

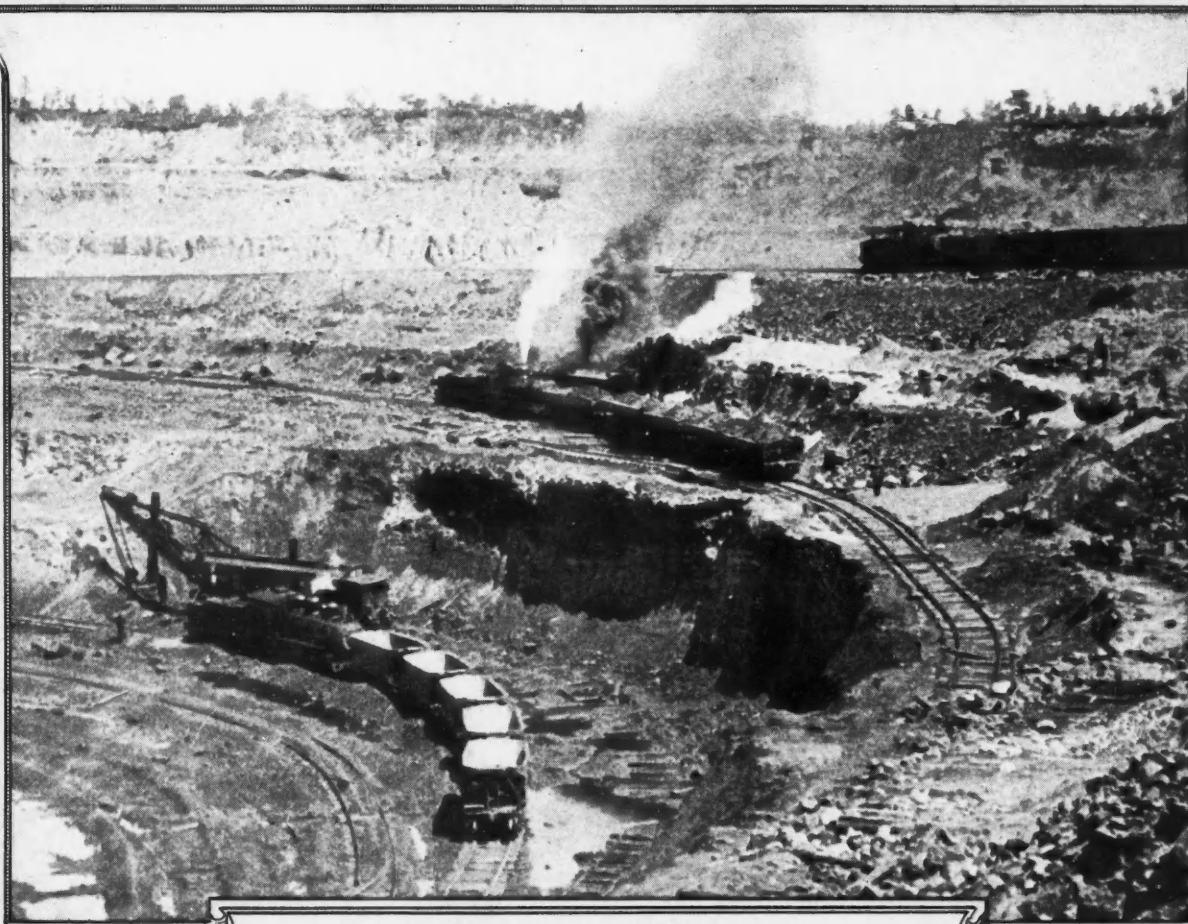
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McGraw-Hill Company, Inc.



Stripping Overburden and Mining Soft Iron Ore  
Mesabi Range in Minnesota—The Greatest Iron Field in the World

## IRON MINING NUMBER

### The Iron Ores of the World

By E. C. Harder and F. T. Eddingfield

### The Lorraine Iron Field and the War

By Lt. Col. Alfred H. Brooks

### Sketch of Benedict Crowell

Mining Engineer and Assistant Secretary of War  
A Specialist on the Lake Superior Iron Ores

May 8, 1920



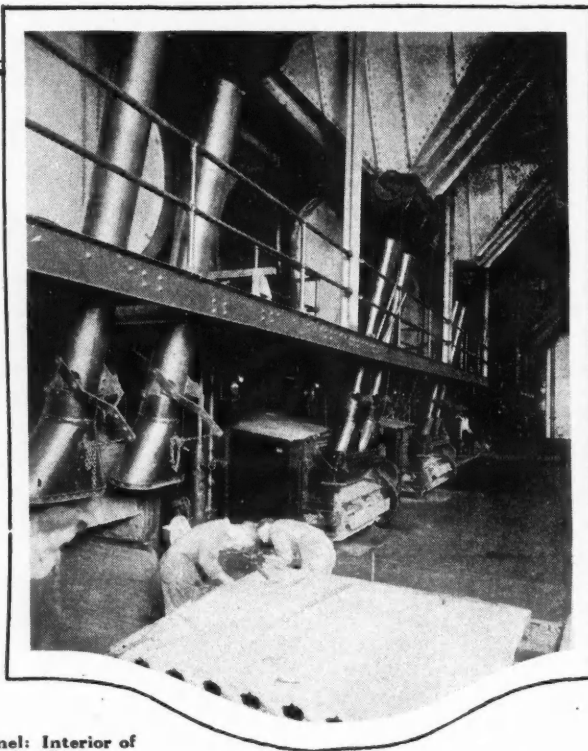
# S-A Coal and Ash Handling Machinery at the Lake View Pumping Station

**E**VERY day in the year the giant engines in the Lake View Pumping Station draw 100 million gallons of water from cribs located miles out in the lake to help supply the city of Chicago with clean, pure lake water.

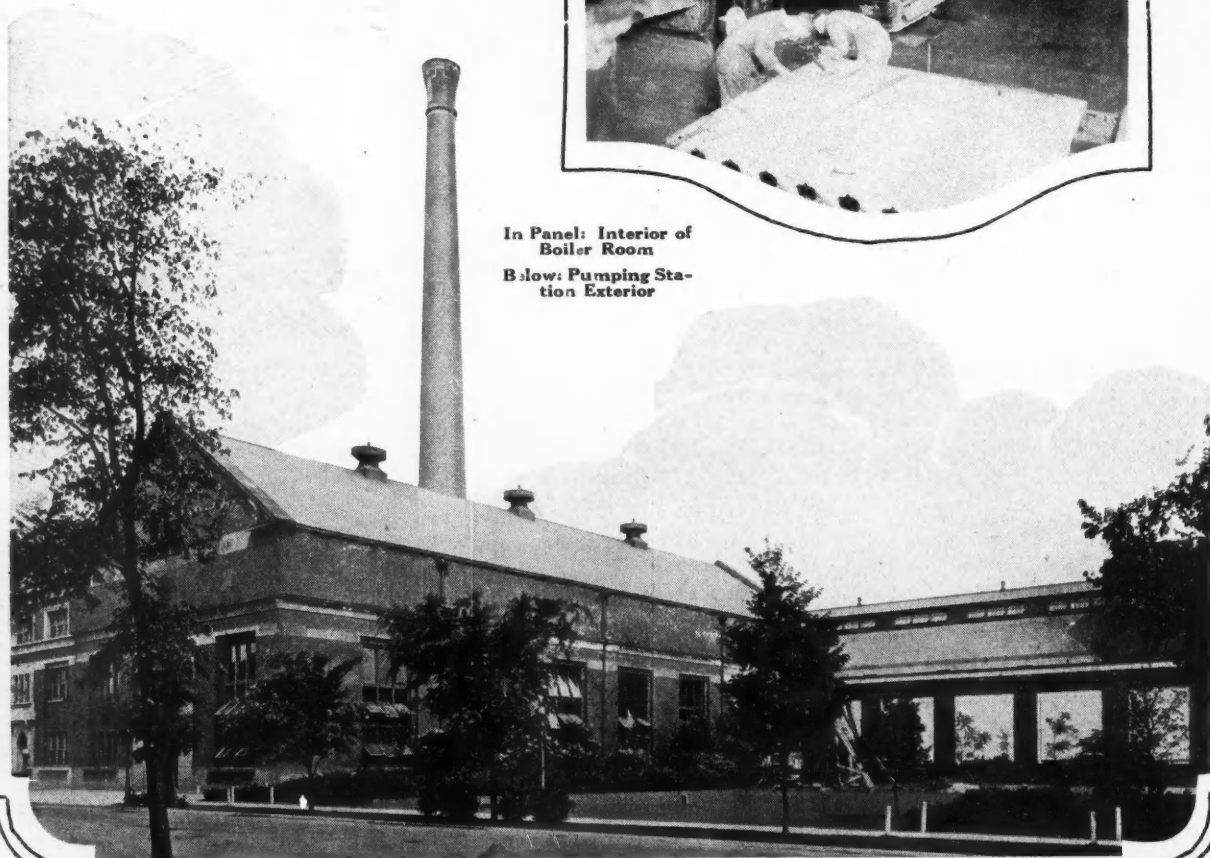
To operate this plant 24 hours a day every day in the year requires equipment that has proven its durability, its dependability and its merit under the most severe operating conditions.

The extensive installation of S-A Equipment in the Lake View Station has played an important part in maintaining the constant high rate of efficiency for which this plant is famous.

**Stephens-Adamson Mfg. Co.**  
Aurora, Illinois



In Panel: Interior of  
Boiler Room  
Below: Pumping Sta-  
tion Exterior



# Engineering and Mining Journal

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*A Weekly Journal of the Mining and Mineral Industries*

METALS

NON-METALS

PETROLEUM

Volume 109

New York, May 8, 1920

Number 19

## The Origin of Iron Ores

IRON is one of the principal elements in the earth's crust: civilization will always have iron and aluminum, among the metals. Only the higher-grade ores will become exhausted, and the practice in the due course of time will deal with ores of less and less iron content. Concentration processes assure an almost indefinitely prolonged supply of ore, after the clean ores have been mined out.

Iron-ore deposits are widespread and are formed in various ways: They are found in sedimentary, igneous, and metamorphic rocks, and are due to all three types of natural processes. More than most of the other metals, however, are important iron concentrations found in sedimentary rocks, under conditions showing that the iron-bearing minerals were deposited with the sediments. The method of precipitation is often very obscure; but in the case of the great Lake Superior ore deposits, it has been established that in part at least they were deposited as green iron silicates, which later decomposed into iron oxide and silica and so formed iron ores and cherty silica. This silicate was discovered and described (in the Mesabi Range) by Spurr in 1894, and was later confirmed by Leith and Van Hise. There is a question as to whether most of the Lake Superior ores may not be assigned to this origin, although the proof in most cases is obscure or wanting. The silicate in question was a chemical precipitate in granular or oölitic form, in marine sediments on the border line between the fragmental deposits of the inshore belt and the calcareous deposits of the ocean bottom remote from the land. In inducing this precipitation, the action of organic matter seems evident.

Certain features of similarity of internal structure and associated rock types between the Lake Superior ores and others not so intensively studied lead to the belief that ore of this origin will be found to be common in the world, and possibly constitute the chief commercial type.

The silicate in the Mesabi ores is a hydrated ferrous or ferro-ferric silicate, of uncertain composition. In Lorraine, Switzerland, and neighboring districts important iron ores consist partly of an iron silicate supposed to be a hydrous silicate of iron and alumina (the iron being ferrous), associated, as on the Mesabi Range, with iron oxides and also having a granular or oölitic structure.

Green iron silicate of this general character is actually forming on the sea bottom in quantity, apparently from the iron in the fine shore-derived silt, under the influence of decaying foraminifera and other organic matter. The zone of its formation is beyond the coarser detrital deposits, and in the outer fringe of all detrital deposits, where only fine muddy particles reach; and this coincides in general with the position of the Mesabi ores, which are above a quartzite and below a shale.

The mineral actually forming in the sea is glauconite, a hydrated silicate of ferric iron and potassium, although some analyses show it as a ferro-ferric silicate. It is found also in the rocks of various geologic ages. Optically, in granular habit occurrence, and in its peculiar mode of decomposition into iron oxide and cherty silica, it seems to be entirely similar to the iron silicate of the Mesabi Range, named by Leith greenalite. The European silicate has been called chamosite, or, when mixed with magnetite, berthierine.

This great class of ore deposits calls for a further broad study and comparison. Prof. F. W. Clarke, in his "Data of Geochemistry," observes: "Whatever the final conclusion may be, it seems clear that glauconite, chamosite, and greenalite, and, possibly, other allied silicates, were all formed by similar reactions, different local conditions having determined which product should appear." Accordingly, they may be conveniently referred to as the glauconite group of iron ores, and the possibility again pointed out that the group may be by far the most important in the world.

## Iron Mining in the United States

THE railroads, canals, and rivers of the United States correspond to the arteries of the human body: the movement of commodities to the blood which courses through the entire system maintains and renews the flesh. Many commodities are transported in this country, but coal and iron ore and the products therefrom constitute a considerable proportion of the whole. Ore and coal, as well as the products of the farm, range, and forest, may be likened to the food that we eat, and the process of manufacture to assimilation.

That industrious compiler of mineral statistics, Ernest F. Burchard, has completed, and the U. S. Geological Survey has just issued, a review of iron ore, pig iron, and steel for 1918. From this we glean the following facts of a quantitative nature, which present an excellent conception of the part played by the iron-mining industry in furnishing its share of the "blood" which nourishes our national body: From 1810 and up to and including 1918, there were produced 1,272,190,019 gross tons of iron ore in the United States. The time interval is 108 years. In 1876, the annual ore production was 5,000,000 gross tons. In 1917, it was 75,288,851 gross tons, the maximum obtained over any other year. In 1854, only 3,000 tons of iron ore was produced in the Lake Superior district; and in 1917, production was 64,437,003 tons.

These are prodigious figures, but it requires a greater stretch of the imagination to picture this mighty stream of ore pouring into the blast furnaces and emerging from our factories as merchant bar, tool steel, structural steel, automobiles, engines, ships, locomotives, cars, and other products too numerous to mention. It

is true, as someone has said, that steel is the backbone of industry. Iron ore is the raw food of the steel industry. Our per-capita consumption of iron ore has risen by rapid stages to over 1,280 lb. in 1910 for every unit of population. It is probably now somewhere near 1,400 lb. When it will reach a maximum, and what that maximum will be, cannot accurately be predicted, but it is on its way.

Let us stop to consider where all this ore comes from. In 1918, there were 458 active iron-ore mines in the United States, and of these over 220 produced more than 50,000 gross tons of iron ore each. A production of 150 tons per day is approximately equal to the last-named figure. A mine producing this amount is too small to be included in the list which Mr. Burchard presents, and yet when a mine of this size is compared with many of our Western metal mines it appears to be of some importance.

Of the 220 iron mines listed, twelve made an annual production of over a 1,000,000 tons of ore. These are the great iron mines of the United States. They are the Hull-Rust, with a production of 5,485,715; the Red Mountain group, producing 2,376,974; the Kerr, producing 2,027,589; the Mahoning, producing 2,924,675; the Canisteo, producing 1,426,465; the Fayal, producing 1,393,589; the Norrie group, producing 1,204,698; the Mesabi Mountain, producing 1,173,311; the Wakefield, producing 1,130,432; the Adams, producing 1,096,466; the Morris, producing 1,044,558, and the Newport and Bonnie, producing 1,002,243 gross tons.

The production figures are for 1918. Of the twelve mines eight are in Minnesota, three in Michigan, and one is in Alabama. Twenty mines produce over 500,000 and less than a 1,000,000 tons per year, or over 1,700 tons per working day.

The prices for iron ores during 1918 were \$2.36 per ton in Alabama, \$3.75 in Michigan, \$3.34 in Minnesota, \$2.43 in Tennessee, and \$3.25 in Wisconsin. On April 28, 1919, the price of Old Range bessemer was \$6.45 (\$7.45); Mesabi bessemer, \$6.20 (\$7.20); Old Range non-bessemer, \$5.70 (\$6.70), and Mesabi non-bessemer, \$5.55 (\$6.55) per gross ton at Lower Lake ports. The current prices are given in the parentheses, and are just a dollar more. Such an advance in price is to be expected, as iron-ore price quotations had to follow prevailing economic tendencies.

Despite the enormous production of the Minnesota and Michigan mines, ore reserves have kept up, and in Minnesota totaled 1,437,737,084 gross tons in 1918, and 203,571,700 gross tons in Michigan in the same year.

Iron-ore imports from Cuba and other foreign sources fell off to a noticeable extent in 1918, and totaled only 787,468 gross tons, valued at \$4.40 per ton. The maximum tonnage imported in any one year was in 1913, when the iron-ore imports reached 2,594,770 gross tons. The war curtailed imports from Cuba. In the future, when shipping becomes stabilized, importations may be expected to increase. The increase in transportation costs in the United States will probably make ocean transportation from Cuba, for example, more advantageous than heretofore.

