 400 kw. is furnished.

The cost of hydro-electric power is \$0.0025 per kw.-hr., whereas that of steam power is \$0.04 per kw.-hr. Coal costs \$7 per metric ton delivered at the plant.

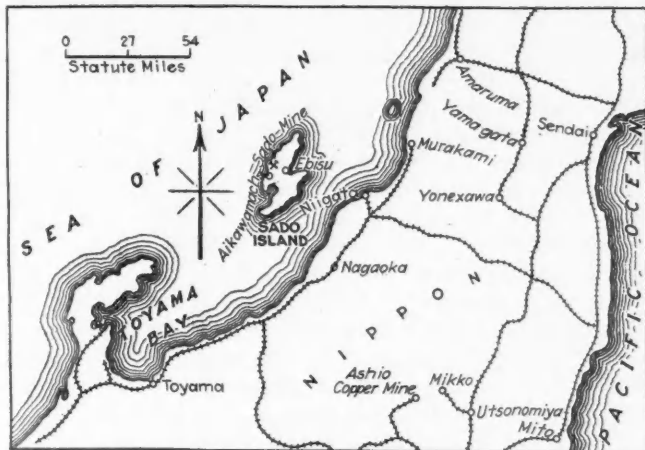
Although the number of underground employees is normal for a mine of this size, there seem to be an unjustifiably large number of surface employees, both men and women, and it is difficult for me to understand how the mine, in spite of the favorable conditions obtaining, is worked at a profit, considering the moderate recovery of gold and silver.

Perhaps the most striking feature about the Sado gold mine is the fact that practically continuous extraction of precious metals has gone on, more or less intensively, on one vein for a period of 320 years, and that, in spite of this, the ore in this vein does not appear to show signs of exhaustion.

I am much indebted to the officials connected with the management of the company for the courtesy shown during my inspection of the property, and I bespeak their indulgence if I have made any errors in the transcription of the information so kindly furnished.

Support in Iron-Ore Mines

Particular attention is being given at the Southern experiment station of the U. S. Bureau of Mines at Tuscaloosa, Ala., to a study of support in iron-ore mines, and preliminary tests have been completed on about thirty-five cubes of ore prepared for crushing tests. The object was to determine the size of test cubes most suitable for obtaining the ultimate strength of the ore, and to secure some definite information regarding failure of ore under crushing loads. In general, it may be said that the ore will sustain loads up to 10,000 lb. per sq.in., beyond which it is not safe to go.



Map showing Sado Island, off the coast of the main island of Japan

levels is \$10 per 100 cu.ft. of material broken. The cost of mining, including development, averages \$2.50 per ton.

ORE IS SORTED BEFORE GOING TO MILL

From the shaft the ore goes direct to the crusher, below which it passes to sorting belts, where women throw out a certain proportion. Thence the ore is carried by aerial tram across a small valley and dumped on heaps above the 110-stamp mill. It is said the stockpile awaiting treatment consists of 12,000 tons. The mill has 1,300-lb. stamps, running at seventy-six drops per minute. It is equipped with five-mesh screens, and Challenge feeders.

The stamp shoes and dies, of cast iron, last from thirty to forty days. They are then scrapped, thrown in the melt, and re-cast. When I inspected the plant the stamp mill was operating, and apparently running efficiently.

From the stamps, where no amalgamation is effected, either inside or outside the mortars, the pulp goes to forty-eight double-deck amalgamating pans, in which it is stated that 40 per cent of the gold content is recovered; thence to six ball mills, which make a product of 76 per cent sand and the remainder slime. The entire product is then flumed a distance of 6,000 ft. in a wooden flume about 10 in. wide, to the cyanide plant. This plant, and the assaying and melting departments, the copper-reduction plant, foundry, steam-power plant, and main office are situated near the beach.

The approximate recovery in the cyanide plant is said by the general manager to be as follows:

	Heads Grams	Residue Grams
Sand		
Gold	3	0.4
Silver	75	40.0
Slime		
Gold	2.5	0.4
Silver	100.0	50.0

Concentration of Rossland, B. C., Ores

Low-Grade Chalcopryrite and Pyrrhotite, Carrying Gold, Formerly Smelted Direct—Treatment at the Le Roi No. 2 Mill of General Application—Heap Roasting, Preceding Differential Flotation, an Interesting Possibility

BY DOUGLAS LAY

Resident Manager, Le Roi No. 2 Ltd., Rossland, B. C.

ROSSLAND ORES, from the milling point of view, consist essentially of a small amount of chalcopryrite accompanied by a large excess of pyrrhotite, in a heavy gangue of altered country rock which is largely augite porphyrite. The output of all Rossland mines from 1894 to 1914 was 4,655,388 tons, having an average assay of 0.49 oz. gold, 0.6 oz. silver, and 1.0 per cent copper. Practically all this ore was smelted direct. The lower-grade ores, which must be concen-

The pioneer company to mill the ores of the Rossland district was Le Roi No. 2, Ltd. In 1903 this company erected a concentrator of fifty tons' daily capacity, comprising coarse crushing in Blake crushers, to 30 mesh in Chile mills, classification, tabling on four Wilfley tables and treatment of the table tailings by the Elmore oil process. The Elmore process was not a success commercially and was abandoned after the treatment of 4,578 tons of tailings, though tabling of low-grade material was continued for many years. Another Elmore plant of 100 tons' capacity, built in 1904 by the Consolidated White Bear Mining Co., using stamp mills for crushing, operated for only a short time. In 1904, the Rossland Power Co. erected a concentrator at Trail, in which coarse concentration was made in jigs, followed by cyanidation of the tailings after recrushing in Trent mills. The results were far from satisfactory, and the enterprise was short lived. In 1905 the Le Roi Mining Co. built a forty-five-ton experimental mill comprising crushing by Blakes and rolls, followed by jigging of the classified material. Jig tailings were crushed in 5-ft. Huntington mills, classified and run over Wilfley tables. Much experimental work was carried on by the Le Roi and afterward by the Consolidated Mining & Smelting Co., but milling was apparently never considered seriously, direct smelting being more attractive.

The flotation process revived interest in the concentration of Rossland ores. The Consolidated Mining & Smelting Co. erected a 1,000-ton Minerals Separation plant at Trail in 1918, but after preliminary runs on Rossland ores, this plant was used to treat the lead-zinc ores from the great Sullivan mine of this company. Le Roi No. 2 then decided to remodel the company's existing plant, installing the Minerals Separation process, for which work I was engaged. About 7,000 tons of ore was treated in 1921. Some details of the equipment, developed in an effort to combat high prices of material and leave efficiency unimpaired, as well as the metallurgical results, may prove of interest.

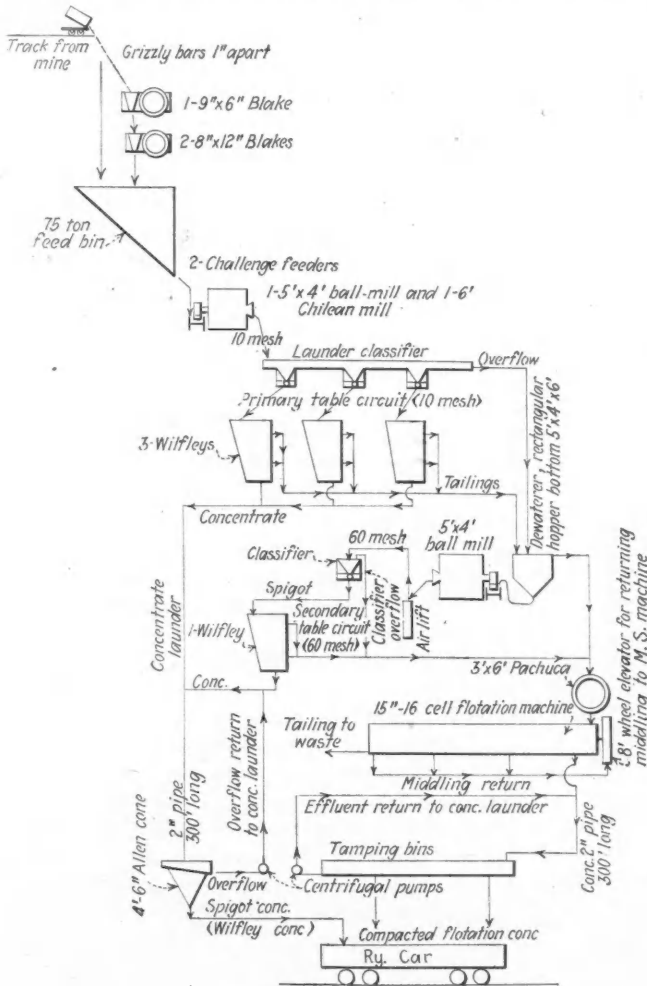


Fig. 1—Flow sheet, Le Roi No. 2 Co.'s mill.

trated, run from 0.15 oz. gold and 0.5 per cent copper up to the figures given for the twenty-year period above noted. The general characteristics of both low- and high-grade ores are the same. Run-of-mine ore contains pieces of coarse pyrrhotite studded with chalcopryrite, in addition to a fine dissemination of mineral throughout the rock. It is therefore apparent that concentration should begin on the coarse material (about 50 per cent of the values can be so recovered), but that all tailings must be reground for further treatment.

WATER SHORT AT THE MINE

It is not feasible to build a large milling plant at Rossland, because of a lack of water. At Trail, however, 2,000 ft. lower, water is abundant, and there is a custom smelter to receive all concentrates. However, the Le Roi mill is situated at the mine, within the city limits of Rossland. All water from the mine can be utilized in the mill, and a minimum daily capacity of 100 tons can be maintained, with 150 tons possible during most of the year.

The ores of Le Roi No. 2 are much the same, from the milling standpoint, as those of the neighboring properties. At least 80 per cent of the total values are gold, a large portion of which occurs free, even in the sulphides. The mode of distribution varies greatly, and the gold must be expected in chemical combination in varying amounts in the various sulphides as well as

free in the sulphides and in the country rock. Much free gold can be recovered independent of the sulphides, an important consideration, as pyrrhotite is valuable only for its precious-metal content. By crude tabling in earlier years, it had been demonstrated that 60 per cent of the gold could be saved, with only 20 per cent of the copper; the pyrrhotite saving could not have been high, although no data on this point were available.

From the practical standpoint, high gold recoveries are much more important than high copper recoveries, for, apart from the difference in value of the two metals, the smelter pays for 95 per cent of the gold. For the copper, he pays for 90 per cent of the copper content of the concentrates, after deducting marketing and refining charges for copper bullion; this amounts to only about 65 per cent of the gross copper content of the concentrates, when the time for settlement comes. The gold dollar saved is worth 95c., but the copper dollar is worth only 65c.

The following factors were considered in the determination of the proper flow sheet: (1) Upward of 60 per cent of the gold and about 20 per cent of the copper could be saved by the former methods of gravity concentration. (2) Flotation would vastly improve copper recoveries, and a tailing could probably be made that would be high in pyrrhotite, which could be tabled if advisable. (3) Vacuum-filter dewatering of the flotation concentrate, though the best method of handling this troublesome material, was rather expensive, and it was proposed that the finished product be settled in bins.

DESCRIPTION OF THE REMODELED PLANT

The accompanying flow sheet, Fig. 1, depicts the scheme of treatment adopted. Blake crushers reduce the ore to about 1-in. ring, and are followed by primary fine crushing to pass 10-mesh screen (0.05 in.). After hydraulic classification, the pulp is passed over three Wilfley tables. These yield a pyrrhotite concentrate containing about 1.5 per cent copper and 1.0 oz. gold. The tailing, after dewatering, is reground in a secondary ball mill to 5 per cent plus 60 mesh, classified, and the oversize passed over one Wilfley table, which yields a concentrate lower in both gold and copper than the primary table product. Tailing from this table is combined with classifier and dewaterer overflow, and after agitation in a pachuca, is treated in a Minerals Separation flotation machine. Both table and flotation concentrates pass separately in a stream of water to separate flat-bottom bins situated immediately over the main concentrate bins on the lowest floor of the mill, and into which they are subsequently shoveled and mixed. From the main bin, the concentrate passes to a self-dumping gravity tram, delivering direct into railway cars on a track about 100 yd. below the mill. It is to be observed that table and flotation concentrates are not mixed until they have been settled.

DETAILS OF MILL PRACTICE

Preliminary Coarse Crushing—Ore is trammed from the surface to a grizzly with bars 1 in. apart. Under-size passes to seventy-five-ton feed bin. Oversize passes to a 16 x 9-in. Blake crusher, thence to two 12 x 8-in. Blakes. The cost of Blake crusher repair parts is 2.5c. per ton crushed, Rossland rock being, I believe, harder and tougher than any other on the American continent.

Primary Fine Crushing—From the feed bin, the ore is fed by Challenge feeders to one 6-ft. Monadnock Trent mill and to one 5 x 4-ft. ball mill. With screens having

a slot width of 0.05 in. (10 mesh, I. M. M. standard), the discharge has the following screen analysis:

Plus 10 mesh.....	nil
Plus 20 mesh.....	1.8 per cent
Plus 40 mesh.....	5.9 per cent
Plus 60 mesh.....	3.0 per cent
Plus 80 mesh.....	6.0 per cent
Plus 120 mesh.....	12.0 per cent
Minus 120 mesh.....	71.3 per cent

Under these conditions, the capacity of one 6-ft. Monadnock Trent is about fifty tons per twenty-four hours. Water consumption is three tons per ton of ore. Power consumption averages 25 hp. Chrome-steel tires and dies wear 1.64 lb. per ton crushed, the cost at present prices being 27.4c. per ton of ore crushed. Screen wear costs an additional 1.1c. per ton, a total of 28.5c.

Ball Milling—The primary ball mill, 5 ft. in diameter and 4 ft. long, is of the simple overflow type, was made locally by the Nelson Iron Works, and embodies features suggested by the staff of Le Roi No. 2. It cost about half that of a standard mill of like capacity, can be readily dismantled and reassembled, and the wearing parts can be renewed readily. It has a scoop feeder, renewable plain trunnion liner at the feed end, and a renewable spiral in the discharge trunnion. The gear is reversible so that both sides of the teeth can be used until worn out. Trunnion liners of an internal diameter of 8 in. can be inserted through the trunnion bearings, these being of liberal diameter. There is no spiral in the feed trunnion, the reason being that although a spiral insures a feed at a certain rate, depending on the pitch, it will have an equally positive action in preventing feed at a faster rate, and experience demonstrates that a scoop will deliver ore quicker through a plain tube to the mill than when the tube is rifled. At the discharge end of the mill, on the other hand, a positive spiral is required, so that the tendency is strong to return any oversize back into the mill against the flow of pulp. For this reason the discharge spiral is double.

An extra-heavy clutch pulley on the pinion shaft, giving flywheel effect, is belted direct to a 35-hp. motor. The advantage of this, when starting the ball mill under full load, will be manifest. The Challenge feeder is belted direct from the ball-mill pinion shaft, so that the mill feeds itself, a self-contained arrangement that has given great satisfaction. The shell of the mill is 3-in. boiler plate, and the heads are cast iron. The sectional lining is of cast iron, with 30 per cent steel, and has lasted well. The shell lining is held in place by the lifting bars which are bolted through the shell. The heaviest individual part does not exceed one ton in weight. The cost of the mill, f.o.b. Nelson, B. C., was \$3,150.

The weight of ball charge is three tons, and 5-in. balls of cast iron with 30 per cent steel are used. Ball consumption is 4.5 lb. per ton crushed, and liner consumption is 1.25 lb. per ton crushed—a total iron consumption of 5.75 lb. per ton, which, at 6c. per lb., amounts to 34.5c. per ton. Even making allowance for the intensely hard and tough character of the ore, this is high. The ball consumption could probably be reduced by one-half, if not more, by the adoption of forged chrome-steel balls, the use of which is under consideration. When the cast-iron balls were purchased, the chrome-steel balls were three times as expensive.

The capacity of this mill, taking crusher-run down to the subjoined mesh, in open circuit, is between forty-five and fifty tons per day. This could probably be increased to sixty tons per day by using chrome-steel balls.

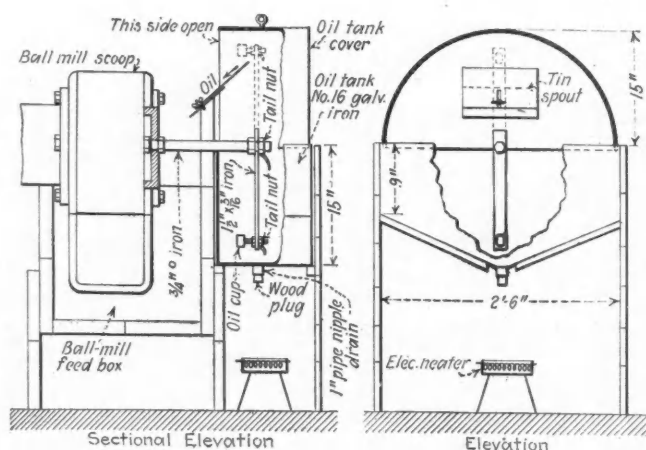


Fig. 2—Flotation oil feeder, operated by ball mill.

SCREEN ANALYSIS OF DISCHARGE

Plus 10 mesh.....	nil
Plus 20 mesh.....	5.3 per cent
Plus 40 mesh.....	20.0 per cent
Plus 60 mesh.....	4.2 per cent
Plus 80 mesh.....	10.7 per cent
Plus 120 mesh.....	11.5 per cent
Minus 120 mesh.....	48.3 per cent

Speed of mill, 26 r.p.m.
 Water used, 0.75 to 1 ton per ton of ore crushed
 Power, full load, 35 hp.

Secondary Fine Crushing—The secondary ball mill is similar to the primary mill, 5 x 4 ft., of simple overflow type, but lacks the up-to-date features of the other mill. The ball charge is two tons of 3-in. cast-iron balls. For reasons that will be subsequently given, this mill is operated in open circuit, although the discharge is tabled before passing to flotation. It is aimed to keep the plus-60-mesh material in the discharge below 5 per cent.

SCREEN ANALYSIS OF DISCHARGE

Plus 60 mesh.....	4.1 per cent
Plus 80 mesh.....	3.6 per cent
Plus 120 mesh.....	6.6 per cent
Minus 120 mesh.....	85.7 per cent

Speed of mill, 26 r.p.m.
 Moisture in discharge, 50 per cent.
 Power, 20 hp.

The ball consumption amounts to 1.5 lb. per ton treated in the primary circuit. Liner consumption is 1 1/2 lb. per ton treated in the primary circuit, a total consumption of 2.75 lb. of iron per primary ton. This, at 6c. per lb. amounts to 16.5c. per primary ton.

Pachuca—This is a cylindrical tank 3 ft. in diameter by 6 ft. high. Its function is thoroughly to mix the pulp streams of varying density, prior to flotation. Pine oil is added in the pachuca.

The tank also, to a certain extent, acts as a stabilizer of the flow to the flotation machine. There are two lifts within the pachuca, one a circulation lift and the other delivering from the bottom to the flotation machine. These air lifts are operated by a small high-pressure Roots blower driven by a 2-hp. motor.

Flotation—The flotation machine is a 15-in. (diameter of cruciform impellers) sixteen-cell Minerals Separation machine of the belt-driven type. The original thrust bearing was modified for the operations here detailed, ball thrusts being inserted, and grease lubrication substituted for oil.

Flotation Oils—The following were found the cheapest and most satisfactory flotation oils, after much investigation: Water-gas tar—added in the secondary ball mill at the rate of 1 lb. per ton of ore. Heavy pine oil—added in the pachuca at the rate of 1/4 lb. per ton of ore. Further slight additions of these oils are made to the middling cells of the flotation machine, but the total quantity of reagents will not exceed 1 1/2 lb. per ton of ore, and the cost is between 7 and 8c. per ton of ore.

Mechanical Oil Feeder—The feeder used, shown in Fig. 2, is extremely simple and effective. Most mechanical feeders are independently operated, but in this installation, inasmuch as the feeder is operated by the ball mill, oil feed automatically begins and ends with the rotation of the ball mill. It can be regulated readily, while the mill is running, and is susceptible of a wide range of adjustment. The oil tank in which the delivery cup rotates is boxed in, and a small electric heater keeps the heavy tarry oils thin when the weather is cold.

Return of Middling—The sketch, Fig. 3, and the photograph, Fig. 4, show the means that I devised for returning flotation middling to the flotation machine. This device is extremely simple and has given great satisfaction. It consists of a wooden tailing wheel, set up at the feed end of the flotation machine. There is

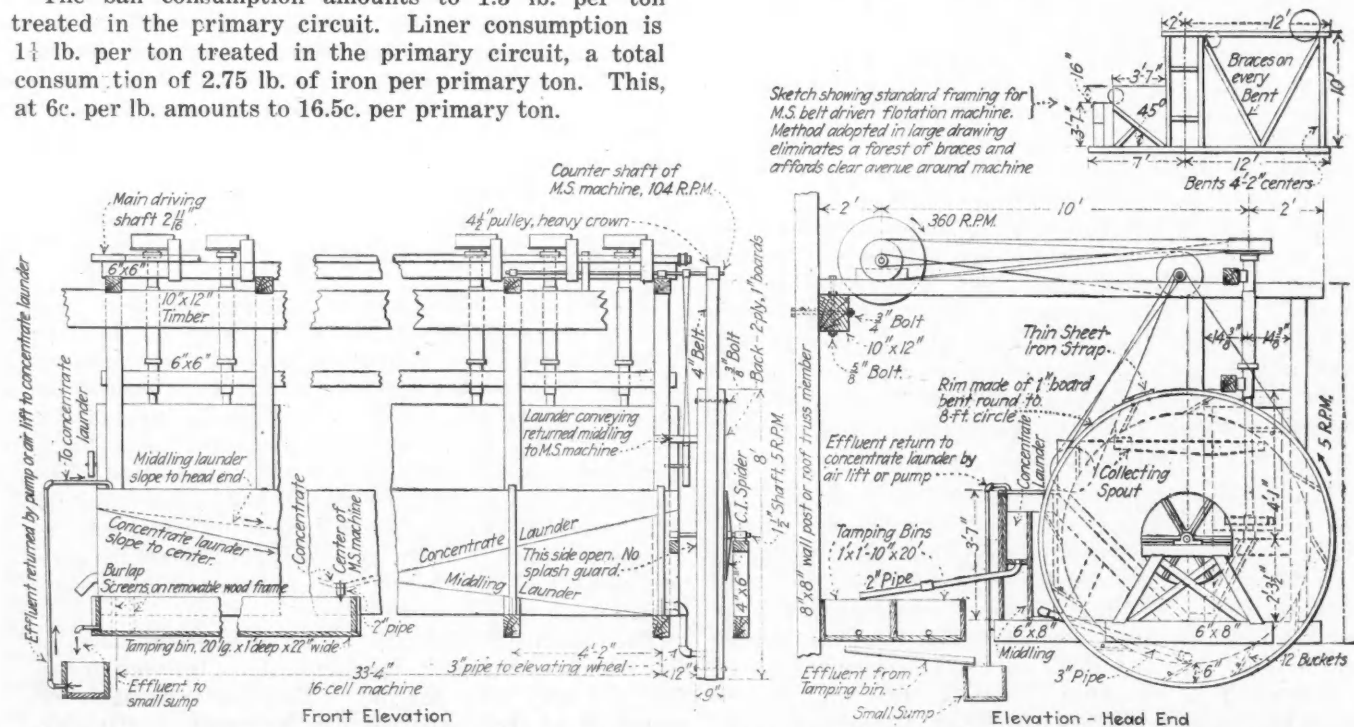


Fig. 3—Wheel elevator for return of middling.