The future of iron-ore mining, at least for the next decade, and perhaps for the succeeding one, will not be greatly different from what it is now, with the exception that a larger and larger production is to be expected as the industry and the population of the

country increase. Part of this increased production will probably come from Cuba and Brazil, and the proportion of these ores coming into the Eastern ore markets may be expected gradually to increase. Our own merchant marine will directly benefit, and the iron industry as well. The importance of this industry in our national welfare is inestimable, and it is to the interest of our mining engineers and mining men to keep the control which they now have and to extend it as far as possible.

### Iron and Power

IT IS A TRUISM that the power of a country depends to a great degree on its resources of iron and production of steel. The discovery of the Lake Superior iron ores, and especially of the soft ores of the Mesabi Range, in Minnesota, determined the world's center of iron production in that district, and enabled the development of the greatest steel industry in the world and the world's greatest steel company.

The second most productive region in the world—that of Alsace-Lorraine—unfortunately located at the boundary between two races, the Teuton and the Gaul, has been the cause of much bloodshed. It lent strength to Germany's commercial development; in the next stage of the world's history it should lend new power to France.

Commercial competition, the fierce onrush of mechanical civilization, and the crowding of races one against another, is characteristic mainly of the northern half of the world—North America, Europe, and Asia. The dominant centers of iron production and steel manufacture in the first two continents are as outlined above. What of Asia—the country of the great past and the great future? The modern spirit of Asia is in Japan; and Japan is building up an iron and steel industry, not only in Japan but in China, Manchuria, and Korea.

Japan has not enough production of iron ore for this rapidly growing steel industry, and she will have to depend largely on China for her raw material. She may even have to import ore from India, or to look to the Philippine Islands, where there are fairly important deposits, for her supplies. In the commercial arena of the Pacific, Japanese steel products should dominate, and Japan may even possibly find part of her market on our own Western coast. It has been reported, but without confirmation, that the Japanese have bought the important Cerro Mercado deposit, in Durango, Mex.

In North America, fortunately, no international political question is involved in this great iron-mining industry. How different it has been in Europe we have already seen. In Asia, political questions are clearly involved, and statesmen would do well to take the economic necessities into consideration. Japan, China, and the Philippines are involved in this Far Eastern iron and steel problem.

### The Geophone in Mining Operations

AN INTERESTING résumé of the usefulness of the geophone in mining operations is given by Alan Leighton in the March "Reports of Investigations" of the U. S. Bureau of Mines. Mr. Leighton says:

In coal mines it has been determined that the geophones should rest on a solid shelf of coal or on the floor of a niche cut into the coal. The floor of the mine is likely to be covered with dirt, and is very seldom solid enough to

transmit sound well. In metal mines the geophones will, of course, be held against or placed upon the natural rock. If the geophones are held with the hands against the coal, vibrations are set up by the circulation of the blood within the hands that greatly interfere with successful observations. On the other hand, the rock appears to withstand these vibrations, and successful results can be obtained by simply holding the instruments in place upon the rock.

The use of the instrument as a means for checking surveys and connections is novel, and the following account illustrates its application to this purpose:

That the instruments are of practical value in this connection can be seen from the following instances: The Bureau of Mines engineers were present in a metal mine at the time when a drift and a raise had "missed." A few minutes' observation in the drift and of pounding in the raise showed that the raise had gone up past the drift about six feet in from the face and to the right. Observations made from the raise upon the sounds of the drill operating in the drift showed that the raise extended to a point six feet above the drift, and that the drift was in the direction indicated by the first set of observations. A survey showed these conclusions to be correct. Again, observations were made of another raise which was being driven to the side of a drift, six to eight feet from it. Observations were made of the sounds from the drill, and a point located on the side of the drift behind which the drill in the raise was apparently operating. The survey mark was then ascertained to be from two to three feet to the right of this mark. A drill set up and operated into the survey mark did not hole through into the raise. A hole drilled at the point indicated by the geophones reached the raise, and proved the geophones to be correct within a few inches.

Perhaps the most significant use, apart from rescue and similar purposes, is that for locating boreholes driven to connect with underground workings. Where such holes come down in the "solid," considerable expense is often incurred in finding the bore. By means of the geophone its location is easy and the expense for a connection reduced to a minimum. Naturally, it will occur to every metal miner that, in view of the long distances that sound is transmitted in rock, the geophone ought to have some application in determining the position of the diamond drill.

The time-consuming, delicate, and uncertain methods at present available for surveying diamond-drill holes leave much to be desired. The practicability of the geophone for this purpose has not been thoroughly studied. Mr. Leighton says that observations to date have been confined to only two diamond-drill holes, one of which was 1,000 ft. in depth and the other 600 ft. The holes were a quarter of a mile apart, and were vertical, cutting across alternate layers of gneiss and "black rock," pitching at an angle of 45 deg. The sound of the bits could be heard only within a limited area, a circle whose radius was approximately one hundred feet, with its center at the drill. Within such a small area no direction determinations could be made in the usual manner. Mr. Leighton is of the opinion that had the bit drifted the area of audibility would have been directly over the position of the bit and away from the drilling machinery. There are notable cases where the drift of the bit has reached a horizontal distance of as great as 1,500 ft. in a hole several thousand feet deep.

It is quite probable that geophones of greater sensitiveness and of special design will have to be devised for this particular purpose. We hope that this will be done and that the investigation will continue until the practicability of this instrument for the purpose has been proved.

### Concentrating Eastern Mesabi Ores

**I**N AN EDITORIAL which appeared in these columns in our issue of Sept. 13, 1919, we emphasized the fact that the Lake Superior iron ranges had a habit of "coming back," or rejuvenating, in each instance demonstrating that the ore supplies, instead of petering out, gave evidence of greater productivity and longer life. This feature is true, although perhaps in a different degree, of the iron deposits of the Eastern Mesabi Range, which are about to be developed on a large scale by the Mesabi Iron Co., which has recently announced that a contract has been let for the installation of a plant at Babbitt, the company's new townsite, for the treatment of low-grade ores by means of a sintering process.

The enterprise is said to involve an outlay of \$3,000,000 for the establishment of the first unit, and is to be under the direction of W. G. Swart, of Duluth. In addition to the increased ore supply which is made available by the commercial treatment of these low-grade magnetic ores, there is an important factor that has a decided bearing on the iron and steel industry of the United States—a factor which was emphasized during the war when the shortage of low-phosphorus iron ores was particularly noticeable.

Lake Superior iron ores, contrary to opinions held by those unfamiliar with the situation, show a wide range of grade and vary to a great extent in iron, silica, and phosphorus content. It is seldom that any one ore presents an ideal analysis for furnace treatment, and it is often required that several ores from various mines or districts be mixed before the right analysis is reached to insure the proper results in the charge. So it happens that a low-phosphorus ore having a low content in iron may be mixed with a high-iron, high-phosphorus ore to procure the grade required.

Unlike the ores now being extensively mined on the Mesabi, which are chiefly hematites, the formation of the eastern Mesabi magnetites differs in that the latter occur on the surface, which condition eliminates the necessity for the stripping that is required as preliminary to the opening up of the Mesabi open-pit mines; so that, in this particular, the initial mining cost is kept at a comparatively low figure, in fact includes only such expense as is required for the purchase of the equipment necessary for the actual removal of the ore.

In November, 1918, the first commercial shipment, amounting to 1,800 tons of low-phosphorus sinter, was made from the experimental plant of the Mesabi Iron Co., to the Midvale Steel & Ordnance Co., at Coatesville, Pa. The results obtained in the blast-furnace treatment of this sinter were highly successful so much so that an extensive plant is now to continue the work on a large commercial scale. The process, which was devised by the engineers in charge of the work, consists of coarse crushing, fine grinding, concentration, and sintering. An average analysis of the sinter shows 63 per cent iron and .008 per cent phosphorus. Such a product ranks higher than most Lake Superior ores, and, furthermore, owing to its physical properties, lends itself admirably to treatment in the blast furnace. Various estimates that have been made regarding the extent of these magnetic deposits, and the tonnage that may be obtained by the treatment of the ores indicates an immense addition to the iron-ore reserves of the United States. Such an addition, by reason of its low-phosphorus content, should in time make us entirely independent of foreign iron-ore supplies.

## WHAT OTHERS THINK

### The Mexican Peon Problem

The food problem is only one part of the Mexican peon problem. C. A. Grabill, in his interesting article, has endeavored to create interest in bettering the condition of the peon. The problem is much broader than food alone. For a number of years I was a member of the Regular Army and also have been a surgeon at mines in Mexico. In my opinion, food is the least part of the problem. Humans get along and thrive on very little food if the other conditions are right. The frijoles and tortillas are nourishing, and, with a few greens, form an ideal ration for the peon. The excessive spicing of food by the peons is no doubt injurious, but until they observe better sanitary precautions, it is necessary to take measures to prevent intestinal disorders. The principal trouble is not a shortage of food, but spoiled food and whisky. Short rations never hurt anybody. It is adulterated and poisoned food that quickly saps the vitality and undermines the strength.

A few days' sickness from ptomaine will do more damage than starvation for a limited period, other things being equal.

The value of an article such as Mr. Grabill's lies in its humane purpose and the spirit of inquiry that it evolves. Business men have long recognized that workers quickly respond to better environment, and when treated decently and fairly repay such intelligent treatment. I am speaking now of the Mexican. There are some nationals that perhaps respond better to harsh treatment, but I am sure such a procedure is an economic mistake with the Mexican. It is not my purpose to advocate living conditions for the peon on a par with the American standards, but only to mention a few of the causes of inefficiency, apart from food, and suggest the remedy as I go along. The standard of living of the Mexican can be raised a considerable amount without infringing on the alien-American prerogative.

The need of protection from the foreign profiteer in Mexico is understood and need not be discussed. Products such as meat and vegetables I found cheaper in Mexico than in the United States. Housing conditions for the peon leave much to be desired. Show me where and how a man sleeps and I will tell you how much work he can perform. As a medical man it is my opinion that sleep renews the vigor of the body as much as does food. If a man was like a furnace, the stoker idea would go; but the problem is not so simple. In man, nerves as well as mechanics are concerned. The brain is the battery and the nerves and cells are the wires, distributors, and collectors of energy, and constantly demanding restoration. They are not made to run twenty-four hours per day. Water and air are as important as beef and hardtack. If a peon sleeps on a damp floor in one room surrounded by squalling children and with the oxygen excluded, even the cracks in the room stopped up with paper, he gets no rest, and he has carbonic gas asphyxia. Is it any surprise he has lessened vigor and runs down and does a frac-

tion of a man's work? Better housing conditions I would place first, and I would not employ a man who lives in a hole in the wall. You may not take the hole in the wall literally, but I have photos of the habitations of the workers of a mining company in Mexico, and they answer this description. Damp, unsanitary, poorly ventilated shafts and workings, preventable in part, aggravate the tendency of the peon to contract rheumatism.

In mines where humane measures have been put in force the larger output has more than repaid every dollar expended for these measures. The Mexican is not ungrateful, nor is he a hopeless subject for improvement. He knows his friends, and, excluding the accidents caused by whisky, and the turmoil incident to unstable government or revolution in any land, he is not unsafe to have around. My wife and I have traveled in Mexico in revolutionary times, and have never been molested in any way. This is not excusing what has happened to those less fortunate—simply stating facts.

Miner's anæmia is responsible for the weak and feeble workers in Mexico. This is caused by ankylostomiasis, or the hookworm. The Mexican health authorities have worked out a plan for the control of this disease, but they were not always able to obtain the co-operation of the mine owners.

The Mexican miner is more often sick than hungry. You would think that with his mescal and pulque and horse liniment, commonly called whisky, no hookworm could survive, but when a hookworm takes up his residence in the intestinal tract it never lets go so long as the supply of blood holds out. Better working conditions in the mines is the answer to the miners' anæmia. Drainage, sanitary latrines, destruction of the larvæ, washing the hands and feet, disinfection, and medical treatment are indicated. All of these sources of disease of which I speak are entirely preventable.

Miner's phthisis is another common cause of inefficiency among the peon workers, although not so readily recognized. Bad housing conditions aggravate the disease. It is common knowledge that work in some metalliferous mines is provocative of lung affections. This is especially true where there is much siliceous dust. The grit, dust, dirt, and lack of oxygen in the mines and in their habitations make the miners peculiarly susceptible to consumption. All these conditions in turn facilitate the rapid spread of this disease among workers and families.

Pellagra also takes its toll of inefficiency and death. The principal cause of this disease is poisoned food, Maize enters largely into the diet of the Mexican, and the pellagra poison is supposed to develop in damaged or deteriorated corn. The disease is preventable, and can be readily alleviated by treatment. It is probably much more prevalent in Mexico than is supposed. There was apparently no campaign for its eradication in Mexico in the years 1912-13, when I was there.

The inefficiency caused by malaria is preventable by better housing and sanitary conditions, as also the

venereal menace, by better attention to the welfare of the worker. It used to be thought that what a worker did after working hours was no concern of the employer. This is a false economic doctrine. The worker and many of his interests, in my opinion, are bound up in the prosperity of his company, and all that goes to make him happier and more contented increases the prosperity of the industry. G. F. CAMPBELL, M. D.  
Pala, Cal., March 27, 1920.

**The World's Shaft-Sinking Record**

I note in your issue of March 13, 1920, p. 670, that the Van Dyke Copper Co., of Miami, Ariz., is credited with having beaten the world's record for shaft sinking, with a distance of 308 ft. in 31 days, the total depth reached being 1,063 ft. It was stated in the article that the previous record had been held by the Crown Mines of Johannesburg, at 279 ft. in 31 days.

In order to keep the published records of this interesting and stimulating rivalry correct, I would point out that the Crown Mines had already beaten the record quoted in your paper by sinking a distance of 310 ft. in July, 1919, reaching a total depth of 2,323 ft. The Van Dyke Copper Co. will have to do a little better if it wishes to hold the palm even for a brief period.

London, March 31, 1920. HUGH F. MARRIOTT.

**The Water-Blast in South African Mines**

Having noted in the *Engineering and Mining Journal* of Dec, 27 mention of the Robertson & Moss water-blast in the article on phthisis prevention, we have considered it likely that you would be interested in more complete details and are sending you a blueprint showing the design, and a photograph taken underground at



WATER-BLAST AT SIMMER & JACK MINES, SOUTH AFRICA

the Simmer & Jack Proprietary Mines, Ltd., giving an idea of the general appearance.

The blast is primarily intended for use in winzing, as it uses only 13 gal. of water; thus, no trouble is experienced from flooding when work is resumed, nor is there excess of water to be pumped to surface. The tank, which is preferably made from a 3-ft. length of 12-in. piping with dished plates riveted in the ends, may be placed in the drive, out of harm's way, as it has been found that the blast will operate efficiently with a 500-ft. length of 1-in piping. The method of procedure is as follows: The miner when going on shift fills the tank with water. After he has lit up for blasting, he turns the valve controlling the air pipe, which is required by law to be led down the winze for dispersing fumes.

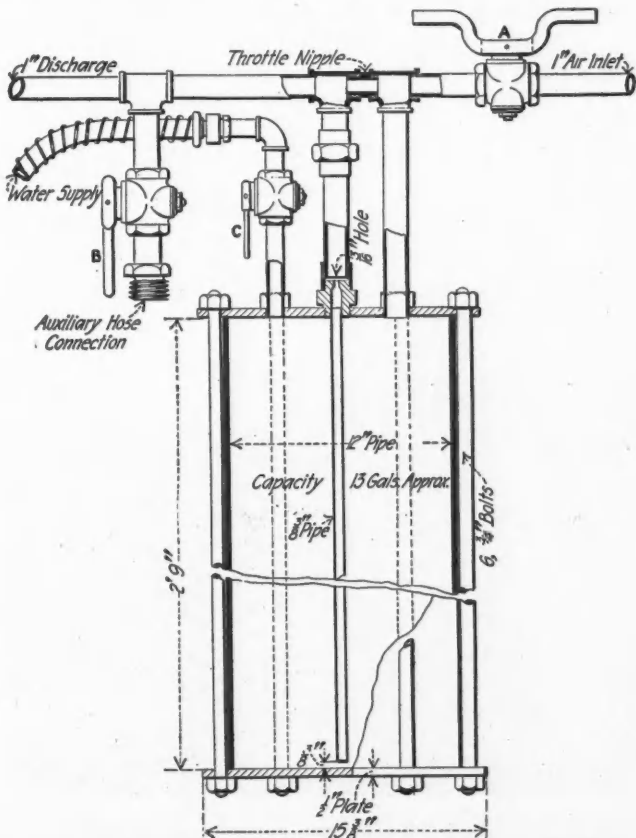
This pipe extends to within 50 ft. of the face and is the only part of the contrivance exposed to the blast. The valve admits compressed air, which by means of the injector and ejector action, easily understood from the print, atomizes the water and delivers it at the bottom of the winze.

It has been found that the blast works satisfactorily with air pressures varying from 80 to 20 lb. per sq.in., and, owing to the restriction of the air passages at the tank, a saving of air is also effected.

A number of mines are now using this blast on the Witwatersrand, and report favorably on its operation. As we have only patented this device in South Africa, we can lay no claim to royalties on its use in America, and we shall be very glad if any mine to which it would be of service will adopt it with our best wishes.

ROBERTSON & MOSS.

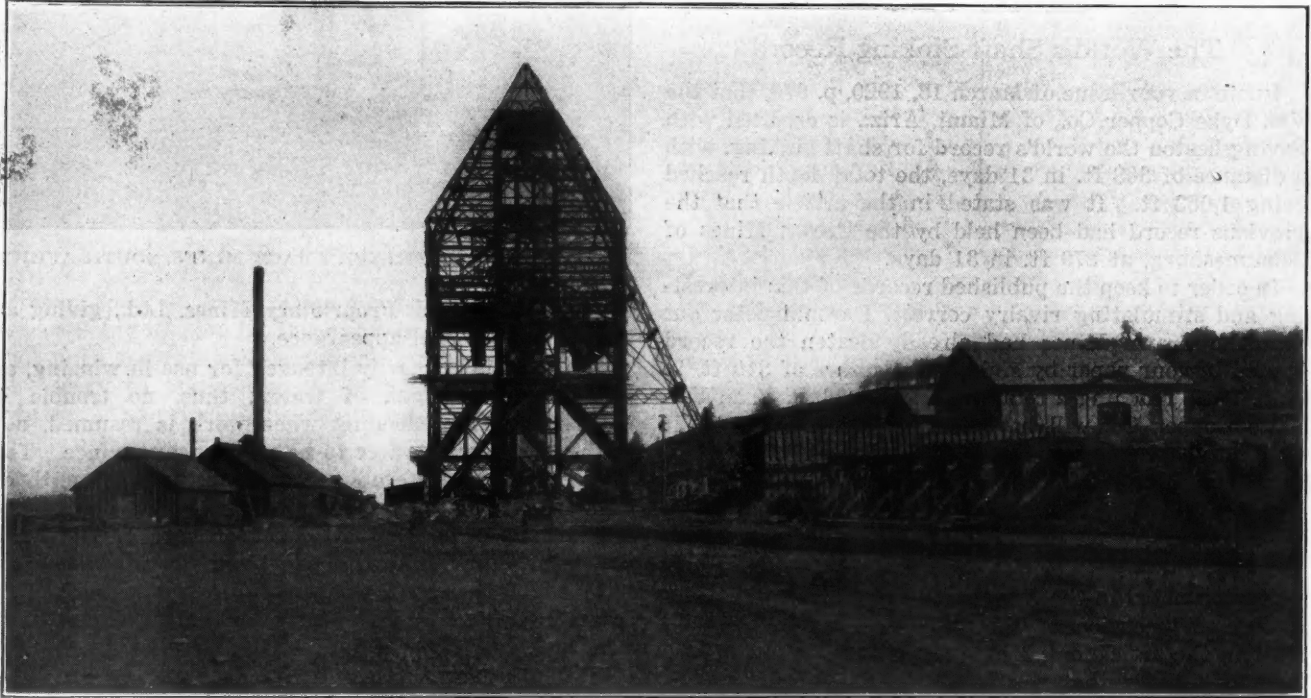
Johannesburg, South Africa, March 8, 1920.



DETAILS OF ROBERTSON & MOSS WATER-BLAST

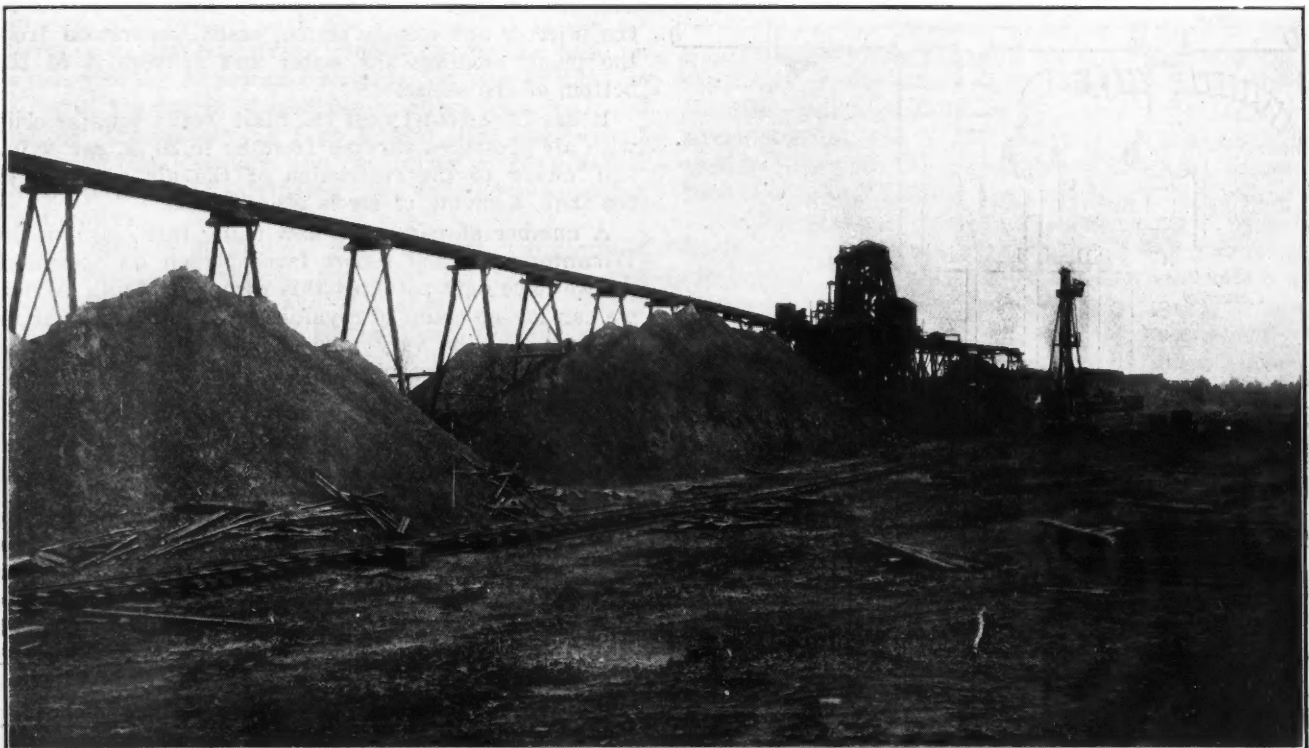
A few years ago a New York investor wrote the postmaster at Searchlight, Nev., concerning the prospects for return for money put into a property at that point. The postmaster solemnly returned answer to this effect: "Ordinarily, a mine is a hole in the ground. Your mine isn't even that. After its promoters had got all the money they could out of Eastern stock sales, they got some more by selling the shaft timbering. The shaft caved in. I wouldn't advise digging it out, for the mine never had any ore. I never like to knock a local property. Guess that, outside of the features noted, it's a pretty good mine."

## Headframes and Surface Structures on the Marquette Iron Range



HEADFRAME AT THE HOLMES MINE, IN THE ISHPEMING DISTRICT

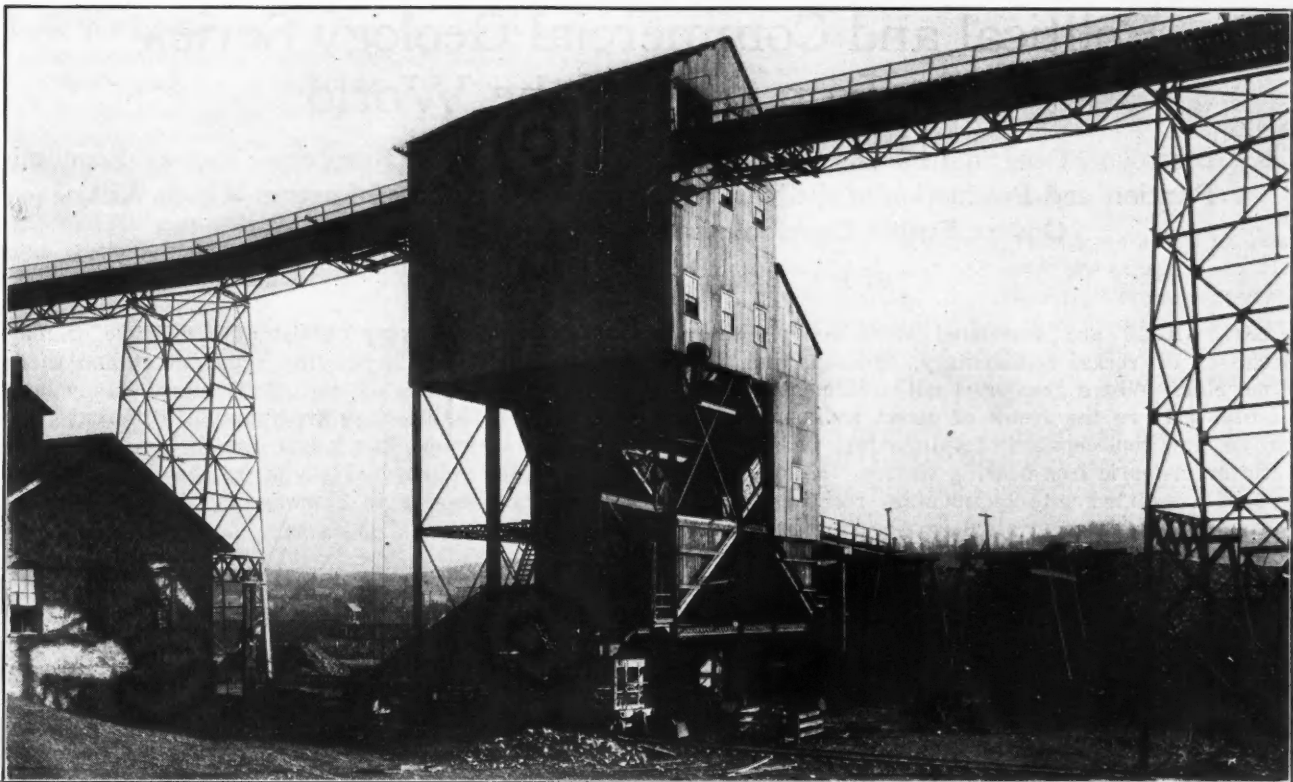
The illustration shows a type of all-steel headframe which has largely replaced the earlier types of wooden construction. Foreground shows space leveled off for stockpiling purposes during the winter season, when ore shipping is suspended.



THE PRINCETON NO. 2 SHAFT, IN THE GWINN DISTRICT

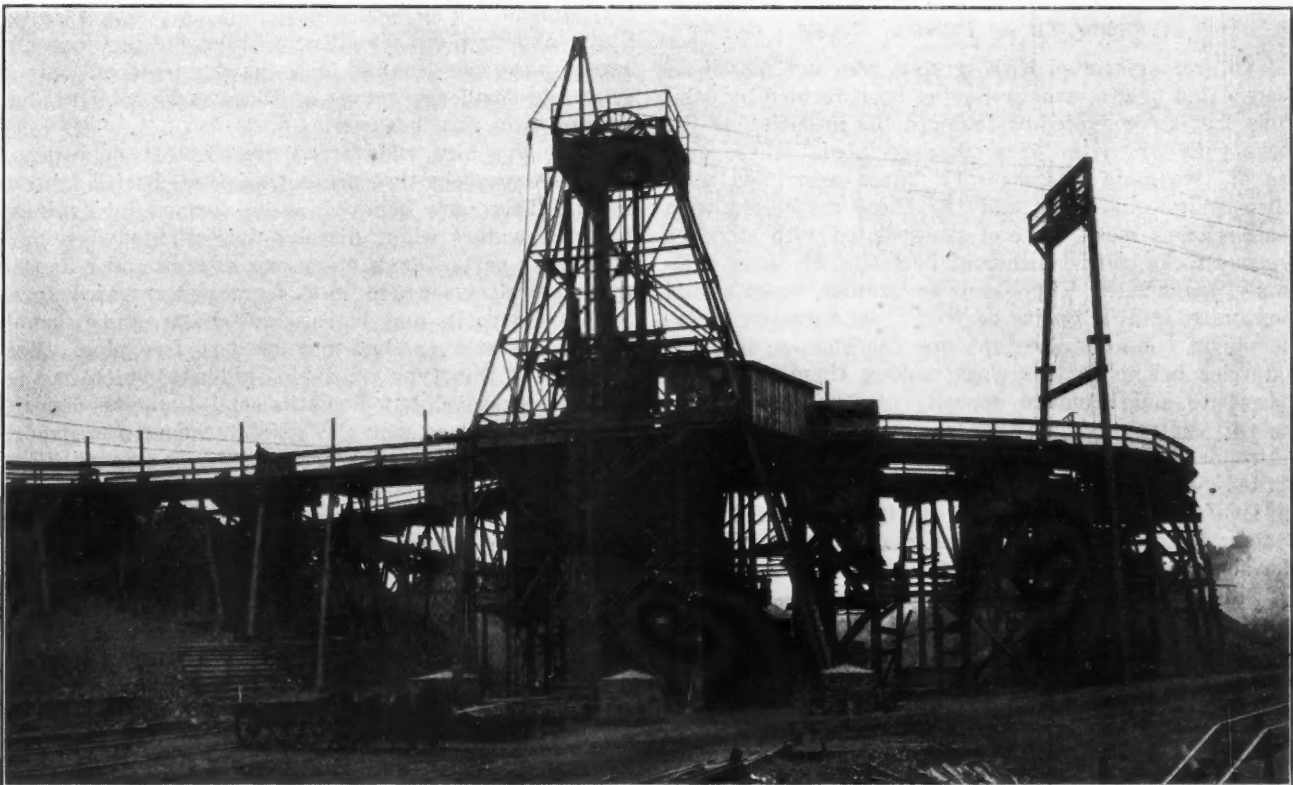
One of the older types of wooden headframes is shown. At the left is the stockpile, with the temporary loading track in the foreground.





CRUSHER BUILDING AT CLIFFS SHAFT MINE, ISHPERING, MICH.

Ore from this property is mined by open-stope and room-and-pillar methods, and consists principally of hard, red, non-bessemer, specular hematite, much of which requires crushing previous to shipment. To date this property has been the heaviest shipper of the Cleveland-Cliffs Iron Co. mines, having produced almost thirty million tons. Part of the ore is trammed, after hoisting, to the crusher building and after being reduced to the proper size is shipped direct or placed on the stockpile.



STEEL HEADFRAME AT THE STEPHENSON MINE IN THE GWINN DISTRICT

The Stephenson mine, also a Cleveland-Cliffs Iron Co. property, uses the caving system of mining. Two trestles extend from the headframe, one of which is used for the stockpiling of ore, and the other serves as a dump for material of lower grade which is not shipped. Stockpiling at most Michigan iron mines is done by means of motor haulage, although endless haulage systems are used to some extent.

# Political and Commercial Geology Series

## The Iron Ores of the World

The Occurrence, Geographical Distribution, and Importance of the Respective Types—Economic Position and Production of the Various Countries—Influential Factors Which Will Govern Future Developments in the Iron and Steel Industry

BY E. C. HARDER AND F. T. EDDINGFIELD\*

**I**RON ORES are associated with many different classes of rocks, sedimentary, igneous, and metamorphic. Where associated with sedimentary rocks, the ores may be the result of direct sedimentation or may be later replacements of sedimentary beds by magmatic or meteoric iron-bearing waters. Many iron-ore deposits associated with sedimentary rocks are formed by the enrichment of original iron-bearing beds, either by solution and transportation of iron compounds, or by the removal of other associated mineral constituents.

Among those important iron-ore deposits of sedimentary origin that have experienced little or no further enrichment since deposition, except perhaps directly at the surface, are the iron ores of the Clinton type of the Eastern United States, the Wabana iron ores of Newfoundland, the minette ores of the Lorraine district in northern France, Luxemburg, and southern Germany, the oölitic siderite beds of the Cleveland district in northern England, and the hematite ores of Minas Geraes, in Brazil. The most important of the sedimentary iron ores that are the result of further enrichment since deposition are those of the Lake Superior district, in the United States.

### OCCURRENCE OF IGNEOUS ROCKS

Iron ores associated with igneous rock are mostly of deep-seated origin, usually having been formed by solutions that accompanied or followed the intrusion of the rocks with which the ores are associated. These ores are of two main classes: (1) Those associated with siliceous igneous rocks, and (2) those associated with basic igneous rocks. The ores associated with siliceous igneous rocks consist either of hematite, or, more commonly, magnetite. They occur in granite, syenite, and monzonite, and in gneiss derived from these by metamorphism. Many important ore deposits in different countries belong to this class, among them being the magnetite and hematite deposits of Swedish Lapland and of central Sweden, the magnetite bodies of the Adirondacks and northern New Jersey, in the Eastern United States; various magnetite and hematite bodies in California and elsewhere in the Western United States; the mixed hematite and magnetite deposits of the south coast of Cuba; most of the iron-ore bodies of Chile; and the newly developed iron ores of Manchuria. As a class, the iron ores associated with siliceous igneous rocks rank next in importance to iron ores of sedimentary origin.