Method of compacting concentrate also shown.

no gearing, but the 8-ft. diameter middling wheel is belt-driven from a 4½-in. pulley on the countershaft of the flotation machine, the belt passing completely around the periphery of the tailing wheel. Owing to the large lap of the belt, despite the enormous difference in the diameters of driver and driven pulley, there is no tendency for the belt to slip, no matter how wet it gets. This arrangement is far simpler than a gear drive and generally more satisfactory; incidentally, it is much

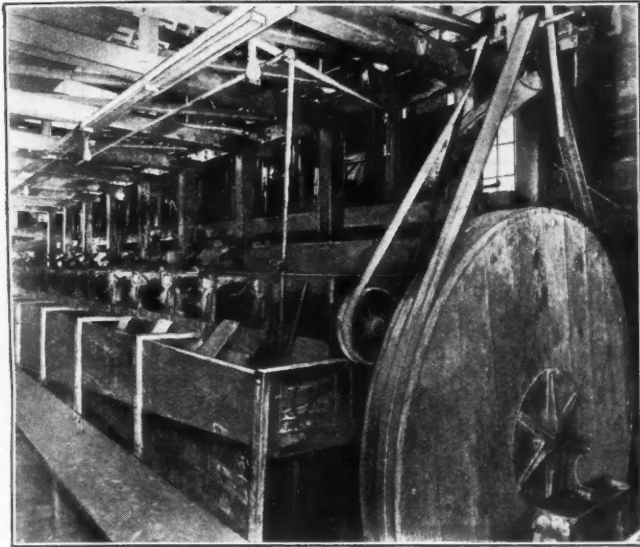


Fig. 4—Wheel-elevator for returning middling

cheaper. Middling is delivered into the buckets at the bottom of the wheel by gravity, and raised to a launder running into the feed end of the flotation machine. The wheel, being only 9 in. wide, occupies little floor space, and the whole arrangement is compact and self-contained. It can readily be fitted to any Minerals Separation machine, and can easily be made on the ground by any carpenter. The periphery of the wheel is made from a board 9 in. in width (or wider—exact dimensions are immaterial) by making saw cuts at right angles to the length every 2½ in., soaking the board in water, and then bending round to conform to the circle. A small piece of thin sheet iron is bolted over the ends. The simple construction of the remainder of the wheel is evident from the sketch.

Settlement of Flotation Concentrate—The only really satisfactory way of dealing with a floated product is by vacuum filtration. Small operators shun the expense of this operation, and seek another way out of the difficulty. All such can rely upon doing a considerable amount of hard thinking before achieving anything like satisfaction. The problem is not merely to settle the floated product; it is to settle it in such a form that it can be handled subsequently without loss, in other words to compact it. The following method was evolved after much trial, and has yielded, on the whole, satisfactory results:

The froth from the flotation machine is conveyed in a stream of water to a launder-like tank, 1 ft. deep, 2 ft. wide, and 22 ft. long—relative dimensions are important. At the outlet end are two vertical burlap screens, readily renewable. Effluent passes out of the bottom of this tank beyond the screens, and into a similar tank placed just below the first, for further settlement. In the bottom of these tanks are placed transverse baffle boards about 6 in. high to promote the accumulation of

the heaviest particles. As concentrates accumulate they are tamped with a wooden tamper for two or three minutes every hour or so. The effect is to compact the concentrates, which acquire a rubber-like consistency, so much so that a shovel driven vertically downward with all a man's strength will not penetrate more than a few inches. This compacted concentrate is shoveled out as it accumulates, into the main concentrate receiving bins, which are immediately below. These chunks of concentrate will not contain more than 10 to 15 per cent moisture, and are ideal for transit in railway cars, as there is no fear of loss.

For reasons which are not quite clear, the effect of passing the flotation froth over the accumulating bed of compacted concentrate is to break down the froth in a remarkable way. On the other hand, if froths are passed into simple settlement tanks, they build up and overflow in obstinate manner without breaking down. Final effluent from these tamping tanks is returned by air lift (or small centrifugal pump) to the M. S. flotation machine.

Operation of Secondary Ball Mill in Closed Circuit—Owing to the desirability of differential flotation—that is, floating the copper in preference to the iron—grinding in closed circuit was not, after trial, continued. Nevertheless, the manner of effecting closed-circuit crushing is given, because it was carried out without the aid of the means usually adopted for the purpose—viz., a mechanical classifier of the drag type, the installation of which is somewhat expensive. As a cheap expedient it may appeal to the small operator.

The discharge from the secondary ball mill was returned by air lift to the dewaterer receiving the Wilfley tailing. This dewatering tank is a rectangular hopper-

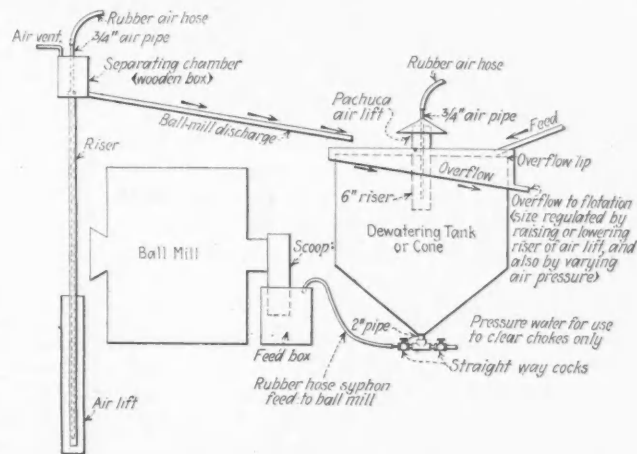
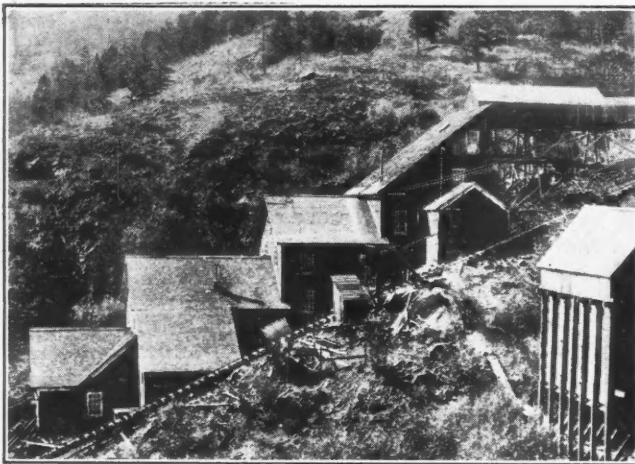


Fig. 5—Alternative to drag classifier for return of oversize to ball mill

bottom tank 5 ft. x 4 ft. x 5 ft. deep, with an overflow on the four sides passing to flotation. The spigot discharge at the bottom passes by siphon feed to the ball mill. In the center of the tank is placed an air lift, the function of which is to keep the upper portion of the contents of the tank in agitation, and so permit of the prompt escape of particles of sufficient fineness for flotation, via the overflow lips. Regulation of size passing out is effected in one or both of two ways, by varying the air pressure to the lift, and by raising or lowering the riser of the air lift, which is held in any desired position by a clamp. The cost of the equipment involved is trivial, and it is to be noted that the size of the finished product does not depend upon dilution,



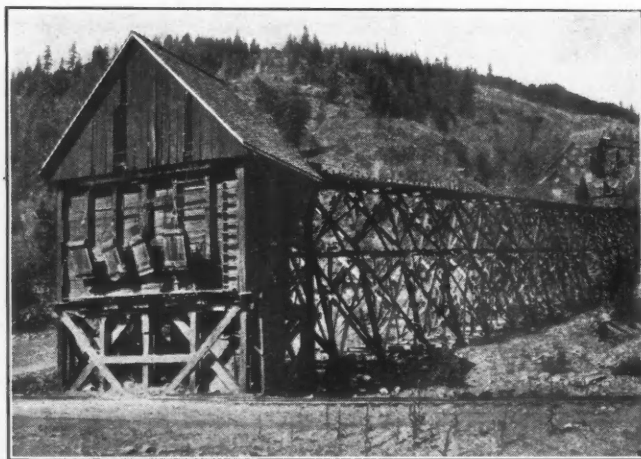
Concentrator of Le Roi No. 2, Ltd.

whereas in drag classification, separation at the finer meshes entails considerable dilution, and dewatering is again necessary before flotation.

Construction of Minerals Separation Machine—Drawings are given showing the mode of construction adopted, which differs from standard construction, but which effects a considerable economy, and affords much more floor space around the machine.

MILLING RESULTS

Before citing actual figures as to results gained, it is well to point out that the nature of Rossland ore is such that an inexorable limit is imposed, and an obstacle placed in the path of really high gold recoveries. Free gold exists to a considerable extent even in the sulphides; nevertheless, a formidable proportion of the total gold exists in chemical combination in pyrrhotite. Such gold, whether the ore is treated by flotation or water concentration, is recoverable only through the sulphide. The local smelting rate (including freight to smelter) is \$6.40 per ton for concentrate. It therefore follows that a concentrate with gross values of only \$6.40 per ton must be regarded as a worthless product, unless a process of chemical dissolution can follow, which cannot here be considered. A copper concentrate is valuable, apart altogether from its combined gold content. A pyrrhotite concentrate, on the other hand, is worthless apart from its combined gold content. Owing to the large excess of pyrrhotite over chalcopyrite in Rossland ore, it is manifest that flotation must follow



Shipping bins

differential lines; otherwise a large proportion of a worthless product will be included. To illustrate this important point, particulars of a flotation test of Rossland ore are subjoined:

Product	Weight, Per Cent	Assays				Percentage of Distribution			
		Au, Oz. Per Ton	Ag, Oz. per Ton	Cu, Per Cent	Fe, Per Cent	Au	Ag	Cu	Fe
Feed.....	100.0	0.294	0.63	0.75	14.6	100.0	100.0	100.0	100.0
Copper concentrates..	7.9	2.54	4.8	7.12	45.8	68.4	59.7	74.7	24.7
Pyrrhotite concentrates.....	18.4	0.23	0.71	0.52	40.8	14.3	20.7	12.7	51.2
Tailing.....	73.7	0.07	0.17	0.13	4.8	17.3	19.6	12.6	24.1

It will be noted that in this test there are two floated products:

1. A copper concentrate.
2. A clean pyrrhotite concentrate which obviously cannot be sensibly improved by re-treatment.

Its gross values amount to only \$5.10 per ton, and it therefore constitutes a worthless product. It is clearly indicated that though a gold saving of 82.7 per cent and a copper saving of 87.4 per cent can be made by running it into the copper concentrate, such increased savings will result in financial loss. Money will be saved by throwing it away or not attempting to float it, and making the lower savings of respectively 68.4 per cent gold and 74.7 per cent copper. Actual milling has demonstrated that this condition is a serious obstacle to making really high gold recoveries, either by flotation or gravity concentration, on Rossland ores. On the other hand, it has been proved that high copper recoveries are readily obtained by flotation.

The following data are representative of the actual milling results obtained over an extensive period. The ore comprised ore sorters' reject and low-grade material from development:

	Gold, Oz.	Copper, Per Cent	Iron as Sulphide, Per Cent
Feed to primary table circuit.....	0.155	0.42	8.1
Feed to flotation machinery i.e. Wilfley tailing.	0.074	0.30	6.3
Wilfley concentrate.....	0.93	1.40	29.6
Flotation concentrate.....	0.91	4.66	28.5
Flotation tailing.....	0.043	0.10	5.2

Rossland pyrrhotite contains 40 per cent sulphur and 60 per cent iron. The above-noted feed showed practically all sulphide iron to exist as pyrrhotite apart from such as existed as chalcopyrite. The sulphide contents are therefore as follows:

	Pyrrhotite, Per Cent	Chalcopyrite Per Cent
Wilfley table feed.....	12.8	1.25
Flotation feed.....	10.06	0.86
Flotation tailing.....	8.5	0.29

The foregoing assays indicate that, from start to finish, the following recoveries were made: Gold, 75.8 per cent; copper, 80 per cent; and iron, 43.6 per cent. The poor iron recovery was due primarily to the heavy overloading of the table circuits, the tonnage treated being close to 100 tons per day.

To improve the iron recovery by flotation one must resort to differential flotation—that is, the copper must be floated first; otherwise any improvement in iron flotation will have the effect of lowering the grade of the concentrate in copper and also in gold. This was actually tried, the secondary ball mill was put in closed circuit, and flotation carried out in an acid circuit, but the results indicated that better commercial practice would be attained by grinding only to such a point as would insure a high copper recovery, and tabling the

ball-mill discharge before flotation, the latter practice being finally adopted after trial. The size of flotation feed was kept at under 5 per cent plus 60 mesh, the screen analysis averaging as follows:

	Per Cent
Plus 40 mesh.....	2.1
Plus 60 mesh.....	2.0
Plus 80 mesh.....	3.6
Plus 120 mesh.....	6.6
Minus 120 mesh.....	85.7

The water-to-solids ratio was so far as possible kept at 4 to 1. Manifestly, the great advantage of tabling in the secondary circuit is that, apart from saving chemically combined gold, the whole tendency is to impoverish the flotation feed in pyrrhotite, and therefore to promote the production of a higher grade copper flotation concentrate.

COSTS OF CONCENTRATION

Milling at the rate of 2,500 tons monthly was accomplished at the following costs per primary ton:

	Cost per Primary Ton
Coarse crushing, wear of crushing media.....	\$0.025
Primary fine crushing, balls and lining.....	0.345
Secondary fine crushing, balls and lining.....	0.165
Power for above, including Wilfley tables.....	0.120
Labor for above, including Wilfley tables.....	0.375
Sundries.....	0.065
Flotation oils.....	0.072
Flotation labor.....	0.148
Flotation power.....	0.040
Flotation sundries and royalty.....	0.050
Total cost per ton milled.....	\$1.405

The concentration ratio prevailing was almost exactly 10:1. It will be noted that the foregoing costs do not include the cost of delivering ore to the mill, nor any cost connected with disposal of concentrate after it has been delivered in bins in a drained condition suitable for transport. No overhead charges of any description are included. Labor costs include foreman and shift bosses. It is also to be noted that by the use of chrome-steel balls it is reasonable to anticipate that the cost of fine crushing could be substantially reduced, and the total possibly brought to \$1.15.

PROPOSED METHOD OF LOADING CONCENTRATE IN RAILWAY CARS

Particulars are given of a proposed cheaper method for loading concentrate: Railway tracks are situated about 100 yd. below the mill. The cars supplied by the railway company are of the gondola type. Under the proposed loading plan, Wilfley and flotation concentrates will be conveyed from the mill in a stream of water in separate 2-in. pipes. Wilfley concentrate will pass into an Allen dewatering cone (4 ft. 6 in. in diameter) set up directly over the railway car, into which the spigot discharge from the cone will pass. The cone overflow will be returned by a small centrifugal pump to the mill for the conveyance of oncoming concentrate. Flotation concentrate will be conveyed by the 2-in. pipe to a tamping bin of the kind previously described, set up immediately over the railway car. Effluent from this tamping bin will be returned by the pump to the mill for conveyance of oncoming flotation concentrate. The compacted concentrate will be shoveled out of the tamping bin into the car.

A SUGGESTED IMPROVEMENT IN MILLING PRACTICE

Actual milling results have plainly indicated the wisdom of tabling in advance of flotation. The more pyritic the ore, the greater the possibility of increasing savings and lowering costs, by interposing jigs in

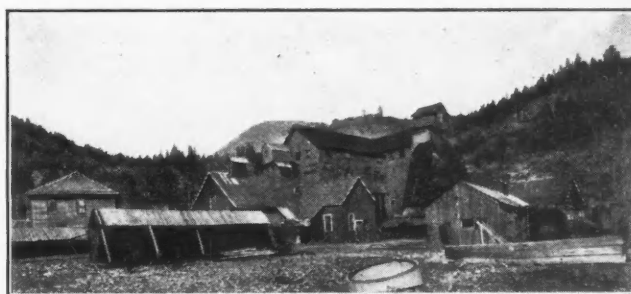
advance of the tables, not necessarily with a view to making any jig tailing, but to avoid sliming mineral already freed from gangue. Tabling or jiggling at 6 mm. would certainly appear sound practice, and likely to more than offset any complication of flow sheet thereby introduced.

Owing to the extremely hard and tough character of Rossland ores, direct ball-milling of crusher-run size is poor practice. The wisdom of reduction by rolls prior to the ball-milling is clearly indicated.

HEAP ROASTING OF ROSSLAND ORES PRIOR TO MILLING

Investigation led to a discovery likely to prove of great value. It is obvious that the high pyrrhotite content of Rossland ores prevents a high concentration ratio, and therefore causes a high smelting cost calculated on the original ton, a difficulty which on first consideration may appear insuperable. There is, however, a solution to the problem which offers great possibilities; it is this:

All pyrrhotites when piled in heaps, with limited admission of air, oxidize readily, and even spontaneously ignite. It is not necessary to theorize on the results likely to be yielded by flotation applied to heap-roasted Rossland ore, because the actual milling results of treating several hundred tons of such material are a matter



Mine surface plant

of record. The material in question consisted of some hundreds of tons of the more pyritic ore which had accumulated on a dump. The latter when broken open showed very extensive oxidation, individual pieces were clotted together, and it exhibited all the characteristics of heap-roasted ore. The chalcopyrite, however, did not show much oxidation. Treatment of such material in the mill showed a high flotation recovery of gold, as well as copper. Evidently the effect of the roasting was to free the gold and leave it in a condition readily amenable to flotation. Actual results of a mill run on this material are appended:

	Gold, Oz. Per Ton	Copper Per Cent
Wilfley table feed.....	0.09	0.47
Wilfley table tailing.....		
Flotation feed.....	0.04	0.35
Flotation tailing.....	0.01	0.13
Flotation concentrate.....	0.34	8.03
Wilfley concentrate.....	0.82	1.94

Not only was a high gold recovery made, but also the lower proportion of sulphide iron made it possible to make a higher-grade copper flotation concentrate. The economics of the question involve the consideration as to whether to apply roasting to the entire bulk of ore before milling, or to the product of a plant aiming at a high sulphide recovery operating on raw ore.

It would appear, then, that by merely storing Rossland ores in heaps for a period of a few months, they will thereby be rendered distinctly more amenable to

milling than if treated raw. I believe that the project may be economically advisable.

It would also seem highly probable that by submitting pyrrhotite concentrates to this heap-roasting action, and again treating them by flotation, it would be possible to produce a high-grade gold-floated product. Success in this direction would remove existing difficulties in floating raw ore, and would assure high recoveries in both gold and copper.

SUGGESTED FLOW SHEET FOR LARGE-SCALE TREATMENT

The results of pilot operations render it possible to design a fairly simple plant capable of yielding a high sulphide recovery on the average run of Rosslund ores containing up to, say, 20 per cent of sulphides.

Shortage of water in Rosslund compelling the location of a large plant at Trail, it is assumed that preliminary crushing down to, say, 2 in. by Blakes and gyratories will be done at the mine in Rosslund.

Referring to the suggested flow sheet for a treatment of 500 tons daily, it is seen that the 2-in. feed

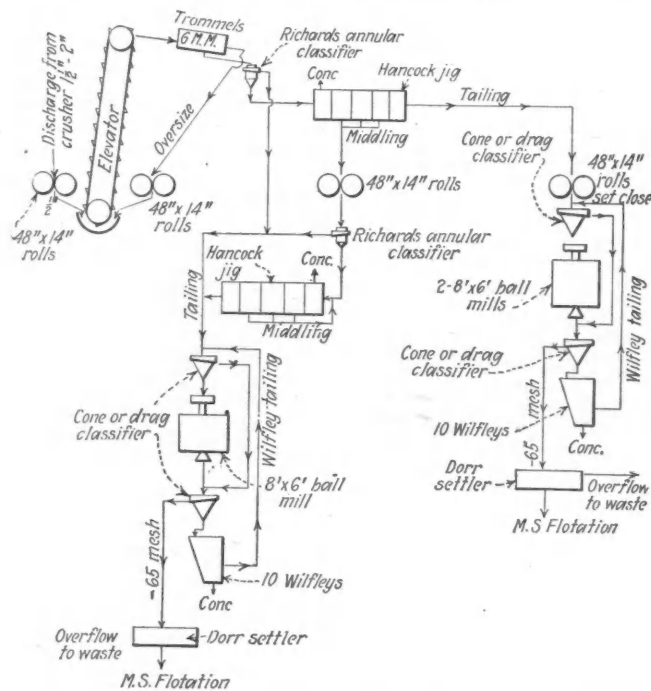


Fig. 6—Suggested flow sheet for Rosslund ores containing 20 per cent sulphides; 500 tons per day

is crushed to pass a 6-m.m. trommel screen by two sets of 48 x 14-in. rolls. One Hancock jig receives the entire feed (less the fines, which are removed by a Richards annular classifier). The function of this jig is twofold: (1) Coarse sulphide concentrate is removed from the circuit as a finished product, and (2) the ore is divided into two broad classes: (a) pyritic—represented by Hancock jig middling, (b) siliceous—represented by Hancock jig tailing. The subsequent treatment of these two classes is different, and they are kept separate throughout the mill.

The Hancock jig middling passes to a third set of 48 x 14-in. rolls, close set; thence to a second Richards annular classifier for removal of fines, and thence to a second Hancock (middling) jig, which removes from circuit, as a finished product, a further proportion of sulphides.

Overflows from the classifiers unite with the tailing, from the second Hancock jig, and pass to a dewatering

cone or drag classifier prior to ball-milling. It will be noted that the ball mill is in closed circuit with the cone or drag classifiers, but that tabling is carried out in the circuit, preventing unnecessary grinding of material already ground fine enough for separation on tables. All tailing from the latter is of course returned eventually to the ball mill prior to flotation.

All material for flotation is ground to pass 65 mesh. Dorr settlers insure steady flow to Minerals Separation flotation machines.

The tailing from the first Hancock jig passes to a fourth set of 48 x 14-in. rolls, close set, after which its treatment is identical with that of the tailing from the second Hancock jig.

TREATMENT OF PYRRHOTITE CONTAINING LOW GOLD VALUES

There is a class of ore in the Rosslund camp, consisting of massive pyrrhotite with low gold content, which has hitherto been considered impossible of economic treatment. It seems highly probable that excellent results will be yielded on this ore by a preliminary roast down to a low percentage of sulphur, followed by ball-milling and flotation. Not only should a floated product very high in gold result, but, also, a low tailing. Sulphuric acid could also be made a byproduct of the process, if desired. The possibility of improving a pyrrhotite concentrate in this way is evident.

Costs at El Oro

A financial report of the El Oro Mining & Ry. Co., Ltd., for the year ended June 30, 1922, gives some interesting details of operating results during the year:

The electric power shortage still prevailed for the first three months of the year, during which period the plant was operated by steam. Notwithstanding the attendant difficulties and increased expenses, the tonnage during these months was not allowed to drop below the average for the year.

The plant treated 401,840 tons of ore and produced bullion to the value of \$2,203,015.22.

The efficient condition of the works was fully maintained, and metallurgical costs were again reduced.

Operating details and working cost figures are given in the following table:

MILL AND CYANIDE STATEMENT, YEAR ENDED JULY 1, 1922.	
Mill run, average days per month.....	26.41
Tons ore crushed.....	401,840
Assay value of ore, gold.....	\$5.14
Assay value of ore, silver.....	\$1.24
Theoretical extraction, gold, per cent.....	88.98
Theoretical extraction, silver, per cent.....	74.15
Theoretical extraction, total, per cent.....	86.12
Bullion realized, gold value.....	\$1,791,247.10
Bullion realized, silver value.....	\$411,768.08
Bullion realized, total value.....	\$2,203,015.24

STATEMENT OF COSTS PER TON (a)	
Mining.....	\$2.13
Development.....	.49
Milling.....	.23
Cyaniding.....	.97
Water supply.....	.01
General expense.....	.24
Taxes.....	.68
Total.....	\$4.75

(a) Further expenses in London add 4c. per ton to costs.

The El Oro Mining & Railway Co. is a British company operating the largest gold mine in Mexico. The milling plant consists of a 200-stamp mill, eight tube mills, and cyanide plant, but owing to the more economical working of the stamp mill the entire battery of stamps is not used.

THE PETROLEUM INDUSTRY

World Oil Problems*

BY A. C. VEATCH

Chief Geologist, Sinclair Consolidated Oil Corporation

FOR a nation to say, "Since oil is a prime necessity to us in case of war, the oil resources of our state must be developed by our own nationals," overlooks the economic and practical points that very large sums are required to develop new oil regions, and that much of the money spent in prospecting is not productive—that in case of war only developed oil fields have practical value, and that, should there be a war, any developed oil field is immediately mobilized, irrespective of whether the development was due to domestic or foreign capital. It is better economics to have the losses of development shared by foreign capital than to have the whole loss fall at home. The most complete self-interest and self-advancement says, "Throw the doors wide open."

Apart from the strategic importance of having developed oil regions for use in time of war, it is sound national policy to secure development, because in the first place it establishes a new source of revenue, which is an important item in most countries at the present time, and it also serves to effect trade balances, and, consequently, exchange, by providing home sources of supply of commodities which would otherwise be imported, and by affording new exports, with the net result that the national imports are decreased and the national exports increased.

Impelled in some measure by the fallacious bogey of imminent exhaustion of the oil supply of the United States and by the prominence of the international aspect of oil, brought about by the war, many companies of a number of different nationalities—largely American and British—have rushed into an attempt to develop foreign oil fields. There has been considerable impetuosity in this regard and some rather dearly bought experience. More is in the course of acquisition.

On the one hand, oil indications of less importance than those found in many parts of the United States, which are not today producing oil fields, have been responsible for large expenditures abroad. Considering the added cost of foreign operations, it is essential that the conditions be better than those in the United States, in order that commercial success may be achieved. If, leaving out the cost factor, they are only just as good, or worse, failure is inevitable. Furthermore, much too little weight has been given to customs and conditions in foreign fields. Another point which has not been sufficiently well recognized is the large added cost of foreign operations in new regions, due to the time factor. Judging by the past, it is safe to allow a decade of serious work and expenditure for the establishment of each new oil field abroad.

The whole situation regarding foreign oil develop-

ment needs to be faced squarely, both by capital and by the statesmen of big, as well as little, countries.

On the point of the oil resources of the world as a whole, these are large beyond any calculation possible at the present time. The situation is summed up in the statement that it is now demonstrated that commercial petroleum may occur in sedimentary rocks of any age from the oldest to the youngest, and in any structural position. The sedimentary rocks occupy the greater part of the earth's surface. Those found in the United States are but a small part of the sedimentary rocks of the world as a whole. It is only in the United States that these sedimentary rocks have been extensively developed for oil, and, great as the development has been here, the oil in the sedimentary rocks of the United States is by no means exhausted. The conclusion may be stated proportionally: as the ultimate production of the United States is to the area of the sedimentary rocks of the United States, so the ultimate total oil production of the world will be to the whole area of sedimentary rocks of the world.

But vast as the oil resources of the world are, they must be developed, if the constantly increasing needs of civilization are to be met, and if none of the other industries of the world are to suffer curtailment through lack of oil. The United States has borne the great portion of the burden of the world's oil requirements, giving freely from its natural resources for the benefit of commerce and civilization. Unless foreign oil fields are developed more thoroughly, the time must inevitably come when all nations will be seriously handicapped. . .

Capital and courage are required, but these alone cannot succeed. Oil produced at a loss is as disastrous to the nation concerned as to the capital involved. A region may be very promising from the standpoint of indications and structure, but is more than worthless unless there are present certain fundamentals for sound development. Only such development can, in the long run, be beneficial alike to capital and to the country involved. Among these essentials are:

First, reasonable royalty fixed according to the accessibility of the region and its existing transportation facilities.

Second, large exploration and reasonable exploitation area, without checkerboarding, to attract the necessary foreign capital and to give companies with experience in such operations a sound basis on which to work.

Third, fixed taxation for all time.

Fourth, security of title.

Fifth, exploitation rights to depend solely on expenditure.

There are few countries in which these conditions exist. There are many regions in Europe which contain promising oil territory whose development is prevented by antiquated laws, international jealousies, and local national feeling, all to the detriment of the countries concerned. In Latin America there is not a single country whose present law and practice make the above things possible.

*Excerpted from a paper presented at the annual meeting of the American Petroleum Institute, St. Louis, Mo., Dec. 6-8.

New Books

The Problem of Assimilating the Alien

The Peril of the Republic. Are We Facing Revolution in the United States? By Daniel Chauncey Brewer. G. P. Putnam's Sons, New York and London. \$1.75.

"There have been a few books written upon immigration to the United States and many upon the institutions of this country," says the author in his first chapter. "I do not think that any books have been written for the purpose of showing how immigration is imperiling such of these institutions as are still functioning. This particular book is written with the sole purpose of pointing out that alien invasion has quickened the drift of political revolution."

Mr. Brewer points out the long drift from individualism to socialism which we are undergoing; he calls attention to the "world ferment," the awakening of yellow, brown, and black peoples from their slumbers; the demoralization of Europe; and the consequent isolation of the United States. And the United States has drifted from homogeneity into heterogeneity; meanwhile, Americans have swung away from the study of political principles "to the consideration of trade and purely domestic matters." He points out the well-known change in the character of our immigrants; of the "awful inrush" since 1880 of aliens who have largely defied assimilation. "The hordes that overthrew the Roman empire were numbered by hundreds of thousands. We have to do with millions and millions." During the last quarter of the nineteenth century the character of our immigration changed from the previous supply from northern and western Europe to "an exodus from the south of Italy and Austria," then "the tidal movement toward America drew heavily on Russia, and made itself felt in various parts of the Empire of Turkey and Persia."

These people cannot understand the principles of America; they immediately return to the political plotting which has been their age-long habit at home. They rage against authority. Yet they are naturalized by hordes. They group by nationalities in certain industrial centers (p. 105); and are drawn into political machines which are subversive of Americanism and intelligence. To these politicians all America is now enthralled, literally speaking. Meanwhile, we are fatuously urging naturalization as a panacea, whereas this really increases the evil. And, side by side with our good-natured obliviousness, revolutionary propaganda and the organization for revolution is steadily progressing among these foreign elements to an extent not generally recognized even by most of those who keep in touch with current events. We

speak of the matter editorially on another page.

What should be done? "The corrective task," says the author "is immeasurably more difficult than that with which the men of 1776 had to do." "Meantime I cannot satisfy myself that there is any other sane course at present for the Constitutionalist to follow than to bend every energy toward preserving ordered society, leaving questions which have to do with the democracy which his fathers knew, or better democracy, to more settled times" (p. 351).

The weakness of this last statement the author seems himself inclined to confess. His book is an outcry, a warning, a call to the colors of the constitution of our forefathers: it is a true and well-weighed presentation of our special problem of the alien and mischievous population; but he does not propose a forward-looking program. Perhaps he is wise thus to separate the presentation of the case from that of the remedy. J. E. SPURR.

Second Edition of Eckel's Book on Building Materials

Cements, Limes, and Plasters. By Edwin C. Eckel. Second Edition. John Wiley & Sons, New York. \$6.50.

The author is a well-known specialist in all building materials of non-metallic-mineral origin. The present volume, a revision and enlargement of the first edition, issued in 1905, is a comprehensive treatise of cementing and plastering materials. The following subjects are covered: Gypsum, lime, magnesia, hydraulic limes, and natural, portland, and Puzzolan cements. About one-half the volume is devoted to portland cement. Distribution of raw materials and mining problems are considered briefly, the chief discussion relating to preparation of materials and manufacturing processes. The main subjects are subdivided logically into separate chapters, each with a bibliography. Important features are the numerous analyses, cost figures, and detailed notes on construction of equipment and its operation, all matters of practical interest.

Although the work of revision is thorough and painstaking, in the bibliographies many omissions of later references are to be noted, as, for example, U. S. Geological Survey Bulletin 697, and U. S. Bureau of Mines Technical Paper 155, on gypsum; Bureau of Mines Bulletin 160, on cement-plant quarry problems, and the works of Emley and Lazelle on lime.

The book contains a vast amount of useful information that is particularly timely at present, when cements and plasters are so widely used in building, and when construction work fills so large a place in public interest and industrial activity. The book should find a place in the library of every one interested in the manufacture or application of the materials described.

OLIVER BOWLES.

Technical Papers

Mineral Resources—"Gold, Silver, Copper, Lead, and Zinc in Utah in 1921," twenty-one pages, is now available from the U. S. Geological Survey, Washington, D. C. The bound volume for 1919 on the non-metals (*Mineral Resources of the United States, 1919. Part II*) is also now available. A recent communication from the Survey states that no free copies are available, so that the book must be ordered from the Superintendent of Documents, Washington, D. C.; no price stated, but presumably \$1. "Owing to the long delay in obtaining some of the figures for the chapters on petroleum, natural gas, coal, coke, and clay-working industries, it has been decided to omit these chapters from this volume and to include complete statistics in the volumes for 1920 or 1921." As it is, the data given in the book are three years old.

Clays of the United States—The U. S. Geological Survey, Washington, D. C., has published Bulletin 708 "High-grade Clays of the Eastern United States, With Notes on Some Western Clays" (314 pages; obtainable on request). The book is an excellent description of the various clay deposits of the regions that it covers and should prove of great value to those interested in this industry. Many maps and plates, up to the usual high standard of the Survey, are included.

Texas Oil Geology—"Geology of the Ranger Oil Field, Texas," is the title of Bulletin 736-E, sixty pages, just issued by the U. S. Geological Survey, Washington, D. C., and obtainable on request. This bulletin makes public the geology of an area 12 miles square in Eastland County, Tex., as determined in the drilling of several hundred wells, and indicates the lessons to be drawn therefrom.

Mine Rescue—The National Safety Council, 168 North Michigan Ave., Chicago, Ill., has recently issued an eight-page leaflet, "Mine Rescue Training and Operation." The data have been prepared by D. J. Parker, chief of the Division of Mines Safety Service of the U. S. Bureau of Mines. Types of approved apparatus are detailed and illustrated, a schedule of training is outlined, and other pertinent information is included. Single copies may be obtained at 25c. each from the National Safety Council. It is recommended that this pamphlet be placed in the hands of every executive, safety engineer, or physician having to do with rescue work.

Treatment of Chilean Nitrate—A. W. Allen discusses "The Donnan Program of Investigation for the Chilean Nitrate Industry" in *Chemical and Metallurgical Engineering* for Dec. 6. (New York; price 25c.; eight pages). The present method of caliche treatment by the Shanks process is outlined and constructive suggestions are offered as to improvement.

Coal-Mine Haulage—Bulletin 132 of the Engineering Experiment Station, University of Illinois, Urbana, Ill., (136 pages; free on request), describes the evolution of coal-mine haulage and the progress in mine-haulage equipment, giving detailed accounts of practice in Illinois, including the handling of cars on shaft bottom, main-line and gathering haulage, underground haulage costs, haulage accidents, and accident-prevention measures.

The Volatilization-Precipitation Process—The *General Electric Review* (Schenectady, N. Y.; 30c.) contains an eight-page article, by Thomas Varley and H. W. Clark, on "The Possibilities of Electrical Precipitation in the Chloride Volatilization Process." A short review of the work at the Pope Shenon plant at Salmon City, Idaho, is included.

Fusibility of Coal Ash—U. S. Bureau of Mines Bulletin 209, 119 pages, obtainable on request to the Bureau at Washington, D. C., describes the manner of testing the fusibility of coal ash adopted by the Bureau and gives the softening temperatures and sulphur and ash analyses of a large number of coals from all parts of the United States.

Canadian Geology—The Canadian Geological Survey has recently published Memoir 130, "Geology and Mineral Deposits of the Bridge River Map-area, British Columbia"; Bulletin No. 35, "Relationship of the Pre-Cambrian (Beltian) Terrain to the Lower Cambrian Strata of Southeastern British Columbia"; and Parts B and E of the Summary Report, 1921. Part E discusses the "Iron-bearing Rocks of Belcher Islands, Hudson Bay," and Part B contains the following papers: "Hay and Buffalo Rivers, Great Slave Lake, and Adjacent Country"; "Mackenzie River District Between Great Slave Lake and Simpson"; "Exploration East of Mackenzie River, Between Simpson and Wrigley"; "North Nahanni and Root Rivers Area, and Caribou Island, Mackenzie River District"; "Geological Structure of the Mackenzie River Region"; and "Kananaskis Lakes-Palliser River Map-Area." Any of these bulletins may be had on request to the Survey at Ottawa.

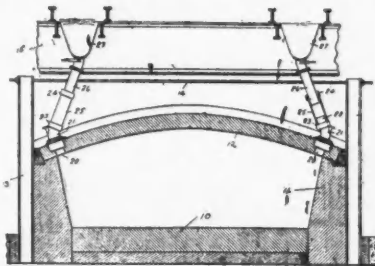
Sulphur Trade—The December issue of *Commerce Monthly* contains a nine-page article entitled "Sulphur, Pyrites, and Sulphuric Acid," discussing the world trade situation in those articles. Copies may be obtained on request to the National Bank of Commerce, New York.

Mine Skips—The *Journal of the South African Institution of Engineers*, for November, (P. O. Box 4609, Johannesburg; price 2s.) contains a twenty-four page article on the "The Tipping and Guiding of Vertical Skips." The discussion is based on the theory of design and is comprehensive. The author discusses the design of tipping gear in such a way as to eliminate so far as possible shocks and excess strains; and also describes an improved form of guiding slipper on skips.

Recent Patents

Tin Smelting—No. 1,435,303. A. L. Jennings and J. F. Dolan, Perth Amboy, N. J. A method of removing the impurities from tin ore before the ore is smelted, by fusing the ore with an alkali metal acid sulphate.

Reverberatory Furnace—No. 1,435,304. A. N. Jette, Anaconda, Mont. The patent covers a feed pipe extending through the roof of a reverberatory



furnace and a solid metallic body containing a cooling coil surrounding the pipe, as illustrated.

Grinding Media—Canadian patent No. 224,430. Harry W. Hardinge, New York City. The patent covers the use of perforated disc-shaped objects in lieu of balls as grinding media in Hardinge mills. Patent No. 224,494, issued to the Canada Foundries & Forgings, Ltd., Welland, Ont., assignee of T. J. Dillon, also covers grinding media which depart from the shape of ordinary spherical balls.

Oxidizing Ferrous Sulphate—No. 1,430,551. C. J. Herrly, Pittsburgh, assignor to Union Carbide Co. Ferrous sulphate is oxidized, in the presence of water and sufficient sulphuric acid, by the action of free oxygen and a nitrogen oxide catalyst.

Classifier—No. 1,430,665. E. P. Mayhew, Kimberly, Nev. A hydraulic classifier and concentrator comprising tanks in which the water is introduced by a number of sprayer heads at various elevations within the tanks.

Cyanide Process—No. 1,430,635. D. L. H. Forbes, Kirkland Lake, Ont. The patent covers the injection of small quantities of dry sodium peroxide into the cyanide solution tanks.

Dredge Bucket—No. 1,430,782. L. G. Attenborough, Ipoh, Perak, Federated Malay States, and J. F. Newsam, Palo Alto, Calif. A lip for dredge buckets, with a flange extending under the bucket, a smoothly formed lip without shoulders, and with an edge adjusted to throw incoming material away from the bottom and toward the back of the bucket.

Treating Carnotite Ores—No. 1,435,180. W. A. Schlesinger, Denver, assignor to the Radium Company of Colorado. In recovering radium, carnotite and allied ores are heated with soda ash under pressure of from 60 to 100 lb. in the presence of moisture.

Vanadium Recovery—No. 1,430,864. K. B. Thews, Sawpit, Colo., assignor to Colorado Vanadium Corporation, New York. A clean and pure calcium-vanadate precipitate is obtained from a solution of vanadates contaminated with iron and aluminum compounds, by adding a calcium reagent and maintaining the solution acid.

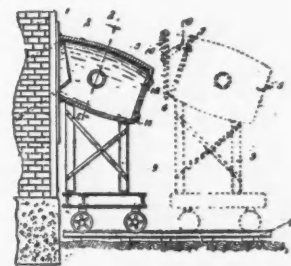
Lithium-Potassium—No. 1,430,877. G. E. Bailey and A. E. Sedgwick, Los Angeles. Lithium and potassium are extracted from their ores by mixing the ore with potassium sulphate and heating the mixture not over 1,500 deg. F.

Electric Furnace—No. 1,430,948. Agamemnon Counas, Paris, France. An electric furnace for treating ores, comprising a rectangular chamber with charging hopper above, inclined electrodes on each side of the hopper, the number depending upon the length of furnace, and a return electrode forming part of the hearth of the furnace and arranged directly below the hopper.

Copper Extraction—No. 1,431,130. H. P. Cottineau, Paris, France. A process for the extraction of copper from the solutions resulting from the treatment of cupriferos pyrites, which consists in electrolytically depositing the copper on iron in the form of a film, and then placing the copper-coated iron in a cupriferos solution to thicken the film of copper.

Zirconium—No. 1,427,817. Otis Hutchins, Niagara Falls, N. Y., assignor to the Carborundum Co., Niagara Falls, N. Y. A mixture of impure zirconia ore and a reducing agent is heated sufficiently to reduce a portion of the impurities, which are then separated from the zirconia.

Zinc Retort—No. 1,432,842. Archibald Donaldson, Kellogg, Idaho. An external portable fume condenser, and



means for varying the area of condensation therein, for use in connection with a zinc retort, as above shown.

Purification of Zinc Sulphate Solutions—No. 1,427,826. C. R. Kuzell and J. R. Marston, Clarkdale, Ariz. Zinc-sulphate solution containing arsenic as an impurity is acidulated with sulphuric acid, the solution treated with a metallic sulphide, and heated to precipitate the arsenic as the sulphide.

Dry Pulverizing Mill—No. 1,427,322. R. E. H. Pomeroy, Canton, Ohio. A drum pulverizing mill with air inlet openings in its periphery. Patents Nos. 1,431,251 and 1,431,252 cover a similar machine.

SOCIETIES, ADDRESSES, AND REPORTS

Working of Executive Budget System Described

Elimination of Waste in Government Engineering Topic of Joint Meeting of Founder Societies

Dangerous attacks on the budget system were foreseen by John T. Pratt, chairman of the National Budget Committee, in an address before the four Founder Societies of civil, mining, mechanical, and electrical engineers at the Engineering Societies Building, New York, Dec. 13. The topic of the evening was "Elimination of Waste in Government Engineering." Robert Linton presided.

Jealousies, Mr. Pratt warned, would arise in federal bureaus, and perhaps in the Cabinet, from reductions in estimates, though these reductions were insisted upon by President Harding. Mr. Pratt asserted that the people of this country must be split into two main parties with clear-cut differences of opinion on national issues.

"For the fiscal year 1923-1924 the actual budget estimates on the convening of Congress this month indicated a very small, or no, deficit," said Mr. Pratt. "All these figures and estimates take into calculation no extraordinary expenditures authorized by Congress, such as the soldiers' bonus, the ship subsidy, or other like bills calling for large expenditures of money.