Iron-ore deposits associated with basic igneous rocks are nearly all of a distinct type, known as titaniferous

magnetites. These ores consist of a mixture of magnetite and ilmenite in varying proportions, and therefore carry a variable amount of titanium. Many large ore deposits of this class are found in different parts of the world, among the larger ones being certain ore-bodies in the Adirondack region in the United States, and several deposits in Norway and in northern and southern Sweden.

### OCCURRENCE OF IGNEOUS CONTACT ORES

An important group of iron-ore deposits results from mineral replacement along the contact of sedimentary rocks with igneous intrusives. These ores usually occur in limestones not far from intrusive masses of granite, monzonite, syenite, or diorite, but they may be found within the igneous rocks themselves near the contact. They are rarely associated with the more basic igneous rocks. These ores are known as igneous contact ores, and their origin is ascribed to iron-bearing solutions that accompanied or followed the intrusion of the igneous rocks with which the ores are associated. Such ores are extremely widespread, occurring in practically every continent. Locally, extensive deposits exist, as in the Cornwall district of Pennsylvania, in Western United States and British Columbia, in Chile, and in China and Japan. Igneous contact ores have furnished only a relatively small percentage of the world's total production of iron ore, however.

There are also widespread replacement deposits in sedimentary rocks that are not associated with igneous rocks. These are believed to be formed by ordinary meteoric waters which dissolve disseminated iron minerals from certain beds or masses of rock and redeposit the minerals elsewhere in a more concentrated form. Such ore deposits may be roughly tabular, and resemble bedded deposits, or they may be very irregular. Most deposits of this type consist of siderite which has replaced limestone, but hematite and limonite deposits formed by replacement also exist. Among the important deposits of this group are the siderite ores of Bilbao, Spain, largely altered to limonite near the surface; the siderite ore of Eisemerz, Styria, and the hematite deposits near Hartville, Wyo. Small deposits of siderite, hematite, and limonite of this type are found in many parts of the world.

Besides the class of iron ores already mentioned, widely distributed iron ores occur as residual products derived from the weathering of either igneous or sedimentary rocks. These ores have been formed by the concentration of iron-bearing materials originally disseminated through the rocks, whose weathered products they now constitute. They are mainly in the form of limonite, and occur either as large bodies of relatively pure ore or as aggregates of irregular masses of various sizes imbedded in clays. To this class belong the brown iron ores associated with clay in the Appalachian region

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of the United States, the limonite ores of parts of Russia, and similar ores in Korea. In this class should also be included the extensive limonite deposits derived from the weathering of serpentine which have recently been developed along the north coast of Cuba, as well as the lateritic iron-ore deposits found in many tropical countries. Limonite ores associated with clays have been smelted since early ages, owing to their accessibility and the ease with which they could be smelted by crude methods. They have, however, furnished a decidedly minor percentage of the world's production of iron ore.

GEOGRAPHIC DISTRIBUTION OF IRON ORES OF THE WORLD

The iron ore consumed by the world has been obtained principally from the four great iron-producing countries—the United States, Germany, France, and Great Britain. Other countries that yield important quantities of iron ore are, in the order of their importance, Spain, Russia, Sweden, Luxemburg, Austria-Hungary, Cuba, Newfoundland, and Algeria. The normal annual output in each one of these countries is more than one million tons. Minor amounts of iron ore are produced in many other countries, but the total is, by comparison of those mentioned, insignificant.

More than one-third of the total annual output of iron ore in the world has come from the United States; and of the American production about 85 per cent is generally produced in the Lake Superior district. This district is, therefore, by far the most important iron-ore district in the world, producing annually more than 30 per cent of the world's total of iron ore.

Germany and France have been next in importance to the United States as iron-ore producing countries, about 80 per cent of the ore mined in these two countries being obtained from the Lorraine iron fields situated on the border. The annual output of these fields, which include also the ores of Luxemburg, has been about 25 per cent of the world's production. The Lorraine district of Europe and the Lake Superior district of the United States together, therefore, produce somewhat more than one-half of the total iron ore annually mined.

The iron ore produced in Great Britain is obtained mainly from the Cleveland district of northern England, this region furnishing about 40 per cent of the British total, equivalent to about 2.6 per cent of the world's annual production. In comparison, the Birmingham district of Alabama and the Krivoi-Rog district of southern Russia, which are next in importance to the Lorraine and Lake Superior districts, furnish about 3.5 per cent and 3.2 per cent, respectively, of the world's annual output.

POSITION OF LEADING COMMERCIAL NATIONS IN IRON PRODUCTION

The world's chief iron- and steel-producing countries are, in the order of their importance, the United States, Germany, Great Britain, France, Russia, Austria-Hungary, and Belgium. The annual pig-iron production of these countries ranged in 1913 from 2,300,000 tons in Belgium to 30,900,000 tons in the United States. The normal consumption of iron ore by these countries in the last years preceding the war and their recent maximum annual production are given in the table at the top of the following column.

NORMAL CONSUMPTION OF IRON ORE BY CHIEF IRON- AND STEEL-MAKING COUNTRIES

Countries	Consumption, Long Tons	Production, Long Tons
United States	62,000,000	75,288,851
Germany	40,600,000	(a) 33,987,112
Great Britain	19,000,000	15,997,328
France	12,300,000	21,572,835
Russia	8,900,000	9,362,746
Belgium	6,800,000	164,734
Austria-Hungary	5,200,000	5,233,055

(a) Includes production of Luxemburg.

The consumption figures represent metallic iron consumed in terms of iron ore, and are obtained on the basis of production and imports of iron ore and imports of pig iron and crude-iron and steel products. Exports of iron ore, pig iron, and crude-iron and steel products are not considered as forming part of the countries' consumption.

A comparison of the consumption and production indicates that the United States, France, Russia, and Austria-Hungary are self-supporting as far as raw materials for their iron and steel industry are concerned. Great Britain and Germany are dependent for a small percentage of their requirements upon foreign countries. Belgium produces a small percentage of her consumption of iron ore, being practically entirely dependent upon foreign sources, mainly France and Germany, for her iron-ore requirements.

In several countries that produce much iron ore the iron and steel industry is still in its infancy. The iron ore from these countries is nearly all exported to the large iron- and steel-making countries. The following table shows the recent maximum annual production and normal annual consumption in some of these:

MAXIMUM ANNUAL OUTPUT AND NORMAL CONSUMPTION OF IRON ORE IN SEVERAL COUNTRIES

Countries	Consumption, Long Tons	Production, Long Tons
Spain	1,000,000	9,705,963
Sweden	700,000	6,878,318
Cuba		1,585,431
Newfoundland		1,433,858
North Africa		1,349,000

Thus, considerable quantities of iron ore are available from these countries for consumption in other countries that have to import ore.

There is shown below the pig-iron and steel production in 1913 of the world's principal iron- and steel-manufacturing countries:

PIG-IRON AND STEEL OUTPUT OF THE CHIEF PRODUCING COUNTRIES IN 1913

Countries	Pig Iron, Long Tons	Steel, Long Tons
United States	30,966,152	31,300,874
Germany	19,004,022	18,659,000
Great Britain	10,481,917	7,664,000
France	5,227,378	4,349,000
Russia	4,474,757	4,750,000
Austria-Hungary	2,335,170	2,641,000
Belgium	2,318,767	2,475,000
Canada	1,015,118	1,044,000
Sweden	728,103	574,000
Spain	418,061	359,000
Italy	420,011	897,000
Japan	236,491	251,000

*United States*—The United States has for many years had in the Lake Superior district the chief iron-ore producing fields in the world. In recent years the Lake Superior district has furnished more than one-third of the world's output of iron ore. In 1917, 75,288,851 gross tons of iron ore, 38,647,397 gross tons of pig iron, and 45,060,607 gross tons of steel were produced in the United States, as compared with 61,980,437 tons of iron ore, 30,966,152 tons of pig iron, and 31,300,874 tons of steel in 1913. The imports of iron ore in 1917 amounted to 971,663 tons and of crude forms of iron and steel to 306,189 tons, as compared with 2,594,770

tons of iron ore and 250,592 tons of crude iron and steel products in 1913. The exports of iron ore from the United States in 1917 amounted to 1,132,313 tons and of crude forms of iron and steel to 4,744,527 tons, as compared with 1,042,151 tons of iron ore and 1,278,131 tons of crude forms of iron and steel exported in 1913.

These figures indicate that in normal times the United States consumes about 85 per cent of the domestic output of iron ore in the manufacture of finished iron and steel products. Fifteen per cent is exported either as iron ore or as crude iron and steel products, which are manufactured into finished products in other countries. Of the finished iron and steel products made in this country the United States itself consumes the larger part. However, large quantities of iron and steel articles and machinery are exported to other countries.

The iron ore exported from this country is mainly Lake ore, which goes to Canadian furnaces. The iron ore imported is largely Cuban ore, which is used at the Sparrows Point plant of the Bethlehem Steel Corporation. This plant has facilities for using only ore arriving by boat, and has been running almost entirely on foreign ores. The Cuban iron mines are largely under the control of this company, and an increased production is expected from them in the future.

The Bethlehem Steel Corporation has also developed an extensive iron-ore deposit in Chile, from which some shipments were made during the first years of the World War. It has been allowed to remain idle recently, on account of lack of shipping facilities. Large shipments are expected from Chile in the future.

A considerable amount of Swedish ore has been imported in recent years by the Bethlehem Steel Corporation to supplement its shipments of Cuban ore. During the war, however, the Trafikaktiebolaget Grängesberg Oxelosund decreased its ore shipments and finally refused altogether to export ore to the United States. These shipments were resumed soon after the cessation of hostilities in Europe.

#### SHORTAGE OF LOW-PHOSPHORUS IRON ORES

Certain high-grade low-phosphorus iron ores which are not present in the United States in sufficient quantity to supply the domestic needs have been imported in past years from Spain, North Africa, and to a small extent from Sweden. During the war, when the shortage of shipping facilities necessitated combing this country for supplies of high-grade low-phosphorus ores, it was shown that the United States is more or less dependent upon foreign sources for such ores.

There are a number of mines in the United States, such as the Lyon Mountain mine, in New York, and the Cranberry mine, in North Carolina, which produce limited amounts of high-grade low-phosphorus ore. Several mines on the Menominee Range, Michigan, produce a very siliceous low-phosphorus ore that can be used to supplement in part the high-grade ores. A considerable quantity of low-phosphorus pyrite residue from sulphuric-acid and fertilizer plants is also used for making low-phosphorus iron. Much of the pyrite yielding this residue is imported from Spain; some of it is of domestic origin, and some comes from Canada. Altogether, the United States supplies about 60 per cent of the material required for the manufacture of its normal output of low-phosphorus pig iron.

Certain developments in progress make it probable that a greater percentage of ore used for this purpose can be supplied from domestic mines. The principal

enterprise is one that plans to concentrate the siliceous magnetite ore of the eastern Mesabi Range. Experiments have yielded a high-grade product, and work on a commercial scale is planned.

#### EXTENT OF IRON-ORE RESERVES IN THE UNITED STATES

The reserves of the ordinary grades of iron ore in the United States are large, and no shortage of such ore is expected for many years. They are easily capable of taking care of a considerably increased consumption. The largest reserves are in the Lake Superior district and in the Southeastern States, but large untouched reserves occur in the Western states as well. The iron ores in the Pacific Coast region have remained undeveloped from the lack of sufficient demand for pig iron and crude forms of iron and steel on the Pacific Coast. Undoubtedly this demand will increase in the future, and iron and steel industries will be established there.

The reserves of ore in the Lake Superior district are large. The grade of ore mined, however, has been gradually getting lower, and it is possible that before many years Lake iron ores averaging considerably below 50 per cent will have to be utilized. At present the average grade of the ores mined in the Lake Superior district is about 51 per cent.

It is clear that there is not likely to be a shortage of the ordinary grades of iron ore in the United States. Reserves of high-grade ores, however, are being gradually depleted, and high-grade ores from foreign countries will find an increasingly ready market. American capital controls a large reserve of high-grade iron ore in Brazil. Much of the Brazilian ore averages above 68 per cent in metallic iron and is very low in phosphorus, making it an exceedingly desirable raw material for the manufacture of special iron and for mixing with lower-grade domestic ores. Doubtless much of the Brazilian ore will go to Europe, as British and other foreign holdings of this ore are extensive. However, it is highly desirable that a certain proportion of the ore should be diverted to American furnaces.

*Germany*—The annual consumption of iron ore in Germany just before the war was 40,600,000 tons, and the output, including the production of Luxemburg, was only 33,987,112 tons. In order to supply German furnaces it was necessary, therefore, to import more than 5,000,000 tons of iron ore from foreign countries. More than 58 per cent of the iron ore mined in Germany has come from the Lorraine district. The production from German iron mines outside of the Lorraine district amounted to 6,906,809 tons in 1913. The production of pig iron during that year was 19,004,022 tons.

The pre-war imports of iron ore into Germany were large, amounting to nearly 14,000,000 tons in 1913. Against these the exports were somewhat more than 2,000,000 tons.

#### IMPORTANCE OF SWEDISH HIGH-PHOSPHORUS ORES

The iron ore imported from Sweden is mainly high-phosphorus ore from the mines of Swedish Lapland and central Sweden. This is especially adapted to the manufacture of pig iron for the Thomas process, much used in Germany. Most of the ores from the Lorraine district are slightly too low in phosphorus to be suitable for the Thomas process, and Swedish high-phosphorus ores, phosphate rock, and phosphate slags are in places mixed with Lorraine ore to raise the phosphorus content. A considerable amount of low-phosphorus iron

ore used in the manufacture of low-phosphorus pig iron is also imported from Sweden, and a larger amount of this ore is imported from Spain. This material is used in Germany for the manufacture of pig iron to be used in making acid openhearth steel.

Since Germany has lost the Lorraine iron fields, the remaining domestic iron mines will be able to supply less than 20 per cent of the requirements of iron ore for the German furnaces. However, it is likely that Germany will continue to receive most of her supplies from the Lorraine fields, in which German holdings at present predominate over those of France, a condition that will probably continue.

*Great Britain*—The United Kingdom has produced from 10 to 14 per cent of the iron and steel of the world annually for the last ten years or more, and apparently has consumed in normal times about 50 per cent of the product and exported 50 per cent, mainly to British possessions. During the war about 75 per cent of the British production was consumed at home and 25 per cent was exported, largely to France. Fifty per cent of the iron and steel products manufactured has been obtained from ores mined in Great Britain and 50 per cent from imported ores. Thus, normally the domestic field of iron ore just about equals the domestic demand for iron, whereas, during the war, the domestic demand for iron was greater than the domestic supply of ore. Great Britain depends upon outside sources for one-third of her iron-ore supply, and this constitutes the source of about one-half of her iron products.

The iron industry in Great Britain before the war was loosely controlled by merchants who acted as intermediaries between producer and consumer, an arrangement that did not work to the advantage of the consumer.<sup>1</sup> British manufacturers had little interest abroad, and were themselves insufficiently organized to operate successfully. If the sources of foreign iron ore were cut off the situation might become critical and exceedingly embarrassing until the domestic mining industry could be expanded. To meet this condition the British Board of Trade Committee advised a consolidation of iron interests by the formation of a syndicate for the purchase and distribution of iron ores and particularly for the acquiring of interests abroad. This syndicate would establish sales agencies and arrange for transportation and trade, similar to the organization of W. H. Muller Co., of The Hague. The committee recommended that these operations be backed by the government and that all the resources of the British Empire be under the control of the government, especially in regard to the granting of concessions to aliens and the imposing of restrictions to favor home producers. It has recently been reported that the iron interests have organized along the lines indicated.

*France*—The annual consumption of iron ore in France for the manufacture of pig iron and crude-iron and steel products amounts to about 12,000,000 tons under normal conditions. The productive capacity of the iron mines of France is more than 21,000,000, leaving a surplus of 9,000,000 tons of ore annually available for export. More than 90 per cent of the iron ore produced in France is obtained from the Lorraine iron mines.

Most of the ore exported in the past has gone to German blast furnaces. Much has gone to Belgium. Imports of iron ore are small, being mostly high-grade

ore from Sweden, in which class of ore France is deficient. French possessions in North Africa have large reserves of high-grade ore, but the bulk of the ore mined has gone to England and Germany.

As a result of the war, that part of the Lorraine iron fields within the boundaries of the disputed provinces of Alsace and Lorraine has been given to France, which thus has control of the entire output of the great Lorraine iron fields with the exception of the part included in Luxemburg. The production of the Lorraine iron fields, including the part that formerly belonged to Germany, has been nearly 48,000,000 tons annually, of which about 7,000,000 tons is mined in Luxemburg. Outside of the Lorraine district, France produces about 1,500,000 tons of ore. Thus, unless iron and steel making expand greatly in France, much iron ore will be mined for export.

*Russia*—In 1913, Russia ranked sixth in the output of iron ore and fifth in the output of pig iron, producing about 4½ per cent of the world's production of iron ore and 6 per cent of the pig iron. Russia's iron-ore reserves are estimated at about 1,600,000,000 tons, a part of which, especially in central Russia, is not economically minable. The district of southern Russia is important, on account of its large reserves, large output, and its location. This is particularly true at this time, on account of Germany's need of iron ore for future use.