"The dangerous attacks on the budget system are likely to come from the very large reduction of some \$600,000,000 made by General Lord, at the insistence of the President, in the tentative figures of the departments for 1923-1924, which were that amount larger than the actual figures submitted by the President in his message to Congress. No such cut can be made in the tentative estimates without arousing jealousies and dissatisfaction on the part of many of the bureau chiefs, and possibly some of the Cabinet officers."

The tendency of the times, according to Mr. Pratt, seems to be one of dissatisfaction with national legislation. The people feel, he said, that they are not getting full, complete, and immediate action from their representatives in Congress in accordance with their ideas.

Mr. Pratt declared that the National Budget Committee would constantly try to create public consciousness in favor of preserving the integrity of the Budget Act of 1921. Other aims, he said, were reorganization on functional lines of the executive department of the government, and co-ordination between the executive and the legislative branches by having Cabinet members

appear on the floor of the House and Senate in defence of their estimates.

Mr. Linton then successively introduced General William C. Langfitt, Fred M. Feiker, and C. T. Chenery, who further discussed the topic of the evening. Mr. Feiker, vice-president of the McGraw-Hill Co., while pointing out that the government was not really so inefficient after all, if the magnitude of its business be considered and its operations be compared with those of large industrial organizations, said that as engineers and taxpayers those present were interested in the rising cost of government and that the executive budget system was the most intelligent approach to the control of this cost. General Langfitt discussed the desirability of co-ordinating the government departments.

Association for Advancement of Science Will Meet Dec. 26-30

The Engineering Section of the American Association for the Advancement of Science, known as Section M, has arranged a special program for the annual meeting to be held this year at the Massachusetts Institute of Technology, Boston, Dec. 26-30. The following will speak on this occasion:

Dr. J. B. Tyrrell, retiring vice-president of the section, Toronto, Canada, on the subject "Growth of the Mining Industry in Canada"; Dr. Ira N. Nollis, president of the Worcester Polytechnic Institute, Worcester, Mass., "Progress and the Engineer"; Dr. C. F. Scott, professor of electrical engineering, Yale University, and president of the Society for the Promotion of Engineering Education, "New Phases of Engineering Education"; and Harrington Emerson, of the Federated American Engineering Societies, "Prevention of Waste in Industry."

A joint session has been arranged by the chairman of Section K (Social and Economic Sciences), Dr. Henry S. Graves, School of Forestry, Yale University, and the chairman of Section M, F. M. Feiker, vice-president of the McGraw-Hill Co., for the evening of Dec. 29, at which Calvin W. Rice, secretary of the American Society of Mechanical Engineers and delegate to the recent International Engineering Congress in South America, will deliver an illustrated lecture on "Engineering Development in South America."

On Friday morning, Dec. 29, Section M and Section K will hold a joint session with a special group of speakers on "The Engineer's Relation to the Conservation of National Resources."

American Metric Association to Meet at Boston

Advantages of Metric System To Be Emphasized by Speakers—Comprehensive Program Arranged

On Dec. 30 the annual meeting of the American Metric Association will be held at the Massachusetts Institute of Technology, Boston, Mass. George F. Kunz, president of the organization, will occupy the chair. The papers to be presented are:

"The Obligation of Chemical Engineers to Encourage the Metric Movement," by Maximilian Toch, of New York, representing the American Institute of Chemical Engineers.

"The Metric System in Electrical Engineering," by Arthur E. Kennelly, past president, American Institute of Electrical Engineers.

"The Metric System in the Electrical Industry," by B. L. Newkirk, the General Electric Company, Schenectady, N. Y.

"Fifty-four Years of Successful Use of Metric Weights and Measures by the Waltham Watch Co.," by E. A. Marsh, consulting superintendent, Waltham Watch Co.

"Why We Use the Metric System," by Theodore H. Miller, works manager, De Laval Separator Co., Poughkeepsie, N. Y.

"How Best to Use the Metric System in Forestry," by Edward Richards, forester, New York.

"Metric Weights and Measures in Relation to Education," by Garrett P. Serviss.

"The Literature of Weights and Measures," by Frank H. Chase.

Reports of officers and committees will be made during the meeting and officers for 1923 will be elected. The annual dinner will be held at the Copley Plaza Hotel. A large attendance is hoped for.

Slate Users to Meet

Users of slate, including manufacturers, producers, distributors, dealers and contractors, are planning to meet in New York at the Commodore Hotel, on Jan. 25 and 26, under the auspices of the National Slate Association. Many of the leading concerns in the industry will hold their own sales meetings with their representatives immediately before or after the dates of the sessions devoted to the problems of the industry. Roofing contractors and other users of slate have responded well to the publicity campaign pointing out the need for co-operative promotion of the use of slate and the betterment of conditions in the industry.

Banquet to Gelasio Caetani Postponed

The reception and banquet which the American Institute of Mining and Metallurgical Engineers had planned to give Prince Gelasio Caetani, the newly appointed Italian Ambassador to



Photo by Underwood & Underwood
Gelasio Caetani

the United States, has been postponed from Jan. 10 until a future date, probably during the week of the Institute's annual meeting in New York in February. This change has been made owing to a complication of circumstances. It is expected that the exact date will be announced soon.

Society of Economic Geologists Elects Officers

The Society of Economic Geologists has elected as officers for 1923: J. E. Spurr, of New York, president; Andrew C. Lawson, of Berkeley, Calif., vice-president; directors, L. C. Graton, of Harvard University; Ralph Arnold, of Los Angeles and New York, and Willet G. Miller, of Toronto, Canada.

The society will hold its annual winter meeting at Ann Arbor, Mich., Dec. 28-30, 1922.

Standardization Policy Endorsed by Petroleum Men

At the convention of the American Petroleum Institute at St. Louis, Mo., Dec. 6-8, a resolution endorsing the standardization, simplification, and improvement of oil industry equipment and methods was adopted. It was declared that it was the policy of the Institute to encourage and to bring about such standardization and simplification. The appointment of committees to work in this direction was urged and the work of existing committees commended.

MEN YOU SHOULD KNOW ABOUT

One of the phases of the fact-finding being done by the President's Coal Commission, which is exciting wide interest, is that pertaining to waste in the mining of coal. This study is under the immediate charge of Carl A. Allen. Mr. Allen was born in Colorado Springs and was educated at the Colorado School of Mines. Following his graduation he worked for four years as a mine superintendent and as a mining engineer in gold and copper properties in Colorado, New Mexico, Arizona and in the states of Sinaloa and Chihuahua, in Mexico. After that for a number of years he engaged in consulting work with offices in Denver. This consulting work included problems of coal mine engineering. From 1911 to 1913 Mr. Allen was assistant professor of mining at the Colorado School of Mines. He established a coal mining course at that institution. In 1916 Mr. Allen joined the staff of the Bureau of Mines and spent a year and a half in charge of one of its mine rescue cars, operating in the Montana and Wyoming district. In 1918 he was sent to Utah to direct the Bureau investigations in Utah, Wyoming, and Idaho. An arrangement was made whereby he was engaged on a part-time basis to serve as the chief mine inspector for the state of Utah. That arrangement is still in effect. His work with the Coal Commission is being done under a leave of absence from his regular duties. Since the passage of the General Leasing Act Mr. Allen has been in charge of the leasing work in Utah, Wyoming, and Idaho.

C. D. Kaeding, of San Francisco, has recently been in Reno and Candelaria, Nev.

C. R. Corning, who recently has been seriously ill, is convalescing satisfactorily.

J. M. Callow, president and manager of the General Engineering Co., in Salt Lake City, is in New York.

Kirby Thomas has been making examinations of zinc properties in Virginia for Pittsburgh interests.

Frederick Bradshaw, general manager of the Tonopah Belmont Development Co., has returned to Tonopah from Surf Inlet, B. C.

G. L. Toeys, of Spokane, was elected a director of the Rex Consolidated Mining Co. at a recent meeting of the board of directors in New York.

T. T. Read, of the U. S. Bureau of Mines, was recently at Morro Velho, Brazil, and will probably visit Chuquicamata and the Chilean nitrate pampa in January.

Frank M. Manson, president of the Western Ore Purchasing Co., and interested in many Nevada mines, has returned to Reno from an eastern trip of three weeks' duration.

A. C. H. Gerhardi, consulting engineer and manager director of the Consolidated Homestake Mining & Development Co., Ltd., in British Columbia, has left for England on a business trip in connection with his company.

At the meeting of the American Association for the Advancement of Science to be held in Boston during Christmas week. J. B. Tyrrell, one of the retiring vice-presidents, will give an address before the Engineering Section on "Mining in Canada."

Mining and metallurgical engineers visiting New York City last week included: W. H. Staver, of Idaho Springs, Colo.; A. E. Remington, of Tampico, Mexico; A. J. Martinez, of Monterey, N. L., Mexico; Samuel L. Hoyt, of Schenectady, N. Y.; Verne Frazee, of St. Louis; and Raymond B. Ladoo, of Washington, D. C.

OBITUARY

F. B. West, a prominent Gulf Coast oil operator, died at Houston, Tex., on Nov. 18. He was born in Clarinda, Iowa, in 1861. In 1900 he moved to Houston, and in addition to his real estate business and extensive rice-farming interests Mr. West was one of the early operators in both the Sour Lake and Humble fields. He was also one of the original drillers at Blue Ridge, but without success at that time. Later he became interested in the Goose Creek field. In 1914 he found an extension to the Sour Lake field, and in 1916 developed the southwest portion of the Humble field. His faith in the Blue Ridge field was vindicated later, when, together with the Gulf Production Co., he completed a producing well in this field.

David Lindsay, noted explorer, whose pioneering investigations were in part responsible for the discovery of the great West Australia gold field, died recently in Australia. He was born in Goolwa, South Australia, in 1856, and entered the Survey Department of the Territory in 1872, since which time he had engaged in surveying, exploring and prospecting trips. He was intimately associated with the development of the mining industry in the various states of Australia.

One of Lindsay's feats was to ride across Australia, from the north to the south, with only a small black boy as a companion. In 1889-90, as leader of the Elder expedition, he crossed the great Victoria district, during which trip he discovered the existence of a great auriferous area. It was on the reports of his findings that prospectors went out and opened up the great gold fields of West Australia.

Lindsay stayed in the gold fields until 1895, assisting in the exploration and exploitations of the extensive mineral belt, later resuming explorations in the northern territory. He made his home in Sydney, New South Wales.

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

The merger of Calumet & Hecla and its "subsidiaries" in Michigan awaits appraisal by Messrs. Finlay, Yeatman, and Kemp, who are engaged at the work. Acquisition of manufacturing plants is also officially intimated.

The Governor's committee investigating the recent disaster at the Argonaut mine, in California, censures Bradshaw, the shift boss, and the Argonaut management.

The Oliver Iron Mining Co., after two years of experiment, has decided upon stope scrapers as the most economical means for loading ore in its mines.

The Premier mine, in the Portland Canal district, assumes leadership of silver mines in Canada. Output was 4,500,000 oz. in 1922.

The Alvarado Mining & Milling Co. will absorb neighboring properties in Parral under A. S. & R. management.

Guanajuato (Mexico) produces steadily, but expansion is not possible under existing conditions.

S. S. Arentz will remodel his bill for mine law revision before retiring from Congress in March.

The Ohio Copper Co. is successfully leaching copper ore in place at its Utah property.

Calumet & Hecla and "Subsidiaries" Will Consolidate

Independent Engineers Are Appraising Properties to Determine Basis for Merger of Big Copper Producers

THE absorption by the Calumet & Hecla Mining Co. of the Ahmeek, Allouez, Centennial and Osceola mining companies, comprising, with Isle Royale, the "C. & H. group of subsidiaries," will in all probability be accomplished within a few months. Three independent engineers, Pope Yeatman, J. R. Finlay, and James F. Kemp, are engaged in a comprehensive examination, with a view to appraising each of the properties to determine a fair basis for consolidation. Twelve years ago a plan was devised for forming a large merger to take in a dozen companies. The terms proposed by the Calumet & Hecla engineers were opposed by sundry stockholders in the smaller companies, and the plan fell through. Now it is believed that the appraisal made by the engineers mentioned will be accepted by every one.

Calumet & Hecla already holds the following shares, according to the annual report for 1921:

	Shares	C. & H. Ownership	Per Cent of Total
Ahmeek.....	200,000	99,168	49½
Allouez.....	100,000	41,000	41
Centennial.....	90,000	41,500	45
Isle Royale.....	150,000	35,000	23
La Salle Copper.....	302,977	152,977	52
Osceola Consolidated.....	96,150	33,560	35
Superior Copper.....	100,000	50,100	50
White Pine Cop. com.....	85,320	10,000	12
White Pine Cop. pf.....	10,000	10,000	100

The value of the company's semi-

liquid assets is estimated at \$37,700,000 as follows:

Net current assets, Dec. 1, 1922.....	\$12,360,000
Timber standing.....	3,000,000
Market value subsid. stock.....	9,400,000
Present worth tailing deposits.....	13,000,000
Total.....	\$37,700,000
Total per share, 100,000 shares.....	377

The valuation of \$13,000,000 for tailing is arrived at by estimating on careful engineering calculations, 29,000,000 tons of copper-bearing material which has been pumped into Torch Lake from operations dating back half a century. These are estimated to contain over 14 lb. of copper per ton. The company has for months been getting a net recovery of 90 per cent of the copper from these sands, or above 12½ lb. per ton. It is estimated Calumet & Hecla can average over 11 lb. of copper per ton, or about an 80 per cent recovery. The Tamarack sands contain 9,000,000 lb. which will average 12 lb. per ton.

Calumet & Hecla before discontinuing all production in 1921, produced 1,500,000 lb. of copper a month from the old Torch Lake tailings at a cost of less than 6c. per lb. It is a fair estimate, therefore, to assume a cost of 8½c. per lb. for reclamation plant production, and on a copper market of 14½c. per lb., these sands, reduced to a basis of present worth, have a value of about \$13,000,000. This does not take into consideration the millions of dollars of surface plant and equipment, reduction

works, smelters and refineries at Lake Superior owned by Calumet & Hecla. It places no value on railroad, ore cars, underground electrification, motors, trams, hoists, and other equipment.

A thorough appraisal will necessarily be made of the physical assets and of the shares of the subsidiary company as well as of Calumet & Hecla before any announcement of the terms of the merger will be forthcoming.

A significant official statement is to effect that plans are also under consideration for the acquisition of manufacturing facilities which will assure the consumption of a large part of the output of the mines, but no further explanation is offered.

Hornsilver Properties in Nevada Will Be Reopened

The Orleans Hornsilver mine, at Hornsilver, Nev., is to resume operations at once, according to an announcement made by A. I. D'Arcy, general manager, at Tonopah. This property was closed down some time ago due to litigation between J. W. Dunfee, who obtained an option which he later sold to Orleans Hornsilver Mining Co. for \$90,000, and C. A. Terwilligar, who claimed one-half the sale price on account of a grubstake agreement between himself and Dunfee. The Orleans Hornsilver was originally named as defendant, but by agreement between litigants the company has been released as a party to the suit. Before the mine was closed down a large tonnage of good ore was developed down to the 700 level. It is likely that work will be resumed at other properties in the district.

Ohio Copper Co. Leaches Copper Ore in Place

Work at Lark, Utah, Demonstrates Success of Plan—Cost Estimated at 7 or 8c. Per Pound

Successful leaching of low-grade copper ore in place has been accomplished by the Ohio Copper Co. at Lark, near Bingham, Utah. In the company's mine there is an area of broken ground, which had been caved from previous mining operations and which engineers estimate contains 37,000,000 tons of broken material with an average copper content of 6 lb. per ton, or 222,000,000 lb. of copper, which can be treated without the expense of moving the material. In addition, there is another part of the property which can be prepared and put in similar shape for leaching by the time the copper in the present caved portion of the mine has been thoroughly extracted.

The character of the Ohio ore is such that once it is broken and exposed to the elements it oxidizes very quickly; this makes it possible to leach the copper with water. The material in the caved area has been broken down and exposed to the air for an average period of about ten years.

On Aug. 24, 1922, a small operation was started by pumping about 200 gal. of water per minute on the surface of the caved area; this water percolated through the mass of broken material, dissolving the soluble copper and ran out into the main tunnel, where the copper-enriched water was impounded and directed into launders which contain scrap iron. This copper in solution is precipitated on scrap iron the recovery being approximately 80 per cent. This product, shipped to the smelter, assays 89 per cent copper.

Percolation brought down into the tunnel water containing 19 lb. of copper per ton, which was too rich in copper content for the small and inadequate precipitation plant to handle. To meet this situation and to prepare for increased operations, the installation of 4,400 ft. of launders, of which one-half will be on each side of the railway track in the tunnel, is under way. It is calculated that beginning in January, with the new plant operating, the operating profits should be at least \$10,000 monthly; this should materially increase, when the plant is completely installed and becomes efficient.

The ultimate goal is to provide a plant with a capacity of 1,000 gal. of water per minute; this amount of water is available in the tunnel, but will require an expenditure of about \$40,000 to install the necessary pumping equipment, pipes, and complementary apparatus to pump the water from the tunnel to the surface of the ground. By the former method of mining and milling, the company did not produce copper under 17c. per lb., whereas by the new method, copper is being produced, from what ordinarily would be classed as "waste material," at a cost of between 7c. and 8c. per lb., according to Charles A. Kittle, president.

Oliver Iron Mining Co. Will Use Stope Scrapers

Method Has Advantages Over Hand Loading and Various Shoveling Machines, It Finds

The Oliver Iron Mining Co., a subsidiary of the U. S. Steel Corporation, after two years of testing and experimenting has decided to adopt "scraper" or "slusher" mining wherever the conditions, such as size and shape of orebody, permit. The company will continue to use the sublevel caving system of mining, but will use small double-drum hoists and scrapers to get the ore into the chutes, instead of shoveling it by hand into "buggies." Shoveling machines have been found satisfactory in main level drifts in ore and rock, but their first cost is high, and they have many wearing parts. For scraping ore, a hoist of 5 hp. to 7 hp., pulling a scraper of about 8 or 10 cu. ft. capacity, has been found to be most satisfactory under the local conditions. Only air-operated hoists have been used, because the air was already at hand and it also assists in ventilation. An objection to electric hoists has been their size and weight.

Explosion Kills One and Injures Three at Premier Mine

Eight cases of dynamite in a temporary magazine in the No. 2 level at the Premier mine, north of Hyder, Alaska, exploded recently, killing one man and injuring three others, who were tramping ore 500 ft. away. Considerable damage was done to the timber in the level. The mine is in British Columbia.

Strike at Leadville Averted—Miners Appeal to Industrial Commission

After serving notice on all mine operators in the Leadville district in Colorado that they would walk out unless a minimum wage of \$4 was agreed upon, the miners, numbering about 450, reconsidered and decided to file their demand before the Colorado Industrial Commission, which requires that such demands be submitted to it at least thirty days before any action is taken by either party in such a controversy.

Operators are said to have opposed the request of the workers for a higher scale on the ground that the ore now coming out of the mines is of such a low grade that it is impossible to raise the wages of the miners and pay expenses.

Recent increases in the cost of living in the Leadville district, due to the revival which mining has been undergoing in the district, are said to have prompted the miners to demand a higher scale.

Two properties, one the Henrietta mine owned by the W. E. Bodwen Co. and the other the Blain shaft, owned by John Cortellini and others, on Fryer hill, have shut down temporarily, but work was resumed after a few days. The present wage scale of \$3.50 is 50c. below that of other camps in Colorado.

Alvarado Company May Absorb Neighbors in Parral

Economical Operation Under A. S. & R. Direction Is Sought for Mexican Properties

Plans are nearing completion for the merging of the Refugio Mining Co., the Hidalgo Mining Co., and the San Juanico Mining Co. of Parral, Mexico, with the Alvarado Mining & Milling Co., to whose property that of the others is adjacent.

In the event the consolidation is effected, the American Smelting & Refining Co. will take over the management of the group—which adjoins its Veta Grande mines in the Parral district—for a ten year period and in consideration of the economies and advantages of the technical skill that will be thereby made available by the A. S. & R. Co. for the new consolidation the A. S. & R. Co. will receive 10 per cent of the common stock of the new company, together with a nominal fee per annum to cover New York office expenses. The A. S. & R. Co. will also purchase \$250,000 worth, par value, of the preferred stock at the price at which it will be issued, which will be at not less than \$90 per share.

It is anticipated that marked economies will accrue to this new consolidation by this arrangement in the way of saving the heretofore relatively large overhead expenses for the separate organizations, and that by the unified management, the enterprise can be handled with much greater efficiency than heretofore.

The major holdings of the Alvarado property are upon the same vein as the A. S. & R. Co.'s Veta Grande operations, upon which the A. S. & R. Co. has at the present time a mining and cyanide plant of 800-ton daily capacity.

The Alvarado has a mining and milling plant of approximately 600 tons' daily capacity and the Refugio has a mill, just about ready to start, of around 250 tons' daily capacity.

The new company will take over the Parral & Durango R.R., certain process patents of the Alvarado M. & M. Co. and certain timber limits, most of them adjoining the P. & D. R.R.

This new company will issue 600,000 shares of common stock, of no par value, and it is contemplated exchanging Alvarado stock, share for share, for the new company's stock, with lesser amounts of the same stock going to the other three companies in exchange for their properties.

It is also contemplated at the present time to issue 10,000 shares, par value \$100, 7 per cent preferred stock, with cumulative dividends, callable at par and accrued dividends at any time, by sixty days' notice prior to dividend date, with privilege of converting the preferred stock into common in the ratio of one share of preferred for ten shares of common, a sinking fund being planned for the preferred, to the end that the retirement of such of the preferred as may not be converted shall be completed on or before Jan. 1, 1936.

Report of Governor Stephens' Committee of Inquiry on the Argonaut Mine Disaster

THE special committee appointed by Governor William D. Stephens, of California, to investigate the Argonaut mine disaster, made returns to the Governor early in December, and the committee's report was made public on Dec. 7, 1922. The committee consisted of A. B. C. Dohrmann (chairman), William J. Loring and J. C. Williams. E. A. S. Whittard was secretary. Extracts from the report are as follows:

Origin of the Fire.—The evidence given regarding the cause of the fire leads to no one definite fact. The following possibilities have all been taken into consideration:

- Incendiarism,
- Defective electric wiring,
- Carelessness with cigar or cigarette stub, carbide lamp or candle.

The witness Mitchell Jogo, who stepped off the skip immediately after the discovery of the fire, and remained there with the hope of being able to do something toward extinguishing it, states that while there were two sets of timber, or possibly three, burning, the larger portion of the fire seemed to be coming from the manway and spreading across the shaft from there. This would warrant the belief that the fire had started in the manway. This manway, besides carrying the ladders for the men moving up and down the shaft, when traveling without the skip, contains the electric-power wires carrying 2,400 volts, and also the electric lighting wires in the mine, as well as telephone, compressed air-line, and water-pump column. If the origin of the fire was either incendiary or caused by defective electric wiring, this would be the natural place for it to start.

From all the evidence considered your committee is unable to arrive at a definite conclusion as to the origin of the fire, which still remains in doubt. Of the possible cause, as previously stated, the first two—viz., incendiarism or defective electric wiring—seem to be the most acceptable.

Action of Men in Charge.—Judging from the evidence it would appear to the committee that shift boss Bradshaw did not use good judgment under the circumstances, in failing to notify the men at work on the levels below and in the stopes, of the fire (which was in the shaft of the region of the 3,000-foot level); that an endeavor should have been made to warn the men of their danger, and that after this warning had been given under the direction of Bradshaw, he then should have proceeded up the shaft and upon failing to find suitable fire-fighting appliances his next action should have been to proceed to the surface as quickly as possible and stop the Muldoon fan, or, better still, the telephone service could have been used for this purpose by notifying the engineer to stop the Muldoon fan, even at the risk of leaving his hoist for a period, which could not have exceeded five minutes, or he could have sent the topman. Instead of this method of procedure, Bradshaw, after he came up through the fire with the two skip tenders, devoted his attention to finding possible means where-

with to extinguish the fire, evidently believing that this could be done and the main shaft then utilized to get the men out who were down below the fire level. The rapid spread of the fire proved this theory fallacious.

This committee feels that more effective effort might have been made in immediately stopping the Muldoon fan, which would, in the opinion of the committee, have quickly reversed the air currents in the mine, causing the main shaft to work as an upcast, not only because of its greater elevation but because the fire, which was said to be burning fiercely by this time, would have greatly assisted in a rapid reversal of the air current. Some of the witnesses have expressed a belief that the skips should have been sent back in an endeavor to bring the men through the fire zone after Bradshaw and the two men who were with him came up. While it is doubtful if this procedure would have been effective, still it should have been tried.

The stoppage of the Muldoon fan at any later period than within possibly the first hour or so of the fire being discovered, would, in the opinion of this committee, have been an unwise procedure, mainly because the fire was creating large volumes of gases which naturally found their way to the bottom of the mine, because of the fact that the down current of air through the main shaft carried the gases with it, following the same course that the fresh air would normally take, being forced to the lowest workings by the suction of the Muldoon fan and by the location of the ventilating doors on the various levels, which were so situated as to force the air, and in this case of fire, the gases, through these same channels as the fresh air took during normal working period, and particularly owing to the fact that all the ventilating doors placed in the several levels of the mine were for the express purpose of forcing fresh air to the bottom of the mine and to the regions where men were employed in various sections of the mine. Therefore, the gas created by the fire in the main shaft, which was the downcast, must necessarily find its way into the same region as did the fresh air prior to the occurrence of the fire.

After the fresh-air current had been substituted by gas and smoke, which very shortly proved to be the case, because smoke and gas were seen passing out through the exhaust fan at the Muldoon shaft, within an hour and a half, or less, after the fire started, it would, in the opinion of the committee, have been unwise to have interfered with the course of the gases, because in all probability the miners below would conform their movements, and any attempt they might be making on their own behalf to save themselves, to the course of the gases, and a reversal or alteration of the movement of the flow of these gases might have been fatal much sooner than was the case by leaving them undisturbed.

As a result of the above findings, which in turn have been the result of a careful study of the evidence given by the many witnesses at the several hearings, we, the committee, wish to state that under the circumstances, considering the very little, if any, training

received by Bradshaw and his companions, and without instructions as to action being taken in case of a fire in the main shaft, etc., Bradshaw cannot be severely reprimanded, with this exception, that he should have notified the men working in the various sections of the presence of fire before he and his companions left the bottom of the mine, because without doubt he could have filled the same skip with men that he and his companions came up on had he used the judgment ordinarily expected of a shift boss under conditions which, as leader of the fatal shift, he should be better acquainted with than the men who were working for him and subordinate to him. No doubt Bradshaw did not think that the fire in the shaft was of sufficient importance to take the action that, in the opinion of the committee, he should have taken. It is for this reason that this committee strongly recommends that every foreman and shift boss, as well as certain other underground men, shall be thoroughly trained in the preservation of life and property under every conceivable condition that might arise underground.

Lack of Fire Protection.—It would appear to the committee that the conditions which led to the fire, resulting in the great loss of life, were not exactly in strict accord with modern and up-to-date methods. It would further appear that attention to detail with regard to the training of men and the provision of safety devices to be utilized by trained men, in cases of disaster or necessity, was lacking. Also, that while the safety regulations according to law were perhaps complied with, insufficient attention was given to the provision of fire-fighting appliances such as could be used for the protection of life and property.

If the men directly in charge of the several shifts at the mine—viz., the shift bosses, level bosses, and others—had been trained in the use of fire-fighting appliances under conditions that might overtake them at any time, a better directed effort could have been made with a more satisfactory result than is shown by the record.

In the above conclusions this committee is dealing with the period from Sunday night, Aug. 27, 1922, when the fire started, until Wednesday, Aug. 30, 1922, when the rescue work was taken over by the operating committee of three—viz.: E. C. Hutchinson, president of the Kennedy Mining Milling Co.; V. S. Garbarini, superintendent of the Argonaut Mining Co., and Fred L. Lowell, mining engineer, Industrial Accident Commission, who were appointed with the unanimous approval of a large number of engineers of repute and operators of mining properties in various districts.

It might further be said that the miners working in the headings driven for the purpose of connecting the Kennedy mine with the Argonaut mine should be complimented on the work they performed, because they evidently made four times more progress for twenty-four hours' work in hard ground than is made under normal conditions.

Recommendations.—The Committee endorsed the recommendation on Mine Fire Control of the Committee of Sixteen (published in *Engineering and Mining Journal-Press*, Nov. 18, p. 914) and made them a part of their report to the Governor.

Mining in Guanajuato Is Quiet but Steady

No New Work Undertaken—Labor Legislation and Low Price of Silver Dominate Situation

BY KEITH A. CUNNINGHAM

Low silver prices and questionable labor legislation have had a depressing effect on mining in Guanajuato, Mexico. Operators have confined themselves to current producing operation, no new work being given consideration.

Guanajuato being a low-grade silver camp, the recent drop in the price of that metal is seriously affecting the operating companies, and it is generally felt that there is little hope of any reaction, and that, barring unforeseen extraordinary world conditions, about 60c. per ounce is all that can be looked for. At this figure, the profits from operations will be small.

Local, as well as federal, labor legislation is causing grave concern among all classes of employers. Not long ago, the local state congress passed a law giving all workmen the right to a day's holiday on full pay each week, outside of Sundays, and absolutely prohibiting any Sunday work except to certain businesses which cater to the needs or amusements of the public, and then only upon the condition that double time be paid. Mines, reduction, and treatment plants are not included in the businesses mentioned, but so far the law has not been enforced, and things are going on as usual. Should, however, the law be enforced, and it is hoped it never will be, the operators here would probably have to close down their plants until the congress could be persuaded that no mine or plant can be run without some Sunday work.

Political conditions throughout the state are quiet, and if there is discontent, it is unexpressed. The railroads are being operated better than for many years, both freight and passenger services being fairly good.

The Guanajuato Reduction & Mines Co. is operating both its plants at full capacity, about 25,000 metric tons being treated per month. The Guanajuato Consolidated Mining & Milling Co. is operating the Sirena and Peñafiel mines and Pastita mill.

The Cubo Mining and Milling Co. is treating about 4,500 metric tons monthly at its Tajo de Dolores mill. The company is doing a considerable amount of exploration and development work in all its mines. At the Cebolletas mine, an old vertical shaft was sunk 100 ft., and a crosscut driven from the shaft bottom to the vein, which is being drifted on in both directions. Ore of good milling grade has been found, and it is planned to connect the mine to the mill by a rope tramway which would be about 1½ miles long. At the Capulin mine, an old incline shaft was cleaned out and is now being deepened. The ore now being milled is drawn from the Villalpando mine.

The San Cayetano plant is treating from 40 to 50 tons daily, the ore coming

from the Tajo de Ajuntas mine and dumps.

The Mexican Reduction Co. will soon resume the treatment of river tailings. The plant has been remodeled and will handle about 100 tons per day, the process being all slime with counter-current decantation.

Gold Output in Transvaal and India

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, Dec. 16—The output of gold in the Transvaal during November totaled 764,476 oz. Production in India in the same period was 32,164 oz.

Premier Mine Largest Silver Producer in Canada

According to H. A. Guess the Premier Gold mine, of the Portland Canal district, British Columbia, produced approximately 4,500,000 oz. of silver and 137,000 oz. of gold during 1922. This large output seems almost unfair in view of the large number of deserving prospectors who are drawing blanks with every round of shots. The mine is the largest silver producer in the Dominion of Canada.

Picher Miners Forego Two-Week Christmas Vacation

Business Is Too Good to Warrant Long Rest of a Year Ago

The two weeks' Christmas vacation that was observed a year ago in Picher mining field in the Joplin-Miami district will not be repeated this year. Instead, the mines for the most part will be closed down only over Saturday, Sunday, and Monday, December 23, 24 and 25, and some will be operated Saturday. Conditions are much different than a year ago, when the vacation of a fortnight was thought advisable on account of the rapidly increasing surplus of ores in bin in the field. This year the surplus is only nominal.

Silver King Coalition Declares Dividend

The Silver King Coalition Mines Co. operating at Park City, Utah, has declared a dividend of 15c. a share, payable Jan. 2 to stock of record Dec. 20. This disbursement, a total of \$182,415, will bring the grand total of dividends for the company up to \$15,928,220. Earnings of the company are satisfactory.

At present the property is in better condition than it has been in years. In addition to providing for dividend requirements, the surplus of the company is being added to substantially. During November, 4,201 tons of ore and concentrates was produced, an output which marks a 40 per cent increase as compared to the July output. The company's new flotation plant is giving excellent results, and with the price for lead high, profits are better than for some years.

New Mining Operations in Eastern Sinaloa

Silver and Gold Ores Are Being Shipped—Several Mills in Satisfactory Operation

BY E. R. HAGGIN

Mining conditions in the State of Sinaloa and western Durango, Mexico, seem to be improving, as several new enterprises have started operations since the end of the last rainy season. The Las Cuates mine, in the Badiraguato district in eastern Sinaloa, is under lease and bond to J. L. Matthes and associates from Philadelphia. They are working extensively with a view to opening again some of the high-grade silver pockets for which this mine was famous years ago.

The La Tuna mine, owned by the Schrevesport Mining Co., is being worked by W. W. Hudson, president of the company. He is installing a compressor and jackhammer drills, with a view of speeding up the work. This is a silver property in the Badiraguato district. In the same district La Trinidad mine is being worked by the Tribolet brothers. It is reported that they have recently encountered high-grade ore, which is being shipped to the smelters. This property is equipped with a small ball mill and concentrating plant for treating low-grade ore. The Mautel Gold properties, being worked by Milward & Haggin, are producing steadily both amalgam and cyanide bullion. Another unit is being added to the mill and cyanide plant. These properties have large ore reserves.

The La Calera mine, in the Tamazula district, is being worked by English capital; W. W. Woods is locally in charge of the property. It is equipped with a Gibson mill, and he is installing a modern cyanide plant. This is a gold property, with very rich ore. The San Nicolas mine, also in the Tamazula district, is being worked by A. A. McAlpin and associates of Globe, Ariz., and it is reported that they are shipping ore of a high grade. This mine has been a producer for a great many years.

The San Fernando mine, in western Durango, is being worked by E. H. Cook, of Culiacan, and ore is being shipped to the El Paso smelter. In Copalquin, Charles Hitchler is operating his mill and cyanide plant, with satisfactory results.

Stargo Mill, at Morenci, Is Practically Finished

The seventy-ton silver mill of the Stargo Mines, Inc., which is being erected near Morenci, Ariz., is expected to be complete by Jan. 1. Treatment will be by cyaniding; plans for the mill were made by General Engineering Co. of Salt Lake City. Large orebodies are said to have been developed that sample above \$12 per ton. Ray Ferguson, formerly of Nogales, is manager of the property. This company was organized by a number of prominent Arizona men, but now is controlled by New Jersey capital.

Ontario Metal Output \$27,000,000 for Nine Months

Substantial Increase in Gold, Silver, and Cobalt Oxide—Nickel Declines

The Ontario, Canada, Department of Mines states that the output of the metalliferous mines and smelters of the province for the nine months ended Sept. 30, 1922, totaled \$27,000,000, compared with \$21,000,000 for the corresponding period of 1921. Production of gold, valued at \$15,500,000, shows an increase of \$5,700,000. Silver is valued at \$5,610,000, and shows an increase of \$1,300,000. Metallic nickel is valued at \$2,000,000, a decrease of approximately \$500,000, and nickel in matte, valued at \$1,600,000, shows only a slight increase. The output of cobalt oxide is valued at \$590,000, an increase of \$260,000. Metallic copper and copper in matte amounts to \$770,000, which is approximately the same as for the preceding years. The department estimates that Ontario's gold production will pass that of California this year, and that during the third quarter of the year the production was at the rate of over \$22,000,000 a year. The production of silver was well maintained, due largely to the increased output from South Lorrain. Mines shipping over half a million ounces follow:

Mine	Silver, Oz.
Nipissing	2,960,000
Mining Corporation	1,289,000
O'Brien	884,000
Coniagas	827,000
Keeley	540,000

The average grade of ore treated for the period by different gold mines was:

Dome	\$11.03
Hollinger	8.38
McIntyre	10.04
Kirkland Gold	6.47
Kirkland Proprietary	6.29
Lake Shore	20.54
Teck Hughes	13.41
Wright-Hargreaves	11.49
Average	9.31

The Northern Canada Power Co. has decided to spend another \$1,000,000 in further dams and power installations. It is expected that this will give in addition 4,000 hp. available for Porcupine.

Nickel Business Is Better, According to Mond Officials

Competition in nickel markets is so keen and business shows such a response, that the Mond Nickel Co. early in the New Year plans to reach wartime refinery capacity. This is said to be made possible by steadily decreasing cost of production. Sales have improved to a gratifying extent. As a consequence, before the close of navigation on the St. Lawrence, the company shipped the remainder of its entire stock of matte that had accumulated during the slump, to the refinery at Clydach, Wales. Preparations at the Coniston smelting works are going forward with the expectation of increased mine and smelter production next spring. The rolling mills and other plants at Clearfield, Pa., and at Birmingham, England, are in operation.

Joplin-Miami Operators Have Developed Efficient Drilling Methods

It is estimated that between 250 and 300 drills are now being operated on exploration and development in the Joplin-Miami district. During the month of October alone the St. Joe Lead Co. put down 31,000 ft. of drill holes. Drilling is being carried on in a more systematic and efficient manner than ever before in this field. A battery of drills will be moved to a certain section and a number of comparatively shallow holes put down. These drills will then be moved to another section, but the drill holes will be studied, and in a short time another set of drills will be brought to the location and drilling will be done to a deeper level at points indicated to be favorable by a study of the first set of holes.

It is understood that one company has turned back 35,000 acres of leases after test drilling. However, the same company has made a number of important strikes in sections of the field where it is considered certain that full development will follow.

Graphite Mines Will Reopen

Plans are being made by the United States Graphite Co. to resume operation of its large graphite mines at La Colorado, 16 miles west of Torres, Sonora, Mexico, according to C. E. Haller, manager. These mines were formerly the largest producers of graphite on the continent, it is stated. The mineral was marketed chiefly in the United States. The revolutions caused the mines to shut down, but now that peace has been restored they are to be reopened. The company is advertising for bids to haul the graphite from the mines to Torres, the nearest railroad point.

Mount Lyell Company Earned \$127,000 During Year

By Cable from Reuters to "Engineering and Mining Journal-Press"

Melbourne, Dec. 11—Profits of the Mount Lyell Mining Co. during the past financial year amounted to \$127,000, compared with \$52,000 in 1921. The chairman of the board is of the opinion that the output of North Lyell is likely to be increased in the near future to around 22,000 tons of ore monthly.

News from Washington

By PAUL WOOTON
Special Correspondent

Mine Law Revision Bill Will Be Amended

S. S. Arentz, Retiring from Congress, Proposes to Revamp Measure Which He Fathered—Badly Received in West

ALTHOUGH he believes the legislative situation at the present short session of Congress is such that no revision of the mining law can be completed, and that the matter, therefore, will have to go over to the next Congress, Representative Samuel S. Arentz, of Nevada, has stated that he will ask that the House Committee on Mines and Mining be called together after the holidays to lay the groundwork for certain amendments to the mining laws.

Basing his action on the results of communications and consultations with mining engineers and others interested in the production of ores, Representative Arentz will ask that amendments be drafted to change the bill proposed by the committee of engineers and which was introduced by Mr. Arentz more than a year ago as the foundation for revision of the mining laws.

Mr. Arentz will retire from Congress next March, as will Representative Rhodes, chairman of the Mines and Mining Committee, and several other members of that committee. As the committee as now constituted has held hearings on this mining bill and members have conducted investigations outside of the hearings, the retiring members consider it desirable to amend the pending bill in line with their experience as a guide to the reorganized committee in the Sixty-eighth Congress, which convenes in March.

After conducting a series of short preliminary hearings by the committee, Representative Arentz, who is a mining engineer, mailed more than 2,000 copies of the measure to persons particularly interested, and employed a special assistant to handle the correspondence connected with the measure, in an effort to develop the attitude of the men on the ground toward the committee's proposals. This method, however, resulted in only approximately 250 adequate replies being filed with Mr. Arentz, who subsequently, on trips to the West, had personal interviews with a number of mining men.

Strong opposition has been shown, according to Representative Arentz, to the provision in the pending bill that locations be on cardinal lines. An amendment will be proposed permitting claims 1,500 x 1,500 ft., run approximately by cardinal lines but not necessarily conforming to section lines. Mr. Arentz believes it should be made possible for a prospector to locate a claim without the aid of a surveyor. Location by vein is favored generally in the West, the Nevada Representative states, so that a claim may be located according to the direction of the vein or lode, 1,500 x 1,500 feet.

Sentiment generally also opposes abrogating discovery rights and doing away with assessment work, Mr. Arentz says, and he will propose amendments

to the bill accordingly. Furthermore, the present system of recording claims is favored over a proposal that claims be recorded in the nearest general land office. Unlimited sites for mills and other purposes also are strongly opposed.

The principal change in the present laws deemed necessary by majority opinion of those consulted, Mr. Arentz states, is one to prevent holding claims without development. This leads to a strengthening of the law rather than a relaxation of the assessment obligations.

Discovery rights and assessment work have made mining in the past, according to the consensus obtained by Mr. Arentz. The engineer and the investor have not entered until the prospector has found some possibilities, he declares.

The West generally feels that development by large interests will be amply assured and protected under less drastic modifications of the present laws than proposed by the committee, as history has established that it is not difficult to reach agreements in proven ground. Continuation of assessment work is essential, Mr. Arentz declares, as otherwise claims would be held indefinitely on payment of small annual fees.

War Minerals Relief

Subject to the approval of the Secretary of the Interior, the War Minerals Relief Commissioner has recommended awards as follows: Shelton & Shinpaugh, Canyon City, Ore., \$1,075.20; C. C. Hawkins, Silvies, Ore., \$375; R. E. Reed, Placer, Ore., \$325; W. G. Green, Georgetown, Calif., \$98 (additional); Ralph W. Goodhue, Indian Falls, Calif., \$2,129; Alex Shinpaugh, Canyon City, Ore., \$169; J. M. Blank, Canyon City, Ore., \$3,165.24.

Disallowances were recommended as follows: Chezum & Warren, Seattle, Wash., commercial importance not established; Herbert H. Long, San Francisco, no ground for additional award; Grover, Presby & Irish, Georgetown, Calif., loss not established; Burwell and Seibert, Sanger, Calif., no additional award found to be justified.

Immigration and Labor Shortage Will Be Studied

After conferences with the Secretary of Labor and with the Commissioner General of Immigration, Senator Ransdell, of Louisiana, will initiate legislation looking to the appointment of a Congressional commission to study the question of the selective admission of immigrants to fill the gaps in the labor supply required by agricultural, metal mining, and other industries.

There is no chance of amending the immigration law at the present session of Congress, it is believed. Before any change can be made in that act, it is admitted that some highly practicable method must be devised which will restrict new labor to certain pursuits for a period of years.

Permits Granted for Hydro-Electric Power Projects

The Federal Power Commission has issued a twenty-five-year license to J. M. Freeman, of Billings, Mont., covering a project to develop 100 hp. on Boulder Creek, a tributary of Salmon River, Idaho, for mining purposes. A similar license has been granted to the Emery Consolidated Mining Co. of Deer Lodge, Mont., covering a transmission line 8 miles long, to connect with the Montana Power Co. line at Deer Lodge. The power is to be used in mining operations. A preliminary permit has been issued to Frank G. Baum, of San Francisco, for two years covering three storage reservoirs of combined capacity

of 35,000 ft. on Black River and tributaries in Arizona which will involve construction of a power house on the line dividing the White Mountain Apache Indian reservation and the Apache national forest, to generate 100,000 hp. for use in the copper mining in Arizona. A conduit 16 miles long will convey water from the reservoirs to the power house.

Stored Asbestos Injured by Fire

The large mill and store shed of the Asbestos Mines, Ltd., at East Broughton, Quebec, were totally destroyed by fire on Dec. 11, about 1,000 tons of asbestos stored in the shed being partly damaged. The loss is estimated at between \$150,000 and \$200,000.