The Russian output of iron ore grew about 2,000,000 tons annually in 1891-93 to 7,000,000 or 8,000,000 tons annually in 1913-17. Southern Russia (almost exclusively the Krivoi-Rog district) produced nearly 7,000,000 tons in 1913, but by 1916 the production from this region had been cut down to half, its difference being made up from other regions.<sup>2</sup> Between 1913 and 1917, Russia produced about 4,000,000 tons of pig iron annually, of which 3,000,000 tons came from South Russia, and most of the remainder from the Ural region.

In 1916 the Central War Industry Committee estimated the monthly requirements of the whole country at 300,000 tons of pig iron for war purposes, and at 80,000 tons for the requirements of the civil population, making a total annual consumption of about 4,500,000 tons, or only about one-half of the normal consumption. In 1917, the total production in the country was estimated to amount to only 30 per cent of these minimum requirements.

Conditions in Russia are so unsettled that a statement of the present situation is valueless. It is reasonable to assume, however, that the iron and steel situation will not materially change as to operations and control. Moreover, it will be safe to predict that Poland will develop more rapidly as an iron-ore producer in the future, as she was handicapped in the past by restrictions on exportation of ore.

*Belgium*—Belgium has been negligible as a producer of iron ore, but has been a comparatively large importer of iron ore and manufacturer of pig iron. The country ranked sixth as a producer of pig iron in 1913, in which year it produced 147,048 tons of ore and imported 4,400,900 tons.

Belgian iron works were greatly damaged by the Germans during the war, and probably some time will elapse before the industry again reaches the position it formerly occupied. The country offers a good market, how-

<sup>1</sup>Advisory Council, Dept. of Sci. and Indust. Research: "Report on the Sources and Production of Iron and Other Metalliferous Ores Used in the Iron and Steel Industry," 1918; Also British Board of Trade, "Reports on Iron and Steel," London; and *Ironmonger* "Metal-Market Yearbook," 1918.

<sup>2</sup>British Board of Trade, "Reports on Iron and Steel," London.

ever, for the iron ores of France, and should in future years be a larger producer of iron and steel wares.

Belgium is practically dependent upon outside sources for ore supply, but is conveniently situated as a market for ores from many countries. The total iron-ore reserves of the country have been estimated at 62,500,000 tons, not enough to last ten years at the present rate of consumption.

*Austria-Hungary*—The former Austro-Hungarian Empire yielded in recent years 2 to 3 per cent of the annual iron-ore production of the world and about 2 per cent of the pig-iron production; therefore, it has been of minor importance in the iron industry. The ore reserves have been estimated at 284,000,000 tons of available ore and 807,000,000 tons additional of probable ore.

The present unsettled conditions will probably result in considerable change in the operation and control of the iron mines and works. Eventually the upheaval may stimulate the iron industry, but the result should not materially alter the international position.

*Japan*—The iron and steel industry of Japan is of small magnitude as compared with that of the United States, Germany, Great Britain, and other leading iron and steel manufacturing countries. The total reserves of iron ore are probably not much more than 60,000,000 tons, or less than has been mined annually in the Lake Superior district in recent years. The steel-making industry is expanding rapidly, however, and at the present time blast furnaces, steel-making furnaces, and steel mills are being erected in Japan and in Korea, Manchuria, and China by Japanese interests.

The output of iron ore in Japan is utterly inadequate to supply this expanding industry. The production of iron ore in Japan has averaged about 150,000 tons annually in recent years, whereas the consumption of crude, semi-crude and manufactured articles of iron and steel is approximately 1,500,000 tons. To supply her needs, therefore, from her own manufacturing plants, Japan would require approximately 3,000,000 tons of iron ore annually. As compared with this, Japan's entire consumption of iron ore, both imported and domestic, is less than 700,000 tons. The remainder of the iron and steel required in Japan is being imported in the form of pig iron and crude and manufactured products.

Japan is making a strong effort to develop iron-ore deposits in neighboring countries, especially in China, Manchuria, and Korea, and the production from these sources which goes to Japanese-controlled furnaces is rapidly increasing. Among the more recent Japanese iron and steel enterprises in these countries are blast furnaces and steel plant now being built at Anchan-chang, south of Mukden, in Manchuria; the blast furnaces at Pen-hsi-hu, southeast of Mukden, and the blast furnaces at Ken-ji-pho, in Korea. The last two of these plants are now producing pig iron, which is being sent to Japan. In the future all three plants will probably build steel works. Iron-ore deposits are being mined in connection with all of them. Besides being used in the local blast furnaces, iron ore is being sent to Japan from these mines. In China, the most important iron and steel enterprise is that at Han-yang, in the province of Hu-peh. This operation was started by the Han-Yeh-Ping Iron & Steel Co., as a Chinese enterprise in connection with the Tayeh mines, in the same province. This company, however, became involved in financial difficulties, and Japanese capital was called upon in order

that work might continue. Considerable expansion of the plant is at present taking place under Japanese supervision. Iron ore from the Tayeh mines and pig iron from the Han-yang plant are sent to Japan for use in Japanese iron and steel works.

#### DEVELOPMENT OF IRON INDUSTRY IN THE ORIENT

It is doubtful whether, with the rapid expansion of the Japanese iron and steel industry, mines in China, Manchuria, and Korea can be developed fast enough to supply the raw materials necessary. There are rumors that several deposits of iron ore in eastern China are now being developed, including the deposit of Chin-ling-chen, and these may afford an additional supply. The iron mines of India also may be called upon to furnish more iron ore to Japan than they have done in the past. The only other important iron-ore deposits known elsewhere in the Orient are in the Philippine Islands. These deposits are reported to be fairly important, and they are favorably situated for supplying Japanese plants. They are controlled by Americans.

The present expansion of the Japanese iron and steel industry is such that it is a question whether the consumption of iron products in Japan will be sufficient to take care of the entire output.

It seems probable that Japan is looking for a large export trade in iron and steel products. The Japanese may be ambitious not only to displace European and American goods in the Orient, but may even attempt to secure a market on the Pacific Coast of the United States and Canada. It is probable that Japanese manufactured articles will be able to compete in the Western United States with goods manufactured in the Eastern states and subject to heavy transportation rates. On the other hand, there is an active movement to start an iron industry on the Pacific Coast, and it is hoped that plants established there will be able to manufacture iron and steel products at a low enough cost to enable them to compete with Japanese products in the Orient.

#### Bismuth and Pepsin

Some persons have extremely hazy ideas about some of the simplest technical matters, their only stock in trade for conversational filling-in being a system of association of ideas and catchwords. Clever folks usually get along pretty well, though at times there is a tendency to confuse correlatives and synonyms. A group of tourists accepted the invitation of an official of a large metallurgical establishment to visit one of the plants. In one department they were shown some slabs and ingots of different metals recovered as byproducts. In turn, selenium, tellurium, cadmium, and antimony were greeted with wise nods and silence. But when a specimen of bismuth was exhibited, the countenance of one of the party was suffused with a simulation of intelligent comprehension, as he exclaimed, "Bismuth? Well! Well! So that is the stuff they get from the stomach of a pig!"

Not a Copper-Mining Company will be called upon to pay excess-profits taxes for the year 1919, according to the *Boston News Bureau*. The Internal Revenue Department has apparently determined, however, that \$68,000,000 is due the Government for 1917 and 1918 taxes, which, it is alleged, were incorrectly figured.

# The Lorraine Iron Field and the War\*

Annual Production in 1913 Was 50,000,000 Tons, and 34 Per Cent of Metallic Iron Used in Europe Came From Lorraine Ores—War Leaves France in Control—Germany Has Nearest Supply of Good Coking Coals

BY ALFRED H. BROOKS

Late Lieutenant-Colonel and Chief Geologist, A. E. F.

WHEN Bismarck, in 1872, drew the new western boundary of the German Empire he was ill advised about the Lorraine iron deposits. Their bedded character not then being recognized, it was erroneously assumed that by seizing the outcrop Germany would hold the iron-ore reserves. In time a better knowledge of the geology of these so-called minette ores showed that they occurred in a well-defined horizon whose low westerly dip carried them under and far beyond the frontier established by Bismarck. Thus, it subsequently proved that Germany had annexed only the shallow eastern part of the field and left to France the deeper and far more extensive reserves to the west. Because of their low grade (28 to 41 per cent of iron) and their high content of phosphorus (1.50 to 2 per cent), these iron ores were then not greatly valued. Not until the discovery of the basic process of steel making was their great impor-

attempt to rectify this error from the German point of view was no doubt one of the most important motives for the attack in 1914.

The main body of the great iron deposits of Lorraine occurs in a belt extending northward from about the latitude of Metz along the pre-war frontier of France and Germany (map, Fig. 2). This iron-bearing zone reaches into both countries, traverses the southern apex of Luxemburg, and ends just within the Belgian frontier. To the south is the Nancy district, lying entirely within the old French boundary and forming an important outlier of the main Lorraine field. The position of the Lorraine field along the watershed of the Meuse and Moselle rivers renders it accessible to these two large tributaries of the Rhine. This situation gives railroad connection by easy grades with the Rhine Valley and with the lowlands of Belgium, which, in turn, have an elaborate canal system



EUROPE	Iron, Tons	Per Cent of Total
France (less French Lorraine)	242,000,000	6.6
French Lorraine	990,000,000	26.5
Luxemburg	60,000,000	1.6
Lorraine Annexée	558,000,000	15.0
Germany (less Lorraine Annexée)	260,000,000	7.0
Sweden	443,000,000	11.9
Spain	353,000,000	9.2
Great Britain	318,000,000	8.5
Russia	284,000,000	7.6
Austria-Hungary	111,000,000	3.0
Norway	86,000,000	2.3
Rest of Europe	31,000,000	0.8
<b>Total European reserves</b>	<b>3,735,000,000</b>	<b>100.0</b>

FRANCE	Iron, Tons
French Lorraine	990,000,000
Rest of France	242,000,000
<b>Total French reserves</b>	<b>1,232,000,000</b>

GERMANY	Iron, Tons
Lorraine Annexée	558,000,000
Rest of German Empire	260,000,000
<b>Total German reserves</b>	<b>818,000,000</b>

FIG. 1. IRON CONTENT (Fe) OF KNOWN IRON-ORE RESERVES IN EUROPE, FRANCE, AND GERMANY, 1913

tance established. Because of this discovery the annual production of ore from the Lorraine field increased from less than 2,000,000 tons in 1869 to nearly 50,000,000 tons in 1913.

Germany, ignorant of the geology of the minette ores and not suspecting their future utility in steel making, failed in 1872 to despoil France of the larger part of the very valuable Lorraine field (Fig. 1). An

connecting with tidewater ports. In addition to its advantageous position with reference to relief and drainage, the value of the Lorraine field is also greatly enhanced by its proximity to the centers of population of continental Europe.

Though the geographic relations described in the foregoing have greatly facilitated the use of Lorraine ores, the decisive factor in determining their value has been the proximity of large reserves of coking coal. The great coal belt of northern Europe, stretching unbroken from France through Belgium and into the Rhineland, and after a short gap continuing east of the Rhine to and including the Westphalia field,

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A more complete paper by the writer is now in course of preparation, and will be published as a bulletin of the U. S. Geological Survey, "The Iron, Steel, and Associated Industries of Lorraine, Sarre District, Luxemburg, and Belgium."

lies only 100 miles north of the iron district (Fig. 2). Approximately 70,000,000,000 tons of known coal reserves, 60 per cent of the total of continental Europe, are included in the fields which make up this belt. These fields include high-grade coking coal, and from this source has come the larger part of the fuel used in reducing the minette-ore. Thirty miles east of the iron district is the Sarre coal field, with a coal reserve of 16,500,000,000 tons. Its coking coal is, however, of an inferior grade and has found only local use in the smelting of the minette ores.

In addition to having geographic advantages, the

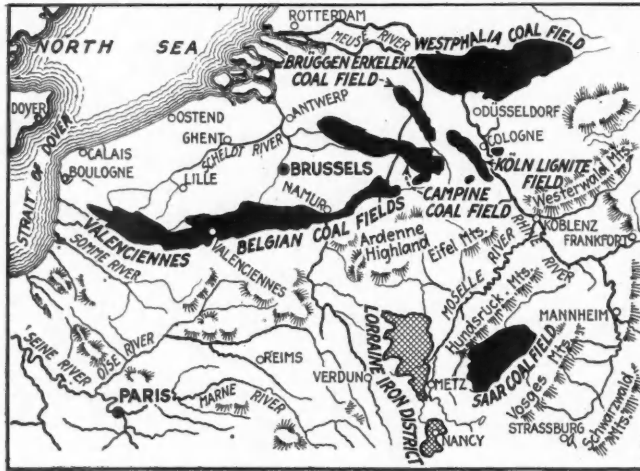


FIG. 2. MAP OF LORRAINE IRON DISTRICT AND OF TRIBUTARY COAL FIELD

occurrence and composition of the minette ore itself has greatly favored its use. The regularity of occurrence in beds two to six meters thick, and the comparatively shallow depth of the deposits, have favored cheap mining. In French Lorraine only about 1 per cent of the ore is taken from open cuts, and much the larger part of the output is from mines 200 to 245 meters in depth. The average cost of mining in 1913 was about 3.80f. per ton.

In German Lorraine the percentage of recovery by different methods of mining (1913) was as follows: Adits, 70 per cent; shafts, 28.5 per cent; open pits, 1.5 per cent. The shafts averaged about 200 meters in depth. In 1910 the average cost of mining in German Lorraine was about 3f. per ton. About 65 per cent of the ore mined in the Luxemburg part of the field comes from open pits and the remainder from shallow underground operations. Here the cost of mining was in 1911 about 3.08f. per ton. Both siliceous and calcareous ores are found in the Lorraine field, and therefore suitable furnace mixtures can be obtained. The high and uniform phosphorus content of the minette ore makes it advantageous for the basic process of steel making, with the valuable byproduct of fertilizer.

The enormous pre-war development of the Lorraine iron field took place as a consequence of the conditions described. In 1913 Lorraine supplied 34 per cent of the total metallic iron consumed in Europe. Germany then drew about 53 per cent, France 95 per cent, and Belgium and Luxemburg 100 per cent of their metallic iron from this source. Though the ownership of the iron ore and the coal used in its reduction was distributed among four countries, trade restrictions did not reduce greatly the free movement of the raw material.

As a consequence, iron and steel industries grew up at localities determined by geographic factors rather than by political boundaries. This is illustrated by Table I, showing the districts of production and reduction of Lorraine iron ore.

TABLE I. PRODUCTION AND SMELTING OF LORRAINE IRON ORE BY DISTRICTS, 1913

Districts Where Smelted	Metric Tons			Totals
	French Lorraine	Luxemburg	German Lorraine	
France:				
French Lorraine	9,516,000	375,400	517,000	10,408,400
Northern and central France	1,868,000			1,868,000
Germany:				
Annexed Lorraine	815,000	278,760	11,726,000	12,819,760
Sarre district	221,000	240,240	2,812,000	3,273,240
Westphalia and Rhineland	1,002,000	541,350	2,896,600	4,439,350
Belgium	4,697,100	1,470,450	237,000	6,404,610
Luxemburg	1,201,350	4,424,850	2,909,000	8,535,200
Great Britain			16,000	16,000
Totals	19,336,510	7,331,050	21,097,000	47,764,560

Table I shows that in 1913 the German furnaces were consuming not only much the larger part of ore output from the Luxemburg and German Lorraine mines, but also about 2,000,000 tons drawn from French Lorraine. In fact, the great German steel industry was built up chiefly on the Lorraine ores. The constantly growing importance of the minette ores to Germany is shown in the accompanying graph (Fig. 3). This clearly indicates that her increasing consumption

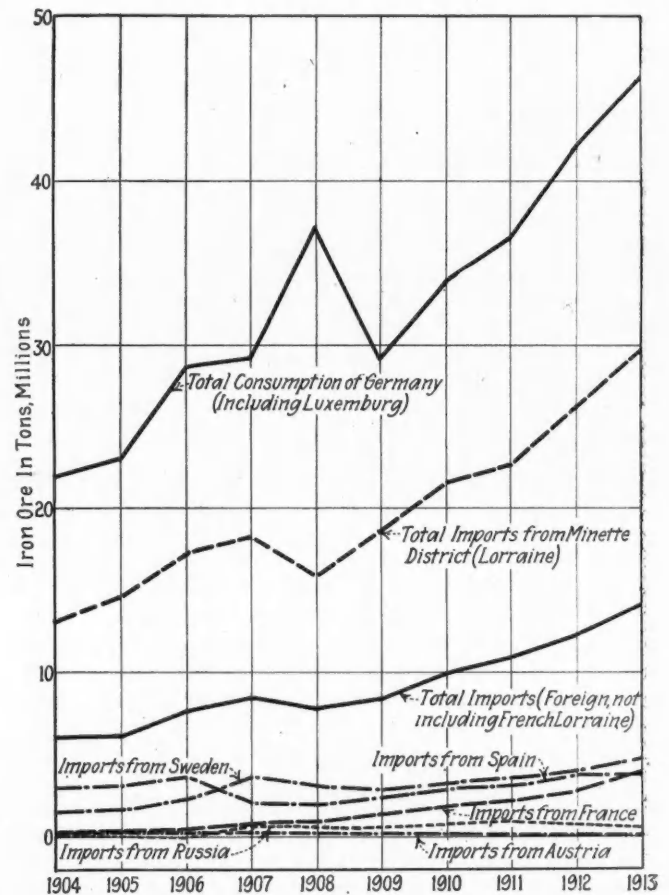


FIG. 3. GERMAN IRON-ORE CONSUMPTION AND IMPORTS

of iron ore has been drawn chiefly from Lorraine, for the imports from Sweden and Spain varied not greatly during the pre-war decade. Germany's political maneuvers of ten years ago to gain a foothold in north Africa were only a partial success and gave no assurance of the control of the iron ores in that field.