News by Mining Districts

By Special Correspondents in the Field

London Letter

Tanganyika Should Produce 42,000 Tons of Copper in 1922—New Reverberatory Will Increase Output

BY W. A. DOMAN

London, Dec. 8—As the Tanganyika Concessions is dependent for its present income almost wholly on the Union Minière du Haut-Katanga, it does not issue its report until the operating company has closed its accounts. The report and accounts of the directors of the Tanganyika are, consequently, always late, which, in the circumstances, is unavoidable, as necessarily difficulties are experienced in getting accounts from Central Africa, where this vast copper enterprise is being conducted. Tanganyika Concessions yesterday issued a circular stating that as the company's position was placed fully before the shareholders in May last, the directors propose to hold only a formal meeting this month, and to adjourn it to a date as soon as possible after the general meeting of the Union Minière in July next, when the accounts for eighteen months to Dec. 31, 1922, will be presented.

The Tanganyika Concessions' circular states that the production of copper by the Union Minière for 1922 is estimated to reach about 42,000 tons. In addition, a reverberatory furnace to produce 6,000 to 8,000 tons per annum is being erected, and will be working during 1923. In addition to the above, the tests with the pioneer leaching plant have come up to expectations, and designs are being prepared for the installation of a plant to produce 30,000 tons per annum. This will form the first unit of the large plant which the Union Minière has in view. As regards the Benguella railway, which belongs mainly to Tanganyika Concessions, the working of the line shows good progress, and arrangements have been made to extend it a further 100 km. to Bihe, and negotiations for the completion of the line are proceeding. No details are given of the Nile-Congo Divide Syndi-

cate; all that the report states is that the expectations of the board are justified, and further prospecting is being undertaken.

As the Van Ryn Gold Mines Estate makes up its accounts to June 30, it is possible to gather from the report just issued something of the beneficial effect which has resulted from the settlement of the revolutionary strike early in the year. During three months of the year, operations at the mine were virtually suspended and naturally affected the profit-earning capacity of the company. The result was that working costs on 301,388 tons of ore crushed were 26s. 2d. per ton, as against 25s. 9d. on 381,230 tons milled in the twelve months to June, 1921, and 19s. 6d. on 408,430 tons milled in 1920. The price obtained for the gold varied, with the result that the profit in the latest accounts was only £42,360, in comparison with £112,855 twelve months earlier. Since the end of the financial year, profits for four months reached close upon £39,000, due, of course, to reforms which have resulted in improved efficiency. Within the past couple of months, working costs have fallen to 20s. per ton, which means that the quantity of ore brought within the range of payability has greatly increased. At June 30, 1921, the tonnage at normal price of gold was 864,583; in the present report, owing to reduced expenses and greater efficiency, the quantity is given as 1,234,088 tons. The value on the present occasion is 5.6 dwt. over 47 in., as against 6.1 dwt. over a stoping width of 48 in.

The sand-filling process instituted at the mine has proved very successful, for during the latest period, 217,936 tons were lowered into the mine, enabling 159,562 tons, or 38.02 per cent of the quantity milled, to be reclaimed, whereas in 1921 the quantity lowered was 238,798 tons, allowing 165,781 tons, or 33.31 per cent of the tonnage milled to be reclaimed. In the latest period, a rather larger percentage of waste was sorted out—i.e., 23.49, in comparison with 19.90.

Johannesburg Letter

Gold Production Up; "Premium" Down
—East Coast Native Labor
Restricted

BY JOHN WATSON

Johannesburg, Nov. 14.—The monthly output of gold for October was declared by the Transvaal Chamber of Mines on Nov. 10, as 778,159 oz., having a value of £3,579,531. This is an increase of 31,070 oz. over the quantity for September. The realized price obtained for the gold was 1s. per oz. down; yet, owing to the increased output, the total value shows an increase of £105,567 over the previous month. These results indicate increased efficiency in rock-breaking, underground, which has kept the mills well supplied during the month. Of thirty-eight Rand properties, only three show a decrease. Among the most notable increases are the City Deep, 5,519 oz.; East Rand P. M., 3,660; Randfontein, 2,524; and Modder B, 2,185 oz. The labor returns show 175,129 natives at work on the gold mines, which is an increase of 564 over the number employed in September.

Some consternation has been caused in Johannesburg mercantile circles by the statement that the Union Government has brought pressure to bear, on the Chamber of Mines, to limit the number of East Coast (Portuguese) natives to 350 recruits per week. This is looked upon as putting in the thin end of the wedge, with a view to replacing the East Coast "boys" by those from the Transkei and other parts of British South Africa. The objection by the merchants is due to the fact that the Portuguese native works a fairly long term on the mines and spends most of his money on the Rand; whereas the Transkeian native works a shorter period and sends or takes his earnings to his own territory. This is a question to which there are two sides. It is admitted that the East Coast natives make good mine workers; but the money for recruiting these "boys" and a portion of their wages go to the Portuguese and not to the Union of South Africa.

At the twenty-fifth annual meeting of the New Modderfontein G. M. Co., Ltd., held on Nov. 7 in the Corner House, Johannesburg, Sir Evelyn A. Wallers, the chairman, in the course of his speech, announced that a comprehensive scheme has been adopted for working the lower levels of the mine. It is proposed to sink a circular shaft, in the southwestern part of the property, which should intersect the reef at a depth of about 2,700 ft. At the same time, two inclines will be sunk on the reef from the 14th level. The eastern incline shaft will start from the bottom of the present circular shaft, and the western will continue in the line of No. 2 incline shaft. These will give an early connection with the new shaft where sinking will begin about June next. The estimated cost of the work contemplated is about £300,000; this will be spread over a period of five years.

Montreal Letter

Mining Corporation Makes Progress—
Dome Earned \$2,302,000
During Year

BY ALEXANDER GRAY

Next to Nipissing, the Mining Corporation of Canada, operating in the Cobalt section, as well as in the Northwest, at the Flin Flon, has continued to be one of the largest producers of silver. Usually its reports are distributed through London. It has been ascertained, however, that the 1922 production is about 1,500,000 oz. of silver. The corporation's custom concentrator altogether accounted for about 3,300,000 oz. It is realized that the central Cobalt properties of the corporation are approaching exhaustion, and consequently efforts are being concentrated upon the new properties in South Lorrain, adjoining Coleman Township, in which Cobalt is situated. In South Lorrain some high-grade has been encountered in irregular shoots, generally of small dimensions. These, therefore, are considered to be promising prospects.

A preliminary estimate of Dome Mines operations in 1922, made by the company, presents the following:

Tons milled	367,200
Production	\$4,168,000
Average yield per ton	\$11.35
Operating costs before depletion, depreciation and Dominion income tax	\$1,866,000
Average cost	5.081
Operating profit	2,302,000
Miscellaneous earnings	150,000
Capital expenditure	115,000

The grade of ore was the highest in the history of the company and the per-ton profit was correspondingly so, extensive development keeping the average cost higher than it would be under ordinary circumstances. The main shaft is at 1,634 ft. This enables the management to carry on development work at three new levels below the 10th; these are at 1,300, 1,450 and 1,600 ft. respectively. A crusher station has been cut at the 1,450 level, and a new crusher has been installed; so that ore from the 9th, 10th, 11th, and 12th levels is handled there. The necessary ore-passes and waste-passes have been put through between those levels, and a bin cut below the crusher, with loading hoppers for rapid loading of the skips. During the year a large amount of stoping ground, about 25,000 sq.ft., was cut up and prepared on the 9th level, and the main drifts on the 11th level have been pushed out to the ore zone where diamond drilling indicates stoping ground.

Cloncurry Mines Waits for £90 Copper Market

By Cable from Reuters to
"Engineering and Mining Journal-Press"

Melbourne, Dec. 11.—Chairman Hampden of the Cloncurry Mining Co. does not hold out any hope of a resumption of activity until the price of copper advances £20 per ton above the present quotation, or to around £90.

QUEENSLAND

Mount Morgan Experiences "Hard Sledging" in Spite of Subsidy

Brisbane—Mount Morgan, after its suspension of operations for nearly a year, has now been working for a little over seven months. On the figures of the two experts who had examined the affairs of the company before it closed down last year, it was clear that it could not carry on except at a loss, but it was hoped that, with the aid of the men, and possibly with an improved market that was hoped for, there would be better results than previously, and that some economies might be effected that would eliminate the loss before experienced. There was no hope of a profit, and consequently no expectation of dividends for the shareholders, who have had none of these since March, 1920. There has been no improvement in the copper market, and the "price" of gold has gone down, and it is not surprising that there have of late been rumors that this big concern, despite the bolstering up that it is receiving from the government, in the form of a rebate of railway freights, to prevent a greater reduction of wages than that of from 5 to 8 per cent which was eventually accepted, was being forced to close down again. This rumor has led to the general manager making a statement regarding the present position. The men, it seems, have to a large extent co-operated toward efficiency, and have reduced the cost of production, but notwithstanding the lower wages and the economies that have been effected, the company is still operating at a loss. The manager asks the employees for further co-operation to reduce that loss, and stresses the desire that there should not be in future, as there has hitherto been, a total stoppage of work for twenty-four hours on the occasion of a fatal accident. Recently such a stoppage that was insisted on cost the company £400. In five months the amount deducted by the government railway department in freight rebates to the Mount Morgan company totaled £12,862, and naturally there are public complaints that a rebate of this kind, granted to prevent a reduction in wages to the extent of 20 per cent, which the company asked for, should be made to this company and not to others.

A state mining undertaking that appears to have proved even a greater failure than some of the others in Queensland, both from a financial point of view and from its failure to give any material assistance to the mining industry, is the Irvinebank battery and tin treatment works, in the Herberton district, North Queensland. These works, together with a tramway 20 miles long, connecting Irvinebank with the Cairns-Chillagoe railway at Boonmoo, were bought by the government from the Irvinebank Mining Co. in 1919, and in the following year there was treated thereat for customers working and owning mines in the locality a quantity of ore that produced

250 tons of tin. Last year, however, the low prices ruling for metals caused these miners to hold back their ores, and for the want of supplies the smelters were closed down, although some work was thereafter done in the keeping of the battery going for a time to provide concentrates. During the calendar year the receipts from the works were £16,800 from the sales of metals and stores and the expenditure was £15,355 for salaries, wages, and general expenses, together with £4,797 for the purchase of stores, or a total expenditure of £20,152. The Auditor General, who is an official appointed by Parliament to investigate and report on all revenue and expenditure received and paid by the government, now, however, deals with the accounts for the financial year, bringing them up to the end of June last. For this period the loss was £5,708, including interest, and the accumulated loss from the inception has been £34,659. The assets are valued at £77,439.

ONTARIO

Night Hawk Peninsular Will Offer Public Issue of 300,000 Shares

Cobalt—The Mining Corporation has found a new oreshoot on the Woods vein, not far from the Keeley line. This discovery is several hundred feet from the main workings on the property, and in places the vein is 24 in. wide, and of high-grade ore.

McKinley-Darragh has picked up an extension of No. 7 vein, running 4,000 oz., over a width of 2 in.

Kerr Lake has declared the regular quarterly dividend of 12½c. per share, payable Jan. 15, to holders of record Jan. 2.

The Castle Trethewey has decided on the construction of a small mill, plans for which are being drawn by McIntyre engineers.

Kirkland Lake—Lake Shore is making preparations on the surface for increased milling capacity. A larger compressor and hoist have been installed and new buildings are being constructed. Larger crushers will also be installed at the shaft. The 600 level has been pumped out and the work of sinking to the 800 level will be started immediately.

Wright-Hargreaves directors have declared a dividend of 2½ per cent, payable January 2.

Porcupine—The Night Hawk Peninsular is making a public issue of 300,000 shares, at \$1 par. The company's capital is 5,000,000 shares of \$1 par, of which 4,600,000 shares will have been issued when the present allotment is disposed of. With the proceeds of this issue the company will have approximately \$600,000 in the treasury, which will be used to continue development work and the erection of a 200-ton mill. Ore reserves are estimated at 133,000 tons of \$12 ore, to a depth of only 300 ft. It is stated that development work is placing \$500,000 additional ore in sight each month.

BRITISH COLUMBIA

Jack Paul Company Has Rich Silver Lode

Grand Forks—A California syndicate has taken an option on 100,000 shares of the Jack Paul Mining Co., with a view to introducing more capital into the concern. The company has been operating a property on Rock Creek, a tributary of the Kettle River, during the last summer, and has done about 300 ft. of drifting and raising, in an effort to relocate a lode that had been cut off by a fault. Recently the lode was recovered, and now the company is drifting on an 18-inch lode that assays from 125 to 150 oz. silver, \$3 to \$5 in gold, and 10 per cent of lead.

Prince Rupert—The Esperanza mine is continuing to produce medium-grade ore, running from 30 to 50 oz. of silver per ton. Recently 225 tons was shipped to the Granby smelter. The owners are pushing the Baldy tunnel forward, and expect to strike the high-grade shoot.

Work has been resumed on the Lone Maid group, situated between the Esperanza and Alice Arm, and shipping ore has been struck.

Stewart—Mobile Mines, Ltd., has been organized, with a capital of \$700,000, to take over and operate the Mobile group of seven claims, on Cascade Creek. A camp has been established, and a tunnel has been started.

The Granby company has closed its Swamp Point quartz quarry, on the Portland Canal, as it now is getting all the silica required for fluxing from the siliceous ores of the Premier and Esperanza mines.

Vancouver—In a case dealing with the transfer of shares of the Granby Consolidated Mining Co., which had been purchased at a sheriff's sale. Justice Murphy ordered the Granby company to keep its transfer books in British Columbia, instead of New York.

Trail—It is estimated that a saving in freight rates alone of \$300,000 per annum will be attained by the Consolidated Mining & Smelting Co., on completion of the new concentrator at Kimberly, on which \$1,200,000 is being expended. Approximately 800 men are employed in the mine and the concentrating plant, which will be in operation by early spring; this will release the concentrator at Trail for reduction of the low-grade ores of the Rossland mines, which are now idle.

Greenwood—The Eholt property, which joins the Providence mine, is installing a compressor preparatory to completing the crosscut and raise to the shaft in the upper workings, where much high-grade silver is exposed.

Trail—Ore receipts at the smelter of the Consolidated Mining & Smelting Co. for the first week of Dec. 1 to 7 totaled 5,672 tons; 5,039 tons came from the company's mines. The other lots were: Alamo, Alamo, 43 tons; Bell, Beaverdell, 43; Black Rock, Northport, 45; Knob Hill, Republic, 97; Paradise, Lake Windermere, 38; G. Peterson, Ainsworth, 23; Quilp, Republic, 103; Silversmith, Sandon, 79; Surprise, Republic, 162.

WASHINGTON

Gladstone Will Ship—Queen Property Will Be Sold at Auction

Republic—Recent announcement that the Quilp Mining Co. will extend its shaft to the 900 level, which will mark the greatest depth attained in the camp, is exciting comment. The Quilp is shipping steadily about four cars of gold ore per week.

Northport—The Gladstone Mining Co., operating 20 miles east of here, has encountered a large chimney of ore on the 100 level which shows a width of 25 ft. Contracts for hauling 30 tons per day to the railroad have been entered into with Chris Johnson, and shipments will begin at once.

Deer Trail—The Queen mine will be sold at auction by E. N. Imus, trustee in bankruptcy, on Jan. 6, 1923. The sale will take place in the Old National Bank building, Spokane. The property includes the Silver Queen and Snow-storm claims, a hoist, an engine, cars, rails, and various other equipment. The Queen mine has been explored to only shallow depths and was an important producer of high-grade silver ore, which was shipped crude to the smelter some years ago.

IDAHO

Tamarack & Custer Increases Capitalization and Declares Stock Dividend

Wallace—The close of the year finds the mining situation in the Coeur d'Alene district of Idaho decidedly good. All the large producers are operating at full capacity, metal prices are high, and the shortage of labor is less serious than it has been. The outlook for the winter and for next year is good.

The directors of the Tamarack & Custer Consolidated Mining Co. met at Wallace on Dec. 18. It was decided to increase the capital stock from 2,000,000 to 5,000,000 shares, the par value of the stock to remain \$1, and to declare a stock dividend of 166 per cent. Nearly all of the stock is held by the Day family and their close associates. No reason has been given for this decision, but the supposition is that it is in anticipation of a law placing a federal tax of 25 per cent on surplus cash, of which the Tamarack & Custer is supposed to have a large amount.

The last cash dividend declared by the company was in 1920, when 75,000 was paid. Total dividends to date are \$521,992.

The mine was closed down for about a year and one-half, up to the first of last July. Since then the company has been active, shipments of lead-silver ore and concentrates being estimated at about 1,500 tons per month. Operations will be greatly facilitated upon the completion of a crosscut now being driven from the old Standard-Mammoth mine to a point under the Tamarack shaft, with which it will be connected by raise. This will give the mine a direct outlet on Canyon Creek a short distance above the mill and will eliminate the present rope tramway two miles long across a high divide.

NEVADA

Labor Trouble in Goldfield Settled With 25c. Raise

Tonopah—Bullion shipments, representing clean-up of operations for the last fifteen days of November, were as follows; Tonopah Belmont, \$107,000; Tonopah Extension, \$104,000; West End, \$75,400; Tonopah Mining, \$50,000. Tonopah Extension is now the largest producer in the Tonopah district, with bullion for the month of November valued at \$198,000. Total production for Tonopah for November was \$580,000, and this figure would be greater by about \$50,000 had not the collapse of a large tank in the mill of the Tonopah Mining Co. closed the plant for two weeks.

Divide—November production of the Tonopah Divide mine was 1,650 tons of about \$35 ore. The higher grade of the shipments was due to rich ore in three of the regular stopes. No further news is available regarding conditions on the 1,200 and 1,400 levels. Progress is slow on the 1,400, on account of the heat and an increase in the water flow.

Goldfield—Labor trouble in this district has been settled by compromise, and all employees are to be raised 25c. per day. The men on Nov. 1 demanded the Tonopah scale, and very little work has been accomplished since then. Wages are now \$5 for muckers and helpers and \$5.50 for miners and timbermen, or 25c. below the Tonopah scale.

Candelaria—Mill tonnage is gradually being increased, and at present about 250 tons is being treated daily. Mill operation is satisfactory. The first bullion shipment will be made about Dec. 12, and it is expected will amount to about \$20,000. This shipment necessarily does not represent what has gone into the mill, on account of metal remaining in the mill solutions. December production will likely be in the neighborhood of \$100,000. Mine developments continue satisfactory, and a considerable tonnage of ore of better than \$20 grade is being blocked out. The new electrically-driven compressor plant has been completed and is in operation.

Pioche—The overhauling of the equipment at the Prince mine and the installation of the new machinery are now approaching completion, and the new unit of the power plant is in operation. Actual pumping of the water, which now stands at a depth of 496.5 ft. below the collar of the shaft, will begin by Jan. 1. Development of the mine at depth will follow unwatering.

Developments on the 1,000 level of the Bristol mine has proved shipping ore in good quantity. Crosscutting on the Tempest fissure over a length of 30 ft. has opened up a body of ore more than 6 ft. wide that will average 18 oz. in silver, 2 per cent copper.

Shipments from the Pioche district for the week ended Dec. 7 were: Bullionville tailings, Prince Consolidated Mining Co., 760 tons; Dry Valley tailings, Prince company, 550 tons; Bristol Silver Mines Co., 455 tons; Prince lease, upper levels, 40 tons; Stella mine, Comet, 30 tons; total 1,835 tons.

ARIZONA

Ray Consolidated Is Employing 800 Men; Bunker Hill Lessees, 300

Tombstone—Twenty-eight leasers are now at work at the Bunker Hill Mining Co.'s property and about 300 men are employed. This company is a Phelps Dodge subsidiary and now owns the Tombstone Consolidated mines. Most of the ore is a silver-lead material and is shipped to the El Paso smelter. The company employs about twenty-five men operating a machine shop and a power plant furnishing power and air for the different leasers.

Morenci—Work is about finished on the 700-ton unit of the No. 6 concentrator of the Phelps Dodge Corporation. Much equipment has been added to the mill to carry out plans made from results obtained in an experimental plant. A large part of the flotation plant has been idle for the last eighteen months and considerable repair work has been necessary.

Jerome—Judgment in the case of R. E. Moore against the Arizona Jerome Copper Co. was given the plaintiff after seven days of trial, during which the court and both sides to the litigation visited the property involved and examined the land and location notices. It was found that the company had failed to file the assessment exemption affidavits during 1919, when assessment was not demanded by the government, and that on three remaining claims there had been a change of location.

Ray—There are now about 800 men employed at the Ray Consolidated Copper Co.'s mine at Ray and the mill at Hayden. About eighty men are at work at the Arizona Hercules property at Ray, doing repair work and getting everything ready for a resumption of development. Three trainloads of twenty-eight cars each are now being shipped daily to the mill at Hayden from the Ray mines.

JOPLIN-MIAMI DISTRICT

Jeff City Mine Is Started—Little Martha Mill Burns

Miami—The Little Martha Mining Co.'s mill, at Chitwood, near Joplin, was destroyed by fire on Dec. 7. The mill had not been operated for two years, and insurance of \$25,000 had only recently been allowed to lapse. H. A. Wolcott, of Carthage, Mo., was district manager for company. It is not likely that the plant will be rebuilt.

Operations have been started at the Jeff City mines, east of Picher, after numerous difficulties. The day before the plant was to be reopened after several months' idleness fire destroyed the blacksmith shop, and a week later, when the property was just ready to start again, the transformer house was burned. The field shaft of the property was formerly the mill shaft of the Darling company. This plant was burned about three years ago. Stockholders of the Cortez and Eagle-Picher Lead Co. own the Jeff City, and it will be managed by W. T. Landrum, manager for the Cortez.

MICHIGAN

Some Companies Are Importing Miners—Convicts in State Prison May Make Copper Shingles

By M. W. YOUNGS

Houghton—Some of the mines of the Michigan copper district have started to import miners, and as a result underground forces are gradually being built up. While the net gain is small, it is encouraging. The majority of the men now coming in are from the Dakotas, Minnesota, and other northwest States, a steady, reliable class of labor. The Calumet & Hecla mines are making no particular effort to increase underground forces at this time.

An encouraging development in Arcadian Consolidated is the finding of silver associated with the copper in the south drift at the 1,250 level of the New Baltic shaft. This is the first time silver has been found in Arcadian, and it is considered an excellent indication. It is taken to mean that Arcadian has a "live" vein of great promise. Silver is found associated with copper in all of the producing mines of the district, and annually a considerable amount of this metal is marketed. The south drift in Arcadian continues in rich rock, it being heavily charged with "barrel" copper. The showing is even better than on the level above, where the rich zone was first encountered.