Measured by the pre-war boundary, France owned at



least 60 per cent of the 5,100,000,000 tons of known ore reserves of the Lorraine iron field (Fig. 2). Moreover, all of the prospective extension of the field was on the French side of the frontier. An assurance of a large tonnage of ore from French Lorraine was vital to expansion and even maintenance of the German steel industry. Fully alive to this, the German steel companies had for some years before the war been buying French iron lands. By 1913 they had acquired between 10 and 15 per cent of the French Lorraine field. There was, however, always the possibility that France, like Sweden, might put limitations on the export of iron ore. Therefore the only certain means of assuring the future of the German steel industry was to obtain national control of the French Lorraine iron field. There is as yet no direct evidence that the acquisition of the French Lorraine iron-ore reserves

minette mines, including the fortresses of Verdun and Longwy, which are necessary to their defence.

This document clearly indicates the plan: France was to be stripped not only of her iron mines but also of her great northern coal field, which supplied 68 per cent of her fuel. The latter clearly reveals the Machiavellian purpose of the war, for Germany needed no coal, having ample reserves in her own territory. Therefore the sole purpose of annexing the coal field was to cripple France's industry for all time. It is clear also that, whatever may have been the military advantages of the capture of Verdun, the prime motive was to master and hold this fortress to protect the iron mines which it was proposed to annex. Again, the attack through Belgium may have been regarded as a military necessity by the German High Command, but back of this lay the motive of despoiling France of the



COAL TIPPLE IN FRENCH COAL FIELD AFTER SYSTEMATIC DESTRUCTION BY GERMANS

was the principal purpose of the war, yet there is at least a strong suspicion that it was one of the guiding motives. Certain it is that the German ironmasters viewed with equanimity a war which they were assured would give them the complete control of the Lorraine field.

Though there may be some doubt that the war was started chiefly for the purpose of controlling the steel industry of Europe by the acquisition of French Lorraine, by 1915 this goal was well defined in the German mind. In May, 1915, six of the largest national industrial and agricultural associations of Germany addressed a memorial to the Imperial Chancellor, from which the following statements are extracted:

Apart from the necessary annexation of the ore of Briey (Lorraine), any other territorial conquest of France would be governed by strategical considerations. Besides the iron-ore region of Briey, it would also be necessary to acquire the coal region in the departments of Nord and of Pas de Calais (northern France). The security of the German Empire imperatively requires the possession of all the

coal field and the annexation of important iron and steel plants.

Verdun was held, the German line broke, and thus the plan for a complete mastery of the iron and steel industry of continental Europe failed. Though the war was lost, the fertile German mind could still see the opportunity to benefit Germany's steel industry by the ruthless destruction of the coal, iron, and steel plants of France and Belgium. This was done by the retreating army, so far as time permitted. With characteristic German thoroughness, experienced civilian engineers were consulted, and the work was carried on under technical supervision. This destruction was directed against French coal mines and against French and Belgian iron and steel plants. *The iron mines were left untouched.* The policy was to destroy the competitive coal and iron and steel plants, but not to damage the iron mines, for the last must furnish the ore needed by the Germans in their own furnaces. They well knew that any damage to the iron mines must

eventually work to the disadvantage of the German steel industry.

It is estimated that about 70 per cent of the iron and steel plants of northern France have been destroyed and 100 per cent of those in the occupied part of French Lorraine. Belgium has lost above 60 per cent of her furnaces and 80 per cent of her steel plants. The plants of German Lorraine, Luxemburg, the Sarre district and of Westphalia are, of course, intact. Aside from the plants in the German Republic, the annual capacity of the remaining blast furnaces is about 23,000,000 tons. This is only half of the pre-war production of the iron mines. Capital and labor being available, it will probably take about five years of construc-

tinental Europe. Her coal output, even with French control of the Sarre field, will, however, be far below her requirements. France must therefore continue to draw on other countries for a considerable part of her coal and coke.

Germany, on the other hand, with the loss of the Lorraine iron ore, cannot continue to be a power in the metallurgical industry unless she draws heavily on other countries for iron ore. She will, however, have in her Westphalian field the largest reserves of coking coal of continental Europe. (See Fig. 4.)

Belgium has no iron ore, but apparently possesses in her undeveloped Campine field large reserves of coking coal. The product of her coal mines will always find, in an open market, a strong competitor in that of Westphalia. Westphalian coal and coke sold at a lower price than that from the competitive fields. In January, 1913, the prices per ton were as follows: Westphalian coal, 15.45f.; coke, 21.25f.; Sarre coal, 16f.; coke, 21.85f.; Belgian coal, 16f.; coke 22f.; French (Valenciennes field) coal, 20.50f.; coke, 26f. These prices are at pit's mouth and oven.

Though the Westphalian field is more distant from the iron and furnace districts, the canal system of the Rhine valley and Belgium affords cheap transportation. As a consequence of these conditions, Westphalian coking coal finds a large use in smelting the Lorraine ores (Fig. 5). Of the coke used by French Lorraine furnaces in 1913, for example, over 50 per cent came from Westphalia. Even in the Sarre district itself, with its abundance of local coal, over 25 per cent of the coke used is from Westphalia.

The natural economic conditions which favor Westphalia coke have not been changed by the war, and its use in France and Belgium will therefore be continued unless prevented by law. Such action would result in a higher price for iron and steel to the domestic consumer and would make it difficult for France and Belgium to compete in the steel market of the world.

The accompanying diagram (Fig. 4) of the coal reserves available for reduction of the Lorraine ore indicates the overwhelming preponderance of the Westphalian field. The tonnage credited to Belgium does not include the undeveloped Campine field. A rough estimate of the available tonnage of coking coal tributary to the Lorraine field is given in Table II.

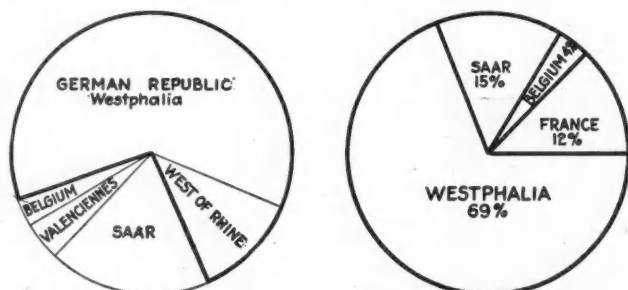


FIG. 4 (LEFT). OWNERSHIP OF COAL FIELDS TRIBUTARY TO LORRAINE IRON DISTRICTS

1919		
	Reserves Tons of Known Coal	Per Cent of Total
German Republic:		
Westphalia.....	53,344,000,000	61.6
West of Rhine.....	10,458,000,000	12.0
French:		
Sarre (French Control).....	16,548,000,000	19.1
Valenciennes.....	3,790,000,000	4.4
Meurthe et Moselle.....	No developed tonnage	
Belgian.....	2,500,000,000	2.9
Total.....	86,640,000,000	100.0

FIG. 5 (RIGHT). SOURCES OF COKE USED IN SMELTING AND REDUCING TOTAL LORRAINE IRON ORE OUTPUT 1913, INCLUDING IRON ORE FROM FRENCH LORRAINE, ANNEXED LORRAINE AND LUXEMBURG

	Tons of Coke Consumed in Reducing Lorraine Ore	Per Cent of Total
France.....	2,552,800	12
Belgium.....	760,000	4
Sarre.....	3,086,300	15
Westphalia.....	14,310,900	69
Total.....	20,710,000	

tion to restore the French and Belgian plants to their pre-war capacity, but even this restoration will not meet the conditions. Some years before the war, developments were begun with a view to increasing the output of the French mines by 10,000,000 tons. If, therefore, the mines are to be worked to their full capacity, the total output of the Lorraine field would soon reach 60,000,000 tons.

The Lorraine iron ore, could it be utilized, would make a quick asset for impoverished France, and it is therefore highly desirable that the iron mines be reopened. However, this can be done only by shipping the ore to the iron and steel plants of Westphalia. This would benefit France directly and would help the whole civilized world by reviving industry in Germany.

The restoration of annexed Lorraine has given France control not only of 48 per cent of European iron (Fig. 2) reserves, but, under present conditions, virtually a monopoly of the iron-mining industry of con-

TABLE II. ESTIMATES OF RESERVES OF COKING COAL IN FIELDS TRIBUTARY TO LORRAINE

	Reserves Metric Tons
Northern France.....	1,000,000,000
Belgian productive fields.....	1,000,000,000
Belgian Campine field.....	4,000,000,000
Sarre field.....	4,000,000,000
Total France and Belgium.....	10,000,000,000
Westphalia.....	35,000,000,000
Aix la Chapelle, Brugen, and Crefeld.....	1,000,000,000
Total.....	46,000,000,000

Table II appears to show that there is ample reserve of coking coal in France and Belgium without drawing on Germany. In fact, however, the Campine Basin is as yet unproductive, and its resources are more or less problematical. Again, the Sarre coking coal is of inferior quality and can compete only locally with higher-grade fuels. The total output of coking coal from the Belgian and French fields was in 1913 about 11,000,000 tons. Though it could probably be doubled in five years, such exploitation would not be econom-

ically sound, in view of the better and cheaper coke that can be procured from Westphalia.

However just it may be to penalize the German coal and steel industries for their part in the war, this could be accomplished only to the detriment of the Allied Powers. The logic of the facts above presented clearly indicates that the economic development of the Lorraine iron ore demands a full use of (1) the high-grade coking coal of Westphalia and (2) of the iron and steel plants of Westphalia and the Rhineland. In other words, the rehabilitation of the iron and steel



COAL-WASHING PLANT IN FRENCH COAL FIELD AFTER DESTRUCTION BY GERMANS

industry of continental Europe must take full advantage of the geographic relations which have been described.

Chromite Shipments in 1919 reached only about 3,900 tons, of which 1,000 tons was mined in 1918, according to U. S. Geological Survey. The shipments from California alone, chiefly from five producers, amounted to nearly 2,000 tons. The remainder was from Oregon, Wyoming, and Maryland. In Oregon more than 600 tons of chromite, carrying 45 per cent of chromic oxide, was mined in the last half of 1919, and nearly all of it was sold, some to consumers as far east as the Great Plains. In California the Placer Chrome Co. moved its mill to the mine and continued concentration in 1919 in the hope of maintaining the industry.

## Powder Allowances in Mining

BY G. L. SCHMUTZ

Written exclusively for *Engineering and Mining Journal*

AT A MINE in Mexico where the labor for stoping and development was paid on a contract basis, but where the powder was furnished by the company, it was found that an excessive amount of powder was being used, and that a large proportion could be saved. With this in view, it was decided to determine the average amounts of powder used in various kinds of work. It was assumed that a certain fraction of these amounts would suffice for the work. The contractor was allowed an additional price per unit (foot of advance or ton of ore broken), represented by the new powder allowance in money. The amount of powder allowed contractors, under the system, is shown in Table I.

TABLE I. POWDER ALLOWANCES IN STOPING AND DEVELOPMENT

	Cut and fill by machine			—Lb. Powder Per Ton—		
	Min.	Aver.	Max.	Min.	Aver.	Max.
Silling.....	0.4	0.5	0.6	0.84	1.05	1.30
Stoping.....	0.2	0.3	0.6	0.42	0.63	1.26
	Square Set by Machine					
Stoping.....	0.20	0.25	0.50	0.42	0.52	1.05
Set—16.5 T.....	3.00	4.10	8.00	6.30	8.61	16.80
	Top-Slice by Machine					
Stoping.....	0.10	0.30	0.50	0.21	0.63	1.05
	Development					
	—Lbs. Powder per Ft.—			—No. Sticks Powder—		
	Min.	Aver.	Max.	Min.	Aver.	Max.
Hand.....	3.0	4.5	7.0	10.5	15.75	24.5
Machine.....	5.0	8.0	14.0	10.5	16.80	29.4
	Winzes					
Hand.....	3.0	4.5	7.0	6.3	15.75	24.5
Machine.....	3.0	5.5	8.0	10.5	11.55	16.8
Station.....	5.0	7.4	12.0	.51	15.54	25.2
	Raises					
Hand.....	3.0	4.5	7.0	10.5	15.75	24.5
Machine.....	3.0	5.5	9.0	6.30	11.55	18.9

Allowances were made according to the schedule in Table I for a period of three months, at the end of which time the average powder consumption for the period was calculated.

The new averages compared with the old are shown in Table II.

TABLE II. POWDER ALLOWANCES

Stoping						
Average Lb. Powder Used per Ton of Ore Broken, Including Waste						
Cut and Fill Sills		Cut and Fill Stopes		Square Sets		Top Slice
Old Av.	New Av.	Old Av.	New Av.	Old Av.	New Av.	New Av.
0.744	0.493	0.494	0.310	0.387	0.276	0.440 0.205
Development						
Average Lb. Powder Used per Foot of Advance						
—Hand—		—Machine—		—Hand—		—Machine—
Old Av.	New Av.	Old Av.	New Av.	Old Av.	New Av.	Old Av. New Av.
5.77	3.61	9.33	7.39	5.73	2.92	6.80 .....
				5.24	3.02	6.79 5.08
Feet of advance used in the calculation of new averages:						
Hand drives, 2,100		Hand winzes, 138		Hand raises, 33		
Mach. drives, 1,448		Mach. winzes, ...		Mach. raises, 1,518		

The rock encountered in this particular mine was principally andesite and latite breccia, approximately equally divided. In addition, there was a small amount of monzonite. The andesite and monzonite were both favorable to good drilling and breaking, but the latite was quite hard. The explosive used in the work would average 35 per cent gelatin dynamite. The holes were not stemmed. Undoubtedly, tamping would have greatly increased the efficiency of the explosive, thereby making it possible to perform the same amount of work with less powder.

# Reverberatory Copper Smelting in Arizona

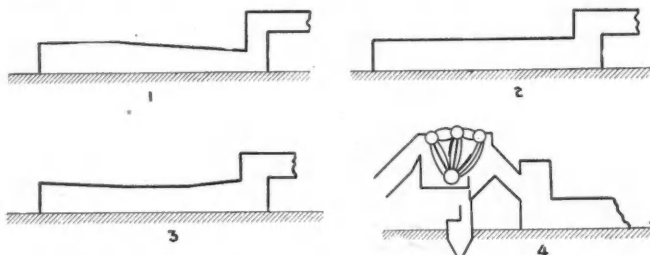
Furnaces No Longer Made With Sloping Arches—Large Uptakes and Flues Have Proved Their Value—Continuous Skimming Becoming More Popular—  
Much Attention Paid to Heat Conservation

BY CHARLES F. MASON

Written exclusively for *Engineering and Mining Journal*

THE world knows the tremendous rate at which the United States was turning out war material when the signing of the armistice brought cessation of hostilities over a year ago. The state of Arizona produced a large share of the copper which went to help defeat the Central Powers of Europe, and the close of the year 1918 saw her copper smelters still operating at nearly full capacity. The end of 1919, however, found the copper production of the Arizona field considerably curtailed.

On a recent visit to all of the Arizona smelters, I saw only one blast furnace in operation, and that was at a plant in which there were no reverberatories. Not many years ago it was generally thought that the reverberatory could not compete with the blast furnace, either as to economy or efficiency, but the reverse is now true. At one plant it was stated



DESIGNS OF REVERBERATORY ARCHES AND FLUES

that one standard reverberatory furnace (19 x 100), after being slightly remodeled, is now capable of smelting, in addition to its own former tonnage, a tonnage equal to that which was formerly smelted at greater expense in a blast furnace.

In view of the practical abandonment of blast-furnace operation in Arizona, this article will deal only with the developments in reverberatory practice which have brought it to its present effectiveness.

## ECONOMIES EFFECTED IN FUEL CONSUMPTION

The largest item of expense in a copper smelter is, of course, fuel. Under this heading we generally look first for economies, and recently many have been made so that whereas a crude-oil consumption of 0.75 to 0.95, or even 1 bbl., of oil per ton of charge smelted was not uncommon during the war, nowadays it seldom exceeds 0.70 bbl. It would not be fair to blame the smelterman for this apparent waste of fuel during war time—he was doing his bit by forcing his furnaces to their utmost capacity, and was generally handicapped by an acute shortage of skilled labor.