At the Quincy stamp mill a building is under construction to house a 2,000-kw. low-pressure turbine, to supply both mine and mill location with light. Heretofore the company has purchased its electric current. The turbine will be operated by exhaust steam from the stamp heads. A considerable saving in mill costs will be effected by this installation.

In addition to the resumption of sinking in No. 2 Gratiot shaft, Seneca, final preparations for which are now under way, drifting will be started on the 9th level south. Drifting also will proceed on the 11th south and the 13th level north.

There is a possibility that the State of Michigan will give some consideration to the manufacture of copper shingles. The matter has been broached to a member of the Prison Commission, who is much interested and who has promised to take the matter before the board. It is contended that such an industry at the prisons would not interfere with the labor situation in the state and would help one of Michigan's leading industries. Jackson prison makes auto plates for Michigan and several other states as well, and the same presses could be used. The only extra expense for the manufacture of copper shingles would be in the purchase of new dies.

Shaft repairs are still under way at Mayflower-Old Colony, the shaft having been retimbered through a crushed section for about 40 ft. The boiler plant and compressor also are being overhauled. When this work is completed, crosscutting will be resumed on both the 1,400 and 1,700 levels.

THE MARKET REPORT

Daily Prices of Metals

Dec.	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
14	13.875@14.125	36.25@36.50	37.50	7.10	6.90	6.975@7.05
15	14.00@14.125	36.25@36.50	37.50	7.10	6.875@6.90	6.95 @7.05
16	14.25	36.50	37.75	7.10	6.875@6.90	6.95 @7.00
18	14.30	36.75@37½	38.375	7.10@7.25	6.875@6.925	6.95
19	14.375	36.50@37½	38.125	7.25	6.95@7.05	6.95
20	14.4	36.25@36.75	38.00	7.25	7.05	6.95

*These prices correspond to the following quotations for copper delivered: Dec. 14th, 14.125@14.375c.; 15th, 14.25@14.375c.; 16th, 14.50c.; 18th, 14.55c.; 19th, 14.625c.; 20th, 14.65c.

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 quotations are for prompt deliveries. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Federal bureaus in Washington which are interested in the mining industries.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
14	62½	63½	69	176½	177½	26	25½	37½	34½
15	63½	64½	69½	176½	177½	26	25½	37½	34½
18	64½	64½	70	180½	181½	26	25½	37½	34½
19	64	64½	70½	180	181½	25½	25½	37½	34½
20	64½	65½	71½	179	180½	26½	26	37½	34½

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

Dec.	Sterling Exchange "Checks"	Silver			Dec.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
15	4.63½	99½	62½	30½	19	4.62½	99½	62½	30½
16	4.64½	99½	62½	30½	20	4.60	99½	62½	30½

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 one-quarter of a cent premium.

Metal Markets

New York, Dec. 20, 1922

Copper

The advance which began last week has continued, with buying somewhat better than usual, but not at all phenomenal, as higher levels have been quoted. Several reasons may be assigned for the advance. It was probably inspired by the Anaconda-Chile Copper deal, which it was generally thought would lift the low-cost Chile production out of competition. For some time producers in general had been well sold up, so at the first sign of a strengthening in price they preferred to hold a little above the mar-

ket and see if the price would not come up to their quotations. At the same time, the foreign demand improved, sterling underwent a sharp rise, and there was talk of a German loan. All these factors had an influence. At present there seems no indication of a runaway market, and it would not be surprising to see prices fairly stable at near present levels until after the holidays, as business is never active at the Christmas season. It is encouraging to find that competition to sell, and thus depress the price, is not now at all evident, which is a contrast with the condition that has existed for some months. Today, the price generally quoted is 14.75c. delivered, with pro-

ducers willing to accept 14½c. where the delivery charges are not excessive

Foreign demand has been good, but the prices realized have not been quite so favorable as usual compared with domestic business. Competition between American sellers in Europe has been somewhat unbridled.

Lead

On Tuesday, Dec. 19, the American Smelting & Refining Co. advanced its official contract price for lead from 7.10 to 7.25c., New York.

The lead market for the week has not been unusually active, and the advance by the Smelting company yesterday came as a surprise to most followers of the market. The increase in price resulted from strong fundamental conditions; from the continued excellent demand of the paint, cable, battery, and ammunition makers, all of whom are specifying rather more than expected; and from the fact that production has not been stimulated by high prices to the extent that had been hoped. There seems to be sufficient lead to meet the demand at present prices, in all markets. Slight premiums are quoted for spot supplies, with little or no demand.

Zinc

The price of Prime Western grades of zinc has continued the decline of last week. Today the metal is freely offered at 6.95c., East St. Louis, for shipment through February. The premium for prompt shipment has narrowed from 15 to about 5 points, but the bulk of the business has been done in future deliveries. Consumption has fallen off, and several producers have shown little interest in the market, preferring to let others cut their prices and take the sales available. The high-grade zinc market shows no change, the metal still being sold at 7.75@8.25c. per lb. delivered in the East. The demand for high-grade metal is good.

Tin

Demand continues almost non-existent, consumers appearing well supplied with all of the metal they need for present requirements. Prices have, of course, followed London, but have ruled somewhat below parity. Forward deliveries have been quoted at one-fourth cent premium over spot and prompt.

Arrivals of tin, in long tons: Dec. 13th, China, 30; 14th, China, 125; 15th, Australia, 75; 19th, Liverpool, 50; total so far in December, 5,095.

Gold

Gold in London: Dec. 14th, 88s. 10d.; 15th, 88s. 6d.; 18th, 88s. 6d.; 19th, 88s. 9d.; 20th, 89s. 4d.

Foreign Exchange

On Tuesday, Dec. 19, cable quotations on francs were 7.45c.; lire, 5.09c.; marks, 0.015c.; and Canadian dollars, $\frac{3}{4}$ per cent discount.

Silver

New low prices for the year were made on Dec. 15 in both New York and London; in fact the London quotation was the lowest since July 29, 1916, when the figure was 30 $\frac{1}{2}$ d. Today London quotes spot silver at 30 $\frac{1}{2}$ d. and delivery in two months at 30 $\frac{1}{8}$ d. The wide difference between spot and future delivery would indicate a squeeze for immediate delivery. The advance in London has been offset by the recent reaction in sterling exchange, and the market closes uncertain.

Mexican Dollars—Dec. 14th, 48 $\frac{1}{2}$; 15th, 47 $\frac{1}{2}$; 16th, 47 $\frac{1}{2}$; 18th, 47 $\frac{1}{2}$; 19th, 47 $\frac{1}{2}$; 20th, 47 $\frac{1}{2}$.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—General market for 99 per cent grade, 22@23c. per lb. London quotations, £92 10s.

Antimony—Chinese and Japanese brands, 6.35c. W. C. C. 6.75@7.25c. Cookson's "C" grade, spot, 8 $\frac{1}{2}$ @9c. Chinese needle antimony, lump, nominal, 4.50c. per lb. Standard powdered needle antimony (200 mesh), 5 $\frac{1}{2}$ c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb₂O₃, 6.75@7c. Market more active.

Bismuth—\$2.45 per lb. London quotes 10s

Cadmium—\$1.15 per lb. London quotes 4s. 6d. @ 5s. 6d.

Iridium—\$240@275 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market quiet at 32@34c. per lb.

Palladium—\$60 per oz.

Platinum—\$118 per oz.

Quicksilver—\$71@72 per 75-lb. flask. San Francisco wires \$71.30. London, £12.

Selenium—\$2 per lb.

The prices of Cobalt, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Tellurium and Thallium are unchanged from prices given Dec. 2.

Metallic Ores

Chrome Ore—Indian chrome ore, \$18.50 per ton, c.i.f. Atlantic ports. Rhodesian and New Caledonian, \$26 per ton. Market quiet.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, \$5 per long ton; old bed concentrates, 63 per cent, \$5.25; Harmony, cobbled, 63 per cent, \$5.25; new bed low phosphorus, 65 per cent, \$7.50.

Manganese Ore—29c. per long ton unit, seaport, plus duty. Chemical ore, \$75@80 per gross ton.

Molybdenum Ore—70c. per lb. of MoS₂ for 85 per cent MoS₂ concentrates.

Tungsten Ore—Wolframite, \$7.50;

scheelite, \$8.50@8.75 per unit of WO₃, f.o.b. New York.

Iron Ore, Magnetite, Tantalum, Titanium, Uranium, Vanadium, and Zircon ore are unchanged from the quotations published Dec. 2.

Zinc and Lead Ore Markets

Joplin, Mo., Dec. 16—Zinc blende, per ton, high, \$46.95; basis 60 per cent zinc, premium, \$45. Prime Western, \$42.50; fines and slimes, \$41@39; average settling price, all grades of blende, \$44.99. Calamine, basis 40 per cent zinc, \$20@22.

Lead, high, \$95.70; basis 80 per cent lead, \$93; average settling price, all grades of lead, \$89.98 per ton.

Shipments for the week: Blende, 22,181; calamine, 143; lead, 2,214 tons. Value, all ores the week, \$1,200,540.

Of the total blende shipment, 19,941 tons were out of Oklahoma, the ore being moved to escape heavy taxation on Jan. 1. The blende tonnage is the largest ever loaded in one week. The week's value was exceeded but once, and zinc blende was then settled for on an average of \$119 per ton—April 15, 1916.

Platteville, Wis., Dec. 16—Blende, basis 60 per cent zinc, \$45 per ton; lead, basis 80 per cent lead, \$93 per ton. Shipments for the week: Blende, 3,476; lead, 135 tons. Shipments for the year: Blende, 34,487; lead, 1,484 tons. Shipments during the week to separating plants, 648 tons blende.

Non-Metallic Minerals

China Clay (Kaolin)—Crude, \$6@8; washed, \$8@9; powdered, \$12@20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, \$14@20, f.o.b. Virginia points. Imported lump, \$15@22, f.o.b. American ports; powdered, \$40@45, f.o.b., New York. 1A grade, refined, \$14@15 per ton, Delaware. Canadian, in lumps, \$16@18, f.o.b. Quebec points.

Fluorspar—Fluxing gravel, 85 per cent CaF₂, and not over 5 per cent silica, \$21.50, f.o.b. mines; not over 6 per cent silica, \$21; 80 per cent grade, not over 5 per cent silica, \$20; ground acid grade, \$45 in bulk; ground enameling grade, \$35 in bulk; packages, \$4 extra, all f.o.b. mines, Illinois. No. 1 lump, \$30; No. 2, lump, \$25, f.o.b. Illinois mines.

Magnesite—\$15 per ton for crude, \$40 for unground calcined magnesite, f.o.b. California points. Northwest American magnesite industry shut down. Dead-burned magnesite grains, \$43.50 per net ton, f.o.b. Baltimore; \$45, Chester, Pa. Demand increasing for white plastic magnesite.

Mica—Scrap material, \$22 per short ton, New Hampshire points; disk, 15c. per lb.; washer, 8@10c. For other mica quotations see issue of Dec. 2.

Talc—Ground from 150 to 200 mesh, \$6.50@8.50 per ton, bags extra (\$1 for 50-lb. paper bags or 10c. each for burlap bags, 12 to the ton), f.o.b. Vermont. Competition keen. Demand has dropped about 20 per cent lately. For other talc prices see issue of Dec. 2.

Asbestos, Barytes, Bauxite, Chalk, Diatomaceous Earth, Emery, Feldspar, Fuller's Earth, Graphite, Gypsum, Limestone, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur and Tripoli are unchanged from the Dec. 2 prices.

Mineral Products

Arsenious Oxide (white arsenic)—Actual sales averaged about 12.50@13.50c. per lb. Small amounts only available.

Copper Sulphate—Large crystals, 6c. per lb., small crystals, 5.90c.

Potassium Sulphate, and Sodium Sulphate are unchanged from quotations of Dec. 2.

Ferro-Alloys

Ferromanganese—Domestic, 78@82 per cent, \$100 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, \$35, f.o.b. furnace; 16@19 per cent, \$34.

Ferrosilicon—10 to 15 per cent, \$38 @ \$40 per gross ton, f.o.b. works; 50 per cent, \$75@80; 75 per cent, \$115@120.

Ferrotungsten—Domestic, 70@80 per cent W, 85@95c. per lb. of contained W, f.o.b. works.

Ferrocium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferro-uranium, and Ferrovandium are unchanged from the prices published Dec. 2.

Metal Products

Copper Sheets—21.50@21.75c. per lb.; wire, 16.375@16.625c.

Yellow Metal—Dimension sheets, 19.75c. per lb.; rods, 16.75c.

Lead Sheets, Nickel Silver, and Zinc Sheets are unchanged from the prices published Dec. 2.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Magnesite Brick, Magnesite Cement, Silica Brick and Zirkite are unchanged from the Dec. 2 prices.

The Iron Trade

Pittsburgh, Dec. 19, 1922

The steel market presents an appearance of quietness, yet there is really a fair volume of business being placed.

Steel prices are unchanged. Bars, shapes, and plates are showing a slight softening tendency from the asking price of 2.00c., other lines being steady or strong. Some independent tin plate makers are quoting 10c. above the regular \$4.75 price.

Pig Iron—The recent buying movement in foundry iron proves to have been quite large, filling the furnaces fairly well for first quarter, and the \$25, Valley, price has been absolutely withdrawn, the market being squarely up to \$26. Basic showed but little activity and is not very firm at the former price of \$25, Valley. Bessemer is off 50c. to \$27.50.

Connellsville Coke—A widespread demand from the east for coke for domestic use late last week has sent prices up sharply. Spot furnace, \$7.50 @ \$8; spot foundry, \$8@8.50. Furnaces are largely uncovered for first quarter.

A Shortage of Arsenic

Large Amounts of Arsenical Insecticides Used in the South Cause Prices to Advance—Production Insufficient for Requirements—Imports Likely To Be Stimulated

BY FELIX EDGAR WORMSER

Assistant Editor, *Engineering and Mining Journal-Press*

THE arsenic market is enjoying a boom far surpassing the hopes of producers a few months ago. Compared with an average value of white arsenic of slightly over 6c. per lb. for the last twenty years, the price today is over 12c. for future shipments, and spot tonnages command even higher prices. The rise has been particularly rapid since last March, when the product could still be obtained for 7c. per lb. The sudden demand which has arisen is due to the call for calcium arsenate by southern cotton growers, who find that chemical exceedingly useful in combating the ravages of the boll weevil. It has been estimated that in 1921 the destruction attributable to this pest amounted to 6,500,000 bales of cotton, a damage totaling \$600,000,000 in value. This loss is so large that the cotton industry is warranted in making unusual efforts to fight the boll weevil. The improvement in the price of cotton has also stimulated the use of insecticides, for when cotton was low in price many growers were of the opinion that a short crop would aid the market, whether brought about by the decrease in acreage planted or the work of the bugs.

GOVERNMENT INVESTIGATING SHORTAGE

The demand for white arsenic has literally swept producers off their feet. When it first gathered impetus, producers saw an opportunity that does not always present itself, of being able to contract for the disposal of their output many months ahead. They did so regardless of the upward tendency of the market. Stocks that had cluttered warehouses, as well as current production, were sold, so that producers now find themselves without supplies sufficiently large to cater to the still insistent cry for the material. Prices have naturally gone skyward under the influence of the forces of supply and demand, irrespective of the absence of any tariff on arsenic. The shortage is now so acute that the Department of Agriculture called a conference of producers and some chemical manufacturers in New York on Dec. 13 to devise a method of obtaining adequate supplies of the chemical.

The situation is largely out of the hands of producers who obtain white arsenic as a byproduct from the smelting of copper and lead ores, such as arsenopyrite, mispickel and others. Consequently, arsenic production is limited by the output of copper and lead in the United States. A few companies, whose aggregate yield of arsenic will be relatively small, plan to make arsenical chemicals directly from the ores as a major product. By far the largest producers are the American Smelting & Refining Co., at Globe, Colo., and Tacoma, Wash., the Anaconda Copper Mining Co. at Anaconda, Mont., and the U. S. Smelting, Refining & Mining Co. at Midvale, Utah, all three of which manufacture a high-grade white arsenic recovered from the smelter fume in baghouses or by Cottrell precipitators.

One of the early incentives to the production of arsenic in the United States was the elimination of smelter-smoke nuisances, and though this is still a minor reason for maintaining an output, the price of white arsenic is sufficiently attractive to make its production desirable. The capacity of the arsenic-smelting plants in the United States is estimated by the U. S. Geological Survey as 18,300 tons, which can probably be stretched should occasion warrant. According to the same source of information, the output of refined and crude arsenic in this country in 1922 will have amounted to 10,947 tons, so that there is still room for expansion. But just as silver, bismuth, cadmium and other mineral products depend upon the production of the major non-ferrous metals, so does the output of arsenic hinge on a similar productive structure, with an important distinction, how-

ever. Advances in the price of arsenic make it profitable to recover more of the arsenic in the ores treated by the smelters, so that the output of arsenic, even with the present supply of lead and copper ores, is likely to increase provided the price of arsenic stays near its present level.

Prior to the war the production of white arsenic in the United States was about 3,000 tons per annum. During the war the output gradually increased, culminating in a war peak of 6,320 tons in 1918. Since then the production has been 6,029 tons in 1919; 11,502 tons in 1920; 4,786 tons in 1921, and 10,947 tons in 1922. The arsenic of commerce is generally above 99.5 per cent As₂O₃. A high degree of purity is demanded by chemical manufacturers, despite the fact that for some purposes, such as weed killing, it would seem that a grade of lower purity would be equally satisfactory.

Although at the present time miners are not paid for the arsenic content of their ores, and are sometimes penalized for the presence of that element, a continuation of the present price level would encourage the handling of arsenical ores now treated with reluctance. However, the only way to stimulate arsenic production through prospecting and mining is to offer a price inducement for its production. Such a move might have a beneficial result in relieving the present shortage. The satisfactory condition of the lead market and the improved position of the copper market would augur well for an increased production of those metals and a consequent greater supply of white arsenic.

Cotton planters in 1922 are estimated to have consumed about 8,000 tons of calcium arsenate, and the requirements for 1923 are expected to be twice that amount. Should the price of insecticides advance, however, it is conceivable that the consumption of the arsenical chemicals will decrease. Imports of Japanese arsenic have been heavy at times, but the output of Japan depends upon the copper production of that country, and hence is not large. Other countries that send arsenic to the United States are Canada and Mexico, where mining and smelting of arsenical ores should receive a stimulus in present prices. The largest producer in Mexico is the American Metal Co., and the Canadian output comes principally from the cobalt-nickel-silver mines in Ontario. The Deloro Smelting & Refining Co., at Deloro; the Coniagas Reduction Co., at Thorold, and the Ontario Smelters & Refiners, Ltd., at Welland, are the chief producing companies. The Deloro plant includes an insecticide subsidiary.

CALCIUM ARSENATE THE INSECTICIDE LEADER

Although it is the demand for calcium arsenate which is responsible for the rapid increase in the price of white arsenic, the amount of calcium arsenate manufactured ordinarily ranks below that of lead arsenate. The U. S. Geological Survey reports that in 1922 about five times more lead arsenate will have been made than all the other arsenical compounds, which include, besides calcium arsenate, paris green. This situation is likely to be reversed in the next six months, and calcium arsenate is in a fair way to become the chemical leader for 1923.

Although experimentation may evolve other methods of exterminating the boll weevil, it is not likely that the use of calcium arsenate will be quickly supplanted and the market for it affected.

Railroads use arsenical chemicals for killing weeds. Arsenic is also a constituent of some larvicides used in mosquito control. Plate-glass manufacturers are additional consumers of the material.

The arsenic market is in an unusually healthy position.

COMPANY REPORTS

Burma Corporation, Ltd.

Silver, Lead; Burma

The report of Burma Corporation, Ltd., for the year ended Dec. 31, 1921, records an improvement in financial position. The operations are planned on a more modest scale than was originally proposed. The present program is based on an output of 700 tons a day, which may be increased to 1,000 tons without the necessity of raising additional capital.

The labor supply and the transport facilities are the two factors that are at present of most importance. Difficulty has been experienced in obtaining labor, and every encouragement is being given to attract a permanently domiciled labor force. The company has met with considerable success, due to the attention bestowed on housing and living conditions. As regards transport, the company's own narrow-gauge railway can only deal with the 700-ton output, and it is essential, if a larger tonnage is to be handled, that the Burma Railways should extend their line to Namtu.

During the last year the output of the mines did not reach the 700-ton daily output aimed at, but averaged only about 400 tons a day. The output of lead in 1921 was 33,694 tons, as compared with 23,821 tons in 1920, while the silver output was nearly 25 per cent higher. In the following table the output of lead and silver is shown:

BURMA CORPORATION METAL PRODUCTION		
	Refined Lead, Tons	Silver, Oz.
1918.....	18,642	1,970,614
1919.....	18,535	2,164,856
1920.....	23,821	2,869,727
1921.....	33,694	3,540,812
1922, Jan.-March.....	9,469	985,119
1922, April-June.....	9,450	996,842

The operating profit, converted into sterling at an exchange of 1s. 4d., was £497,807, an increase of £42,291 over the corresponding figure for 1920. The net profit was less than in the previous year, partly on account of the payment of debenture interest over twelve months instead of only two during 1920, partly to an increased provision for depreciation, and partly to the allocation of a considerable sum to a reserve fund, for the purpose, amongst other things, of redeeming the debenture loan. The leading items of the profit-and-loss accounts for the last two years follow:

	1921 £	1920 £
Lead and silver sales and on hand.....	1,386,828	1,192,477
Sundry revenue.....	22,972	14,280
	1,409,800	1,206,757
Operating expenditures, including development.....	865,899	731,580
Head office and sundry expenditure.....	46,094	19,661
Surplus.....	497,807	455,516
	1,409,800	1,206,757
Allocations of Surplus		
Interest on debentures.....	77,586	9,645
Depreciation.....	137,019	95,019
Income and super taxes.....	49,103	39,475
Reserve fund.....	66,667	—
Expenses of debenture stock issue.....	—	46,835
Interest and sundry.....	—	17,772
Balances net profit.....	167,432	246,770
Total.....	497,807	455,516

During the current year the operations have been reported quarterly. For the first quarter, the operating profit was £138,353, and for the second quarter £163,573, the increased revenue being due to improved metal prices. The scale of ore production is still a long way short of the 700-ton daily program; during the June quarter, for example, the extraction was 470 tons a day, which, however, was an improvement on the daily average 395 tons during 1921.