Pulverized coal as a copper reverberatory fuel has made its appearance in the Arizona field and has come to stay, although the nearest coal fields are in northern New Mexico, and only the most favorably situated smelters can cut down their fuel bills by using coal, even in its most economical and efficient form. At one smelter where a very poor grade of

New Mexico slack coal was used, a powdered-coal consumption of 520 lb. per ton of charge smelted was obtained, and at another plant using a better grade of coal from the same field the consumption was 380 to 400 lb. per ton smelted. It is interesting to note in passing that pulverized coal is now being used successfully in all processes in the production of copper, from roasting ore to refining the metal.

## "STRAIGHT-LINE" REVERBERATORY ARCH POPULAR

The tendency in reverberatory furnace design, which is largely responsible for the present-day high tonnage and fuel economy, is toward "straight-line" arches, as shown in Fig. 2, in place of the old-style sloping or "verb" arch, as shown in Fig. 1. The idea that the "verb" would retain more heat in the furnace than a straight arch, and also concentrate the heat on the bath at the skim-door, seems to have been discarded almost entirely. Some designers have even given the reverberatory arch a slight rise toward each end, as shown in Fig. 3, and these furnaces are said to be doing good work.

Larger uptakes and flues seem to be a logical development of the straight-line idea, and have proved beneficial wherever tried. Short flues of large cross-sectional area are essential to efficient recovery of waste heat, also, as will be shown later. There appears to be no good reason for building reverberatory furnaces any longer than those made at present, especially in the case of a finely ground charge which has a low angle of repose and will not stand up against the side walls of the furnace, when side-charged. Extra long furnaces which have been built in other places do not show any marked economies, and are not so easily handled on reduced capacity. At one Arizona smelter, noted for its progressiveness, the 90-ft. furnace is still the standard, and is doing good work.

## SIDE-CHARGING EFFICACIOUS

Side-charging has well proved its worth, and is practically standard practice in Arizona. There appears to be no unanimity of opinion, however, as to how far the charge should be dropped from the back, or burner, end of the furnace. At one plant only 22 ft. of the furnace is charged, and every effort is made to maintain a "blow-pipe" flame within that space, though other operators prefer to charge as far toward the front end of the furnace as possible without increasing the slag loss—a point usually determined by experiment. In the latter case, a correspondingly longer flame is generally maintained.

Drag conveyors, inclosed in dust-tight housings for conveying the charge from the point of discharge from the cars to the proper charge holes, have proved their efficiency and economy when applied to the side-charging system, especially in smelters where a high-grade concentrate is handled, with a proportionately large loss

in case of excessive dusting. The only objection to those now in use is that they radiate considerable heat from the charge while on its way to the charge holes in the furnace.

I have long been an enthusiastic advocate of the continuous skim—perhaps it would be more correctly named the continuous slag tap—and am pleased to note that it is coming into more general use, or a modification of it at least. The old practice of opening up a 2- or 3-sq.ft. door and running off 60 or 80 tons of slag in a very few minutes is no longer seen in the Arizona district. Even where no attempt is made to allow the slag to run continuously, care is now taken to hold it to a small stream and to allow none of the top "blanket" to escape. Some operators maintain as nearly as possible a continuous flow of slag from immediately under this blanket. At one plant, where high-grade concentrates are smelted, and the slag blanket contains correspondingly high values, it is the practice to throw finely ground lime on top of the blanket in the front of the furnace and then agitate the whole bath violently by means of air jets in order to flux the blanket before skimming. At another smelter a forehearth, or settler, is being built, into which it is intended to run all the slag from one reverberatory furnace continuously and there superheat and clean it with sulphide. It will be interesting to learn whether the metal thus recovered will pay for the fuel for superheating.

#### UTILITY OF THE STEAM BOILER IN HEAT CONSERVATION

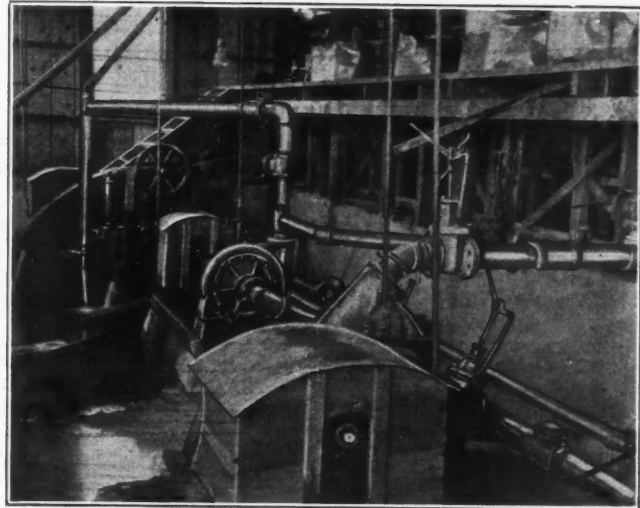
Apparently it is not yet realized by many copper smelters that the steam boiler is the most efficient agent for the recovery of waste heat that we have today. Figures show that if the waste heat from a copper reverberatory were used for preheating the air for combustion, a considerable economy would be effected. But from openhearth steel furnace practice we learn that the regenerative system will cool the gases only to 800 deg. F. or 900 deg. F., whereas a well-designed boiler will take heat from the same gases down to a temperature of 450 deg. F. or even 400 deg. F. All Arizona copper smelters are equipped with waste-heat boilers, but many of them leave much to be desired from the standpoint of efficiency.

The fault lies, in most cases, in the use of long connecting flues of small cross-sectional area, which allow (compel is a better word in this case) excessive radiation of heat from the furnace gases before they enter the boiler. Fig. 4 is a sketch of an excellent example of waste-heat boiler setting. It is in use on an Arizona copper reverberatory furnace fired with powdered coal, and has been evaporating water at the rate of 4.7 lb. per lb. of coal fired at the burners, for several months. It will be noted that provision has been made for cleaning out the coal ash deposited in the boiler, and it is stated that after several months' continuous run no accumulation of ash has taken place. Dust is blown off of the boiler tubes with an air jet whenever the draft decreases beyond a given point.

The year 1919 witnessed a number of changes in copper-smelting practice in Arizona, and it is probable that this year will see many more. It would be a risky undertaking to prophesy what new "wrinkles" will develop during 1920, but from the present outlook it seems safe to state that the most rigid economy in all departments of the copper industry will be in order.

#### Protection of Motors in Mills

Motors direct-connected or geared to pumps in cyanide mills must frequently be installed in pits and other places where they will be exposed to the splashing of slime or solutions. Without some protection they quickly become covered with muck, or else the solutions get into the windings. This interferes with the me-



PROTECTIVE HOOD FOR MOTOR

chanical and electrical condition of the motor and also makes it unsightly in appearance. At the mill of the Tonopah Extension Mining Co., in Tonopah, Nev., the motors are protected by a light wooden housing which can be readily lifted out of the way for inspection or cleaning. As will be noted from the accompanying photograph, the top of the box is a curved plate of corrugated iron.

#### Storage of Gasoline at Mine Surface Plants

BY DOUGLAS LAY

Most mines use gasoline for some purpose, and its storage is important. If it is desired to keep it under lock and key, the building should be placed in as isolated a site as conditions permit and be constructed with both sides and door of coarse-mesh heavy netting, so that there will be at all times abundant circulation of air. It is inadvisable to store cases of gasoline in a closed building, because if a fire does spread to the building, an explosive mixture of gasoline vapor and air is almost certain to form.

If it is unnecessary to keep gasoline under lock and key, the best method of storage is to throw a sheet of tarpaulin over the cases or drums piled alongside the trail or wagon road, at some convenient point. The best way to cope with a gasoline fire is to throw snow, not water, over it in winter, or earth or sand in summer. Both can be thrown from a distance, if necessary.

Révue pratique des Industries métallurgiques, (Paris), No. 155, points out that it is very dangerous to bring a greasy substance in contact with oxygen under pressure. Consequently one must refrain from introducing grease or oil into the valves of oxygen cylinders, the screw-threads of the valves, the regulating cocks, or the oxygen conduits to the burners.

## Increasing Iron-Ore Production on the Mesabi Range

By R. S. BOTSFORD

Written exclusively for *Engineering and Mining Journal*

**T**HE largest operator on the Mesabi Range is the Oliver Iron Mining Co., the iron-mining subsidiary of the United States Steel Corporation. The biggest open pit in the district, in fact the largest artificial hole in the world, is the Hull-Rust mine, which is one mile across, one and one-half miles long and 185 ft. deep. Together with the adjoining Mahoning and Scranton pits, the entire excavation is about four miles long.

Within the boundaries of each property the overburden is removed by successive steam-shovel cuts, loaded into automatic self-dumping cars, and hauled to suitably located dumps. Other shovels working in ore load into fifty-ton cars which are made up into trains and hauled to the docks at Duluth. The pits are well sur-



LOADING ORE IN THE HULL-RUST PIT

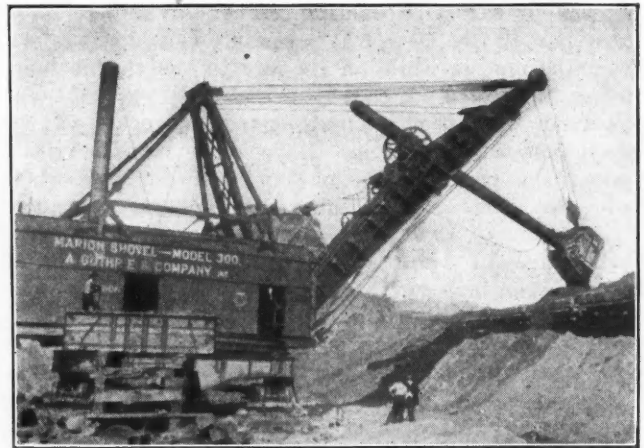
veyed and sampled, and the samples assayed, the results serving as a guide for the selection of ore necessary to maintain the grade required at the furnaces, and also to some extent to determine the positions of the shovels in the pit.

An important consideration in open-pit haulage is that of track grades, and it has been found that 2½ per cent is the most suitable. A steeper grade greatly reduces the number of cars which can be hauled by the locomotives, and a lesser one requires a longer distance haulage. In either case more trains are required.

Within the last four years large 350-ton revolving shovels, of the type similar to those first used at Danville, Ill., and elsewhere for stripping coal, have come into extensive use in stripping overburden on the Mesabi. In addition to being the largest and most powerful shovel built, the machine will strip 100 ft. in one operation and load into cars 42 ft. above the working level. However, 35 ft. is a more suitable height at which to load, and this allows more latitude in operation.

The standard 115-ton shovel, which is still used at Mesabi Range open pits, loads into cars placed on a track alongside, and such an arrangement is of great advantage in saving 35 or 40 ft. of vertical lift which had to be taken care of by the locomotives. Fewer trains are required and less track.

With the first cut made at a depth of between 35 and 40 ft., material moved by the big shovel is delivered on



REVOLVING 350-TON SHOVEL IN THE DANUBE PIT

the surface, thereby eliminating the grade and permitting more cars on the train. Loading takes place on both sides of the cut, so that the shovel is occupied practically all of the time, or about nine out of the ten hours. As an example of the progress that was made under these conditions, a local contractor, using 16-yd. air-dump cars, loaded 317 cars on the day shift and 318 at night. Although better work is usually done in the daytime, most of the repairs are made by daylight, also moving the track and spreading on the dump, whereas at night there are fewer delays.

The use of the larger type shovel has permitted the development of a special cut or section which materially modifies the working conditions. Arrangements are



A "CLOSE-UP" OF THE BIG FELLOW

made for loading on both sides of the cut, from 35 to 40 ft. above the working floor, over 100 ft. wide at the bottom at grade, and exceeding 160 ft. at the top. Although the shovel will deliver into cars and reach 200 ft. from track to track, it is well to have about 10 ft. excess reach, so that any spill on the track can be removed by the shovel dipper. The next cut is taken parallel to the first, but leaves one loading track in a position between the two cuts. The new cut has two loading tracks, one on each side as before. When loading at a lower level the shovel is placed between two of the upper cuts, with a loading track on either side, where the shovel has previously been working, now taking in the remaining ground right up to the surface and loading onto the tracks 35 ft. from the surface, whence it is hauled out on a 2½ per cent grade.

In some instances, under favorable circumstances, one cut taken with the large shovel corresponds to ten cuts with the standard 110-ton shovel, and the economy in shifting track and moving up once instead of ten times, and elimination of grade due to loading 35 ft. higher than otherwise, is considerable.

### Rock Drifting at the Barnes-Hecker Mine

ONE of the most interesting developments in underground mining during the last few years has been the progress in the use of underground loading machines. Following the effort to improve, in every possible way, the mechanical methods of hoisting, pumping, and other operations associated with mining which require strictly a mechanical application, engineers have come to appreciate that more attention must be paid to that branch of work which is dependent on manual labor; that with rising costs and a scarcity of labor, some adjustments must be made to show a balance on the proper side of the cost sheet when the season's operations are finished.

During the month of January, 1920, excellent progress was made in driving a rock drift at the Barnes-Hecker mine of the Cleveland-Cliffs Iron Co., near Ishpeming, Mich., the advance made in this work besting all previous records established in tunneling in the Lake Superior districts. Of particular interest is the fact that an underground loading machine was used.

The advance made on an 8 ft. x 10 ft. haulage drift through slate was 511 ft. in 474 hours, the work being done under the direction of Captain Tippet and the supervision of John M. Bush, superintendent. At the beginning of the shift, the miners (four men) mounted two No. 248 Ingersoll drills on a bar above the dirt-pile. One and one-eighth-inch round drill steel was used. With the above set-up the top half of the heading, consisting of fourteen six-foot holes, was drilled. Before the miners had finished drilling this portion of the heading the dirt was all removed, so that no delay was caused in drilling operations or in subsequent mounting of the drills for the three bottom holes, which were also six feet deep. Two cuts were drilled, blasted, and shoveled during each shift. Explosives used consisted of Astra 60 per cent Keystone Standard gelatin, Lion No. 6 caps, and Eagle River fuse, the powder amounting to 12,500 lb., or an average of 24.46 lb. per foot of drift and 2.47 lb. per ton of rock, figured at 15 cu.ft. per ton.

The shoveling crew consisted of one operator for

the Armstrong Shoveloder and two trammers. The trammers pushed the loaded car to a motor, approximately 150 ft., and returned with an empty car. Rock handling totaled 1,261 cars of 65 cu.ft. capacity, and total shoveling time was 257 hours, the latter representing the periods spent by the crew from the beginning of shoveling until all the rock in the cut had been loaded, and therefore includes the time consumed in trampling to motor, moving up, and laying sections of track.

[On the same basis of calculation as used in the article which follows on this page drifting at the Barnes-Hecker mine shows that 98.56 cu.ft. per man per shift was removed.—EDITOR.]

### Drifting in Magnetite Iron Mines At Mineville, N. Y.

Written exclusively for *Engineering and Mining Journal*

THE deposits of magnetite iron ore in the Mineville district are inclined, dipping toward the west, and are much faulted. The ore is mined by sinking slopes between the faults, with a storage bin or pocket built in the rock at the head of each slope. The storage bins are connected to the main haulage slope by an electric haulage system. This haulage system is generally installed in a rock drift driven in the foot wall of the orebody, and necessitates much drifting.

Recently, a 7-ft. x 12-ft. drift was driven through hard gneiss rock in the Harmony mine of the Witherbee, Sherman & Co. property at Mineville, from the main orebody through the foot wall to connect to a storage bin, and the record compares most favorably with results obtained in the Michigan iron country.<sup>1</sup>

The distance of 213 ft. was advanced in thirty-six eight-hour shifts, with five men, two machine men, and

COMPARATIVE RESULTS OF DRIFTING

	Ishpeming, Mich., and Mineville, N.Y.	Holmes Mine, Ishpeming, Mich.	New Bed Drift	Harmony Pocket Drift
Size of drift.....	8 ft. x 8 ft.	7 ft. x 11 ft.	7 ft. x 12 ft.	
Holes drilled per round.....	17 to 19	30	26	
Number of ft. drilled per round..	100	270	234	
Number men per shift.....	10	5	5	
Advance of heading per shift.....	9 ft.	5 ft.	5.92 ft.	
Advance of heading per man per month.....	24.2 ft.	27 ft.	31.93 ft.	
Cu.ft. rock removed per man per shift.....	57.4	77	99.46	

three men mucking and trampling. No. 248 Ingersoll-Leyner drills with 1¼-in. round hollow drill steel with crossbits and ¼-in. change were used. The gage of the starter bit is 2½ in., four changes were made, and the holes drilled according to the V-type cut system. Time fuses, No. 8 caps, and Du Pont gelatin were utilized in blasting. The two machine men drilled, loaded, and fired twenty-six 9-ft. holes per shift, which is 234 ft. of drilling per round. The muckers loaded the dirt in 1½-ton cars and pushed same to the main slope.