The total ore reserves at Jan. 1, 1922, amounted to 4,290,358 tons, averaging 25.1 per cent lead, 17.5 per cent zinc and 23 oz. of silver. Included in this tonnage is 335,681 tons classed as copper ore containing, besides silver-lead and zinc, 11 per cent of copper. The total tonnage is less by 139,100 than was developed on Jan. 1, 1921, development having been carried out on a reduced scale last year.

Owing to difficulties in disposing profitably of the zinc concentrates, due to the high cost of transportation and high returning charges at European spelter works, the production of these concentrates was stopped last November, the effect of which was to increase the recovery of lead and silver in the products sent to the smelter, and thereby to increase the immediate financial return. The proposal to erect zinc works in India was abandoned last year.

The proposal to erect an entirely new lead-smelting works has also been abandoned in favor of remodeling and enlarging the old plant. It is estimated that it will take two years to complete the work.

Colombian Corporation, Ltd.

Gold; Colombia

A report of the operations of the Colombian Corporation, Ltd., for the year ended Dec. 31, 1921, indicates that the authorized and issued capital remains the same as at Dec. 31, 1920—255,000 preference shares of £1 each, of which 5s. per share has been called, and 255,000 ordinary shares of £1 each, fully paid. The balance of the funds necessary for the requirements of the company has been provided, as in the previous year, by increasing the loan on security of the uncalled capital and property.

The directors publish a statement showing the capital and cash position nearly up to date, the figures for 1922 based on field costs to June 30, 1922, and on London costs to Oct. 23, 1922, and naturally, therefore, subject to adjustment.

	ASSETS			As at Oct. 23, 1922		
	As at Dec. 31, 1921			£ s. d.		
Cash at bank and in hand.....	11,789	2	4	21,237	1	8
Gold.....	3,787	17	11	3,787	17	11
Debtors, including expenditure on Dos Bocas road.....	21,958	11	0	22,084	7	8
	37,535	11	3	47,109	7	3

	LIABILITIES					
	£ s. d.			£ s. d.		
Nechi Mines, Ltd.	146,547	4	10	106,270	6	5
Sundry creditors	7,799	13	5	154,346	18	3
Debit balance.....	116,811	7	0	63,092	1	8

	CAPITAL POSITION			£ s. d.		
	£ s. d.			£ s. d.		
Uncalled capital.....	191,250	0	0	95,625	0	0
Less balance above.....	116,811	7	0	63,092	1	8
Remaining capital resources.....	74,438	13	0	32,532	18	4

During the financial year a considerable amount of new development and other work in connection with re-timbering, cleaning out of levels, and ventilating the workings was done at the Constancia mine. In addition to the above, the ditch line for the purpose of providing power was extended 2,452 m., and a further 8,800 m. of the road completed.

Mr. Pritchard reports that a 300-ton mill had been designed with a possible capacity of 450 tons per day, and that with an expected recovery of 85 per cent of the gold value at an operating cost of \$3 per ton the net yield would be £7,800 per month, or £93,600 per annum.

MINING STOCKS

Week Ended Dec. 16, 1922

Stock	Exch.	High	Low	Last	Last Div.	Stock	Exch.	High	Low	Last	Last Div.
COPPER											
Ahmeek.....	Boston	58½	57	58½	Dec. '22, Q \$1.00	Alaska Juneau.....	New York	1½	1	1	
Alaska-Br. Col.....	N. Y. Curb	2	2	2		Atlas.....	Toronto	*12	*8	*11	
Allouez.....	Boston	22	19	22	Mar. '19	Carson Hill.....	Boston	7½	6½	6½	
Anaconda.....	New York	50½	47½	50½	Nov. '20, Q	Creason Consol. G.....	N. Y. Curb	2½	2½	2½	Oct. '22, Q
Arcadian Consol.....	Boston	4	2½	3		Dome Mines.....	New York	43	42½	43	Oct. '22, Q
Ariz. Com'l.....	Boston	8	7½	7½	Oct. '18, Q	Golden Cycle.....	Colo. Springs	*86	*86	*86	June '21, Q
Big Ledge.....	N. Y. Curb	*5	*4	*4		Hollinger Consol.....	N. Y. Curb	*6	*6	*6	Dec. '19,
Bingham Mines.....	Boston	18	17½	18	Sept. '19, Q	Home Stake Mining.....	New York	80½	80½	80½	Nov. '22, M
Calumet & Arizona.....	Boston	57	54	56½	Dec. '22, Q	Keora.....	Toronto	*9½	*8½	*8½	
Calumet & Hecla.....	Boston	290	280	289	Dec. '22, Q	Kirkland Lake.....	Toronto	*41	*40	*40	
C. nada Copper.....	N. Y. Curb	*2	*2	*2		Lake Shore.....	Toronto	2.90	2.84	2.90	Nov. '22, Q
Centennial.....	Boston	8	8	8	Dec. '18, SA	McIntyre-Porcupine.....	Toronto	19.00	18.35	18.45	Sept. '22, K
Cerro de Pasco.....	New York	45½	42½	45½	Mar. '21, Q	Porcupine Crown.....	Toronto	*18	*15	*17	July '17,
Chile Copper.....	New York	28½	26	28½		Portland.....	Colo. Springs	†40	†30	†39	Oct. '20, Q
Chino.....	New York	26½	23½	26½	Sept. '20, Q	Schumacher.....	Toronto	*45	*43	*45	
Copper Range.....	Boston	36½	35½	36½	Mar. '22, Q	Teek Hughes.....	Toronto	*81	*74	*78½	
Crystal Copper.....	Boston Curb	1½	1½	1½		Tom Reed.....	Los Angeles	*77	*70	*70	Dec. '19,
Davis-Daly.....	Boston	3½	2½	3	Mar. '20, Q	United Eastern.....	N. Y. Curb	1½	1½	1½	Oct. '22, Q
East Butte.....	Boston	8½	8	8	Dec. '19, A	Vindicator Consol.....	Colo. Springs	*2	*2	*2	Jan. '20, Q
First National.....	Boston Curb	*46	*40	*42	Feb. '19, SA	Vipond Cons.....	Toronto	*64	*59½	*59½	
Franklin.....	Boston	1½	1	1½		White Caps Mining.....	N. Y. Curb	*11	*11	*11	Oct. '22,
Gadsden Copper.....	N. Y. Curb	*85	*70	*85		Wright-Hargreaves.....	Toronto	3.15	3.03	3.03	Oct. '22,
Granby Consol.....	New York	26	24½	26	May '19, Q	Yukon Gold.....	N. Y. Curb	*76	*76	*76	June '18,
Greene-Cananea.....	New York	26	24½	26	Nov. '20, Q	GOLD AND SILVER					
Hancock.....	Boston	2½	2½	2½		Boston & Montana.....	N. Y. Curb			*5	
Howe Sound.....	N. Y. Curb	36½	32½	36½	Jan. '21, Q	Cons. Virginia.....	San Francisco	*10½	*9½	*10½	
Inspiration Consol.....	New York	4½	4	4½	Oct. '20, Q	Dolores Esperanza.....	N. Y. Curb	*2	*2	*2	Oct. '22
Iron Cap.....	Boston Curb	22	20½	21	Sept. '20, K	El Salvador.....	N. Y. Curb	*2	*2	*2	
Isle Royale.....	Boston	32½	31½	32½	Aug. '22, Q	MacNamara M.&M.....	N. Y. Curb	1½	1½	1½	July '10,
Kennecott.....	New York	32½	31½	32½	Dec. '20, Q	Monopah Belmont.....	N. Y. Curb	*74	*70	*70	May '22, Q
Keweenaw.....	Boston	3	2½	3		Monopah Divide.....	N. Y. Curb	3½	3½	3½	Oct. '22, Q
Lake Copper.....	Boston	1½	1½	1½		Monopah Extension.....	N. Y. Curb	2½	2½	2½	Oct. '22, SA, X
Magma Copper.....	N. Y. Curb	1½	1½	1½	Jan. '19, Q	Monopah Mining.....	N. Y. Curb	1½	1½	1½	Dec. '22, Q
Mason Valley.....	N. Y. Curb	2½	2	2½	Nov. '17, Q	West End Consol.....	N. Y. Curb	1½	1½	1½	
Mass Consolidated.....	Boston	27½	27	27½	Nov. '22, Q	SILVER-LEAD					
Miami Copper.....	New York	2	2	2	Nov. '22, Q	Caledonia.....	N. Y. Curb	*8	*8	*8	Jan. '21, M
Michigan.....	Boston	58	55½	58	Nov. '22, Q	Cardiff M. & M.....	Salt Lake	*37	*35	*35	Dec. '20,
Mohawk.....	Boston	15½	14½	15	June '22, I	Chief Consol.....	Boston Curb	5½	5	5	Nov. '22, Q
Mother Lode Coa.....	N. Y. Curb	16½	15½	16½	Sept. '20, Q	Columbus Rexall.....	Salt Lake	*15	*13	*13	Aug. '22,
Nevada Consol.....	New York	9½	9	9½	Oct. '18, Q	Consul. M. & S.....	Montreal	24½	23½	24½	Oct. '20, Q
New Cornelia.....	Boston	17	16	17	Dec. '18, Q	Eagle & Blue Bell.....	Boston Curb	*13	*12	*13	Nov. '22, K
North Butte.....	Boston	*60	*48	*60		Federal M. & S.....	New York	12	10	10	Jan. '09,
Ohio Copper.....	N. Y. Curb	31	27½	30½	Aug. '22, Q	Federal M. & S. pfd.....	New York	52½	51	51½	Dec. '22, Q
Old Dominion.....	Boston	†165	†155	†165	Oct. '22, Q	Florence Silver.....	Spokane	*37	*36	*37	Apr. '19,
Oceola.....	Boston	33½	31	32½	Mar. '20, Q	Grand Central.....	Salt Lake	†60			Jan. '21, K
Pelpha Dodge.....	Open Mar.	13½	13	13½	Dec. '20, Q	Hecla Mining.....	N. Y. Curb	*81	*71	*71	Sept. '22, Q
Quincy.....	Boston	41	37	40½	Apr. '22, K	Iron Blossom Con.....	N. Y. Curb	*27	*27	*27	Apr. '22, Q
Ray Consolidated.....	New York	8½	7½	8½	Nov. '17, Q	Marsh Mines.....	N. Y. Curb	*7	*5	*7	June '21, I
Ray Hercules.....	N. Y. Curb	*55	*50	*55	Nov. '17, Q	Park City.....	Salt Lake	3½	3½	3½	
Seneca Copper.....	Boston	8	7½	7½	Jan. '20, Q	Prince Consol.....	Salt Lake	*47	*45	*47	Nov. '17,
Shannon.....	Boston	*75	*50	*75		Silversmith.....	Spokane	*33	*30	*30	Oct. '22,
Shattuck Arizona.....	New York	1	1	1		Simon Silver Lead.....	N. Y. Curb	*6	*6	*6	Dec. '15,
South Lake.....	Boston	*60	*47	*60		Stewart Mines.....	N. Y. Curb	31	3	3	Jan. '21, K
Superior & Boston.....	Boston	28	26½	27½	Nov. '22, Q	Tamarack-Custer.....	Spokane	3.02	2.85	2.92	Sept. '22, K
Tenn. C. & C. cfs.....	New York	2	1½	2	Sept. '18,	Tintic Standard.....	Salt Lake	3½	2½	2½	Nov. '20, K
Tuolumne.....	Boston	64½	62	64	Sept. '22, Q	Utah Apex.....	Boston				
United Verde Ex.....	Boston Curb	1	*80	1	Dec. '17,	IRON					
Utah Consol.....	Boston	†11½	†11	†11		Bethlehem Steel "B".....	New York	65	62½	63½	Oct. '22
Utah Copper.....	New York	8	7	8		Chr. Iron.....	Detroit	1½	1½	1½	
Utah Metal & T.....	Boston	1½	1	1½		Char. Iron, pfd.....	Detroit	25½	24½	25½	May '21
Victoria.....	Boston	1½	1	1½		Colorado Fuel & Iron.....	New York	31	30½	31	Nov. '22
Winona.....	Boston	1½	1	1½		Col. Fuel & Iron, pfd.....	New York	105	105	105	Nov. '20
Wolverine.....	Boston	8	7	8		Gt. North'n Iron Ore.....	New York	31	30½	31	Nov. '20
NICKEL-COPPER						Inland Steel.....	N. Y. Curb	43	41½	42	Dec. '22
Internat. Nickel.....	New York	14½	13½	13½	Mar. '19,	Mesabi Iron.....	N. Y. Curb	12½	12½	12½	
Internat. Nickel, pfd.....	New York	70½	65	65½	Nov. '22, Q	Reolize Steel.....	New York	26	23	26	
LEAD						Republic I. & S.....	New York	48	45	47	May '21
Carnegie Lead & Zinc.....	Pittsburgh	4½	4½	4½		Republic I. S., pfd.....	New York	83	84	82	Jan. '22
National Lead.....	New York	129½	121	123	Sept. '22, Q	Sloss-Sheffield S. & I.....	New York	40	40	40	Feb. '21
National Lead, pfd.....	New York	115	114	115	Nov. '22, Q	U. S. Steel.....	New York	108½	102	107	Sept. '22
St. Joseph Lead.....	New York	19½	18½	19½	Sept. '22, Q	U. S. Steel, pfd.....	New York	121	120	121	Nov. '22
ZINC						Virginia I. C. & C.....	New York	55	55	55	Jan. '22
Am. Z. L. & S.....	New York	16½	16	16½	May '20,	Virginia I.C.&C., pfd.....	New York	81	80	80	July '22
Am. Z. L. & S. pfd.....	New York	52	51	52	Nov. '20, Q	VANADIUM					
Butte C. & Z.....	New York	10½	9½	9½	June '18,	Vanadium Corp.....	New York	36	34	35½	Jan. '21, Q
Butte & Superior.....	New York	33	30	32½	Sept. '20,	ASBESTOS					
Callahan Zn-Ld.....	New York	9½	7½	9½	Dec. '20, Q	Asbestos Corp.....	Montreal	66½	66½	66½	Oct. '22, Q
New Jersey Zn.....	N. Y. Curb	172½	168	172½	Nov. '22, Q	Asbestos Corp. pfd.....	Montreal			85	Oct. '22, Q
Yellow Pine.....	Los Angeles			*75	Sept. '20, Q	SULPHUR					
SILVER						Freeport Texas.....	New York	19	18	18	Nov. '19, Q
Batopilas Mining.....	New York	1	1	1	Dec. '07, I	Texas Gulf.....	New York	60	57½	58	Dec. '22, QX
Beaver Consol.....	Toronto	*30	*28½	*28½	May '20, K	MINING, SMELTING AND REFINING					
Coniagas.....	Toronto	1.90	1.90	1.90	May '21, Q	Amer. Metal.....	New York	49½	47½	49½	Dec. '22, Q
Crown Reserve.....	Toronto	*31	*28	*28	Jan. '17,	Amer. Metal pfd.....	New York	111½	110½	111½	Dec. '22, Q
Kerr Lake.....	N. Y. Curb			3	Oct. '22, Q	Amer. Sm. & Ref.....	New York	58½	53	57	Mar. '21, Q
La Rose.....	Toronto	*26	*26	*26	Apr. '22,	Amer. Sm. & Ref. pfd.....	New York	99½	98	98	Dec. '22, Q
McKinley-Dar. Sav.....	Toronto	*22	*20	*20	Oct. '20, Q	Amer. Sm. Sec. pfd. A.....	New York	101½	101	101	Oct. '22, Q
Mining Corp. Can.....	Toronto	*97	*97	*97	Sept. '20, Q	U. S. Sm. R. & M.....	New York	39	38	39	Jan. '21, Q
Nipissing.....	N. Y. Curb	61	5½	5½	Oct. '22, Q, X	U. S. Sm. R. & M. pfd.....	New York	48½	46½	47	Oct. '22, Q
Ontario Silver.....	New York	6½	5	5½	Jan. '19, Q	*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.					
Temiskaming.....	Toronto	*35	*31	*31	Jan. '20, K	Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.					
Trethewey.....	Toronto	5	4	5	Jan. '19,						
Alaska Gold.....	New York	1	1	1							

NEW MACHINERY AND INVENTIONS

Electrically Operated Back-Pressure Valve Arranged for Remote Control

Where exhaust steam is used for heating buildings or for drying or other industrial processes, the back-pressure valve is ordinarily situated at the top of the building, usually on a vertical exhaust riser. In this location the valve is difficult of access, so that there is a tendency for operating men to carry the same back pressure on the engine at all times, regardless of varying needs for exhaust steam or the back pressure really required. Needless back pressure increases the steam consumption of engines or turbines and may result in a considerable waste of fuel. If the back-pressure valve is not only in an inaccessible place, but is also difficult of adjustment, the probability is that unnecessary back pressure will be carried much of the time.

A new form of back-pressure valve has been especially designed for easy regulation. A number of small disks are used, instead of one large disk, and each disk is held to seat by spring pressure, the pressure upon all of the springs being regulated simultaneously by a movable pressure plate, the position of which can be adjusted from outside the valve case. If it is desired to operate the valve from a short distance away, as from the floor above or below, chain and chain wheel or bevel gear and rods can be used.

To regulate the back pressure from a greater distance, an improved electric motor control has been devised. The valve can be elsewhere in the plant, while the remote control panel is placed in the engine room, alongside the back pressure gage. By simply throwing a switch or pushing a button, the operator sets in motion a motor which drives through a worm gear the pressure plate of the valve, the operator meanwhile watching the pressure gage and pulling the switch open when the right pressure is reached, or the operator can stop the pressure plate at any desired point. Over-travel of the pressure plate or injury to the motor is prevented by a limit switch attached to the valve casing. The limit switch interrupts the supply of current to the motor, which can, however, be started again by throwing the control switch in the opposite direction.

The worm wheel is mounted on a sleeve which connects with a hand wheel mounted over a spline on the shaft. The hand wheel shaft is connected to the shaft which drives the valve spindle through a flexible coupling. By loosening a wing nut on the hand wheel, the wheel may be drawn back from engagement with the worm wheel, and the pressure plate can then be lowered or raised manually in case the motor should be out of order or

the current supply should be interrupted. The motion of the pressure plate is limited by stops, so that a predetermined back pressure (which is fixed by the strength of the springs used) cannot be exceeded, and since no part connected with the disks extends outside the casing, there is no possibility of jamming by over-tightening of stuffing boxes, or of over-weighting or tying down.

Two types of remote control switches are supplied. The knife remains in either the closed position or the open position indefinitely. A cylindrical switch is also used, which must be held closed in order to keep the motor in operation and which flies back into neutral position as soon as released. In addition to the indicating and recording gage, which should be placed near to or just above the switch, two pilot lights are used to show when the valve is entirely opened or closed, respectively. This back-pressure valve with remote control is a development of the H. S. B. W.-Cochrane Corporation, Philadelphia, Pa.

INDUSTRIAL NOTES

Ingersoll-Rand Co. and A. S. Cameron Steam Pump Works announce the opening of a branch office at 718 Ellicott Square Building, Buffalo, N. Y. The new office is equipped to render service to those interested in air, gas and ammonia compressors, vacuum pumps, turbo blowers and compressors, condensers oil and gas engines, pneumatic tools, rock drills, centrifugal and direct-acting pumps, and other products manufactured by these companies.

The Department of Commerce announces that reports made to the Bureau of the Census show a decrease in the activities of the establishments engaged primarily in the smelting and refining of copper during 1921, as compared with the year 1919. The total value of products reported amounted to \$234,895,200 in 1921, and to \$651,101,600 in 1919, a decrease of 63.9 per cent. The decrease in production has been accompanied by decreases in the number of persons employed, in the total amount paid during the year in salaries and wages, and in cost of materials.

American Mining Machinery in South Africa

Imports of mining machinery into South Africa in 1921 exceeded those of 1913 by more than 20 per cent and show an appreciable increase over those of the intervening years, says the Industrial Machinery Division of the Department of Commerce. The most notable feature shown by these import statistics is the expansion which has taken place in machinery imported from the United States. Despite the fact that there was a decided drop in imports from the United States in 1920,

as compared with those of 1919, the salient fact is that in 1921 the manufacturers of the United States supplied more than 35 per cent of the mining machinery purchased by the mines of the Union of South Africa, which is more than twice the amount purchased from the United States in 1913.

TRADE CATALOGS

Stokers—The Laclede-Christy Clay Products Co., St. Louis, Mo., has recently issued an 8-page booklet describing Armour & Co.'s experience with Laclede-Christy stokers. The bulletin will be of interest to prospective stoker buyers.

Micarta Gears—The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has issued a 20-p. booklet, Folder 4,506, entitled "Salient Facts on Silent Gears." The booklet describes the advantages of the use of micarta gears and pinions and gives photographs and data describing some of their applications, tables of gear data, and other technical information, enabling the gear user to judge whether or not they are applicable to his machinery.

Oil Engines—The De La Vergne Machine Co., New York, N. Y., has recently issued bulletins Nos. 180 and 181. The former includes a general description of Type SI De La Verne oil engines and outlines the various particulars of the machines. The later is devoted to the details of the vertical Diesel engine of the same type. There are a number of convincing facts contained in these bulletins that should be of particular interest to those who are inclined to doubt that the oil engine is an absolutely dependable unit. When it is realized that in the last twenty years 370,000 hp. of Diesel engines have been installed in this country, and that 360,000 hp. are still in operation, the importance of that type of prime mover becomes evident.

Crushing Machinery—The Smith Engineering Works, Milwaukee, Wis., has recently issued a bulletin, "Mining, Quarry and Gravel Machinery." Some of the interesting features of this book are descriptions of the following: A complete new line of TelSmith primary breakers, with several new sizes. The new model TelSmith breaker includes many improvements over earlier machines. The No. 3 TelSmith reduction crusher is a new size, not described in any previous catalog. The company's line of rotary screens has been redesigned, introducing a renewable steel tracker ring and angle iron frame. Similar changes have been made in the TelSmith heavy-duty washing screen. Sand-settling tanks, are listed, with improved tilting discharge, designed to produce a thoroughly de-watered product. These tanks are guaranteed to be absolutely automatic in operation.