A 7 ft. x 11 ft. drift at the New Bed mine was advanced 5,001 ft. per eight-hour shift, or 135 ft. per month of twenty-seven days on one shift per day. The material was hard granitic gneiss, and the drifting was done by five men per shift. Two machine men drilled, loaded, and blasted thirty 9-ft. holes per shift, and three muckers and trammers cleaned the dirt. This gives the advance per man per month in the New Bed mine of twenty-seven ft. and a removal of 385 cu. ft. of rock per shift, or an average of 77 cu.ft. of rock per man per shift.

<sup>1</sup>"Breaking the Michigan Record in Tunnel Driving," *Engineering and Mining Journal*, March 20, 1919.

## Mining Engineers of Note Benedict Crowell

By PAUL WOOTON

Written exclusively for *Engineering and Mining Journal*

**B**ENEDICT CROWELL began his career as a mining engineer with the idea that it would be all-inclusive, like that of a general practitioner in the medical profession. He had not done a great deal of work, however, before he began to realize the need for specialization, and then he had an experience which was his rubicon so far as any return to general practice was concerned. Fully convinced that he was a real expert, young Crowell undertook to examine and report on a large placer proposition in northern California. He assumed the work without the slightest uncertainty as to his ability to handle it. To determine the value of the property he did extensive prospecting. Numerous shafts were sunk, some of them as deep as 200 ft. As the material examined had to be handled with rockers, the opportunities for salting were particularly good. Some of the numerous workmen engaged took full advantage of them, and the salting process was carried out in a highly successful manner. Thus a winter filled with hardship, a large expenditure of money, and much labor on the

part of the engineer failed to result in that degree of success that had been so confidently expected. Following that experience, Mr. Crowell became a firm believer in specialization, and since has devoted his professional attention to iron and manganese.

As First Assistant Secretary of War, Benedict Crowell was intrusted with the responsibility for the munitions program during the war, and as director of munitions was given the necessary power to see that the munitions required for military operations were procured and furnished to the army in the field. Selected to this job because of his capacity for work and a record for securing results, Crowell immediately put several original ideas into effect and disentangled his department from unnecessary red tape.

It is the intention of Mr. Crowell to get back into the practice of his profession at the earliest possible time. He is convinced that no industry has a future so roseate as that of mining. He believes that the war

has brought home to us more than ever before the value of our great asset in the way of minerals.

That we have no conception at this time of the extent to which our mineral development will go is illustrated by Mr. Crowell by his own experience in

having prospected, along with thousands of others, time and time again over that portion of Nevada and the adjoining successful camps which later developed gold fields. As clues to mineral deposits generally are few, and frequently do not exist at all, Mr. Crowell anticipates that many a mine in the future will be opened on ground not suspected of being valuable today. In addition, Mr. Crowell cites the development of the magnesite industry in the United States as an indication of another class of development which will be repeated many times as a result of the changing of world conditions. Men in the mining industry, he asserts, are becoming additionally enterprising and additionally skilled. Just as the necessity occasioned by the war brought about the development of a domestic magnesite industry, the necessities of our en-

larged commercial importance will bring forth new triumphs. It would not surprise the Assistant Secretary of War if even so difficult a problem as that presented in the effort to secure domestic production of tin should be solved by America's mining genius.

After graduating from Sheffield Scientific School, Yale University, in 1891, Mr. Crowell first went to work as assistant chemist in the Otis Steel Works, Cleveland, Ohio, occupying various positions in this company until 1895, when he organized the specializing firm of Crowell & Murray.

The firm has always specialized in Lake Superior iron ores, and Mr. Crowell has personally examined and assisted in the development of many of the large properties in this district. In addition, he has also examined most of the large iron and manganese deposits in North and South America. At present Mr. Crowell is president of the Rosiclair Fluorspar & Lead Mining Co., the largest producer of fluorspar in the world.



BENEDICT CROWELL



# CONSULTATION

## Kinds of Iron Ore

"What are the varieties of iron ore and in what proportions are the respective kinds mined?"

There is an interesting compilation of the various kinds of iron ore produced in the United States, together with the respective quantities of each kind, in *Mineral Resources of the United States*, 1918, Part I, pp. 527-584. The table begins with the year 1880, in which period there were produced 2,243,993 tons of hematite, 2,134,276 tons of magnetite, and 823,471 tons of carbonate ores, making a total of 7,120,362 tons. In 1918, no carbonate ore was mined and of hematite there was produced 65,894,709 tons, of brown ore, 1,613,844 tons, and of magnetite, 2,149,725 tons, out of a total of 69,658,178 gross tons. The production of brown ores is diminishing, the production of carbonate has dwindled rapidly, magnetites have maintained a more or less steady figure, and hematite has increased greatly in quantity.

## Names of Iron Mines in U. S.

"Where can I get a list of the most important iron mines in the United States?"

In Part I, pp. 527-584 *Mineral Resources of the United States*, 1918, you will find a list of the iron mines of the United States arranged in the order of their importance and with the quantity of ore mined in 1918, as well as the variety of ore produced, the state, and the nearest town.

## Oil-Shale Land Located Prior to January, 1919

"Referring to the Oil Leasing Act and that portion of it pertaining to oil shale, will you explain in your 'Consultation' department the status of owners of shale land located under the Placer Mining Act prior to Jan. 1, 1919?"

Section 21 of the Mineral Land Leasing Act contains the following provision:

"Provided, that any person having a valid claim to such minerals under existing laws on Jan. 1, 1919, shall, upon the relinquishment of such claim, be entitled to a lease under the provisions of this section for such area of the land relinquished as shall not exceed the maximum area authorized by this section to be leased to an individual or corporation; Provided, however, that no claimant for a lease who has been guilty of any fraud or who had knowledge or reasonable grounds to know of any fraud, or who has not acted honestly and in good faith, shall be entitled to any of the benefits of this section: Provided, further, that not more than one lease shall be granted under this section to any one person, association, or corporation."

Under this provision, you would be entitled to lease from the Government not to exceed 5,120 acres of oil-shale land, even though your prior claims may have exceeded this maximum acreage. Secure a copy of circular No. 671 of the General Land Office covering "Regulations Concerning Oil-Shale Leases." This circular contains the regulations issued to registers and receivers of U. S. Land Offices as well as forms and contents of lease applications.

## Imports of Precious Stones

"What are the importations of precious stones into the United States, and where may I obtain information on this subject?"

You will find an excellent review of precious stones by George F. Kunz in *The Mineral Industry*, vol. 27, p. 604. Detailed information upon imports and exports you can obtain from the "Monthly Summary of Foreign Commerce of the U. S." This is a publication issued by the Department of Commerce, Bureau of Foreign and Domestic Commerce, and sold by the Superintendent of Documents, Washington, D. C. for 10c. per copy, or \$1 per year. From the February, 1920, number of this publication we take the following figures: For the eight months ending February, 1920, there were imported:

	Carats	Value
Diamonds	19,442	\$727,448
Glazers' and engravers', uncut	152,898	13,527,776
Uncut	343,973	51,469,543
Cut but not set		11,313,690
Pearls and parts of, not strung or set		1,994,755
Other precious stones uncut and bort.		4,243,531
Other precious stones, cut but not set		1,150,680
Imitation precious stones		
Total		\$84,427,423

## Accident Prevention and the U. S. Steel Corporation

"What does the U. S. Steel Corporation do in accident prevention and accident relief?"

It would be difficult to find sufficient space to detail the methods and practice of accident prevention by this corporation. Perhaps an adequate conception both of the magnitude of this work and its importance may be gleaned by the fact that \$1,131,446 was spent for safety work in 1919. The last annual report states that in that year there had been no material reduction in accidents, but that the low record of 1918 had been sustained. This record shows a decrease in serious and fatal accidents of 46.47 per cent compared with the record of 1906. The entire time of 112 employees is taken up with safety work, and 5,694 employes serve on safety committees. For accident relief there was disbursed in 1919 the sum of \$4,267,355, of which amount 83.28 per cent was paid directly to injured employes or their families or in taking care of them. To provide prompt and adequate treatment in case of injury the corporation maintains through its subsidiaries 286 emergency stations, 25 base hospitals, with a staff of 162 surgeons and physicians whose entire time is given to company work, and 104 outside surgeons retained on a salary. Sixty-three stations for training employees in first-aid and rescue work are maintained. The cost of sanitary work in 1919 was \$3,208,661.

"Where can I get a list of gem names?"

A very complete list of gem names is published by the U. S. Geological Survey in *Mineral Resources of the U. S.*, 1917, Part II, p. 148. The list given in this reference is of surprising length and the variety of names given for slight variations in color or form of the same mineral is an excellent example of ingenuity.

## BY THE WAY

### Offended Dignity

"M'son," said Cap'n Dick, "Did'st thee ever 'ear tell as 'ow Jan Trevarrow wuz goin' to put h'up one o' these 'ere big brick chimneys that takes tha smoke offen tha boilers? Naw? Well, Jan wuz gettin' a bit too h'old to be h'any use h'unnergroun', so 'e asked could 'e put in a bid for to put h'up this 'ere stack. An' w'en 'e got h'all 'is figger'n made 'e wuz as 'igh up in tha h'air as tha top o' that bloody chimney. An' tha boss sez to Jan, sez 'e, 'Ow in 'ell does thee get so many brick in tha stack; dos't thee build un solid?' So, Jan sez, 'Ow else would I build un?' 'Oh, gos' along do,' sez tha boss, 'don't thee naw a stack 'as a 'ole in she for tha smoke to gaw h'up?' 'Ole 'ell,' sez Jan. 'Aint there a 'ole in tha bottom for tha smoke to go in at? W'y, dam-me, I'm gawin' in tha 'ole an' sink a raise clean through to tha top o' she, to let tha smoke get h'out! An', min' you, m'son, Jan's mad to this day cause 'e didn't get tha job. W'ot's think o' that, naow?'"

### Weighty Facts

Under the heading "Tonnage Tax Facts That Every Minnesota Citizen Should Know" the *Grand Rapids* (Minn.) *Herald-Review* says:

If we encourage mining in Minnesota it will last—not a few years more—but many CENTURIES.

Mining is the most permanent industry known.

Millions of acres of fertile lands have become barren wastes, but there are almost no abandoned mines.

There are single counties in the New England states that have more square miles of abandoned farms than all the abandoned mines in the world.

The prospects are bright for a good year on the iron ranges, anyhow, according to reliable information.

### A Bit of Iron History

A time-yellowed pamphlet, entitled "Report of a General Convention of the Friends of Domestic Industry" and dated Oct. 26, 1831, is to be found in one of the miscellaneous volumes on the literature of the iron industry in the Public Library in New York City.

It includes the report of a committee of fifteen on the production of iron and steel, and a reply and protest against a movement to prevent the then pending enactment of higher import duties on iron and steel. According to the statistics gathered, there were 202 iron furnaces in operation in the United States in 1831, the output of which was 155,348 tons, representing a converted product of 90,168 tons of bar iron and 28,273 tons of castings. The industry had been growing rapidly, for, according to the committee, the output in 1828 was 130,881 tons, in 1829, 142,620 tons, and in 1830, 163,340 tons. Thus, it was pointed out, the production of iron had increased 25 per cent in four years, but—and this was the burden of the argument—the market value of the product had increased only 5 per cent. The average price of bar iron in 1828 was given as \$118½ a ton. The importation of iron in 1829 was 32,750 tons.

All these and more figures of similar import and interest were noted in a plea for "protective tax, if tax it be, for the duty does not fall upon the consumers of the importing country but upon the producers of the foreign article."

A forecast of Pittsburgh's greatness is in one paragraph which boastingly says: "The citizens of Pittsburgh are able to enter into successful competition with almost any other quarter in the fabrication of nearly every other article of necessity (in iron) and in one endeavor (the manufacture of steam engines)—justly esteemed the proudest effort of human ingenuity—they have attained a degree of perfection which enables them to challenge comparison with the skill and experience of any nation whatsoever."

### Ready-Made Brass Stopes

A persistent salesman of moribund mining properties with fabulous tonnages of possible ore, hailing from the state where examining engineers should provide themselves with a license and a diving suit, expatiated on the manifest advantages of one particular hole in the ground: "You see, this here plan shows that the mine is all full of ready-made stopes where they took out silver ore in the old days. Now, right here is a lot of copper ore, thousands and thousands of tons of it, that assays 3 per cent copper, 3 ounces silver, 3 pennyweights gold, and no zinc. Over here on the other side of the shaft is another immense body of ore that runs 3 per cent zinc, 3 ounces silver, 3 pennyweights gold, and no copper. You can call it either a copper mine or a zinc mine, just as you like." The weary fourth-assistant consulting engineer, having in mind the fact that the caller was notoriously *persona non grata* to the firm, retorted, "Now I know where you get that stuff. You have a No. 3 brass mine."

### A Pen Picture of the Prospector

"There is an old maxim, often quoted in mining circles, that prospectors are not miners. This is only too true, though quite contrary to the general public's illusion in that particular. Prospectors, as a rule, are as ignorant men as were the twelve Apostles. If they had not been prospectors they would have been hunters, or trappers, or fishermen, or pearl divers. The fascination of the lucky chance, and that noble element of eternal hope planted in the human breast, stronger, perhaps, in theirs than in others, have ever led them on in endless procession. The prospector grows to have sublime faith in the Goddess of Fortune, and dreams that he will some morning wake up in the very treasure vault of the Forty Thieves of the Arabian Nights. Inspired by visions of sudden and magnificent wealth and fame, he bravely pushes on and ever on, toward the goal of his heart's desire. Lengthening years of hardships, privations, hunger, and toil waste his energies, but do not dim his hopes. His once raven locks, tossed in the storms of the mountains and bleached by the suns of the desert, whiten to oncoming death. His manly form, once rugged and straight as the giant mountain pine, becomes feeble, old, and bent. The desert seems more hot and dusty, the mountain trail more hard and steep; the pick and the spade slip his nerveless grasp. His footsteps falter—all empty handed and forlorn, he lays him down to rest in an unknown land, but 'with the hillside for his pall, and the stars for tapers tall, he continues to search in the shadow lands of the mountains and deserts of the Great Beyond.'"

The above striking bit of descriptive writing is from a mining engineer's report on a mineral property. We do not know the name of the engineer, nor how he ranks as a mine valuer, but as a poet his stock looks favorable.

# THE PETROLEUM INDUSTRY

## Possibilities of Oil and Gas in North Dakota\*

By A. G. LEONARD

IN 1907, gas was discovered in Bottineau County, N. D., and a preliminary examination of the region was made in the fall of 1908 by J. G. Barry, who prepared a brief report on this field. In 1910, A. G. Leonard visited the gas wells near Westhope and Lansford, and published a brief account of the occurrence of gas in that district and in other localities in North Dakota. Recently, A. J. Collier has described the Nesson anticline, and reports that a flow of gas was struck at a depth of 750 ft. H. E. Simpson has examined a number of the gas wells in Bottineau and Renville counties in connection with investigations of the underground waters of that region for the State Geological Survey, and has gathered considerable data regarding gas in many of the water wells.

The geological formations of North Dakota are chiefly clays, shales, and sandstones of Cretaceous and Tertiary age. Cretaceous beds underlie the entire state, except much of the Red River Valley, and in the western half they are overlain by strata of Tertiary age carrying numerous lignite seams.

If oil and gas occur in North Dakota they will most likely be found in the Dakota sandstone rather than in any other formation in the state. The thick shales which lie above the Dakota sandstone seem to contain in this region only a few thin sandy layers, and therefore are not favorable for the accumulation of oil or gas in commercial quantity.

The Dakota formation has yielded oil and gas in several localities. In central Wyoming this sandstone in some places is saturated with dark asphaltic oil, and in the Powder River field the Dakota is the principal oil-bearing formation. In the Big Horn Basin of Wyoming, the Cloverly, which has the stratigraphic position of the Dakota sandstone, and probably corresponds in part at least to the latter, is one of the oil and gas-bearing formations. The great tar seepages of the Athabaska River in northern Alberta come from the outcrop of beds which have been referred to the Dakota horizon, and it is from this sandstone, or from sandy beds near the base of the overlying Benton shale, that the gas is derived in the Bow Island field. Bow Island is 340 miles northwest of the northwest corner of North Dakota. Gas from this field is piped 160 miles to Calgary and fourteen other towns along the route.

The Dakota sandstone is reached in many wells, but does not appear at the surface anywhere in the state. In the southeastern counties, as well as in South Dakota and elsewhere, this sandstone is the chief source of artesian water. It is a non-marine formation, and was deposited either in a large lake or was spread by rivers over their broad flood plains. The Dakota sandstone underlies the entire state, except a considerable portion of the Red River Valley, where it has been removed by erosion.

Above the Dakota sandstone are the Benton, Niobrara, and Pierre shales of the Colorado and Montana groups of the Cretaceous system. The aggregate thickness of these three formations in North Dakota ranges from 1,300 to 2,200 ft. and over. So far as known, these shales contain no sandstone beds of any considerable thickness in this state, and in their absence it is not probable that oil or gas is present in these shales in any quantity. As porous sandstone beds are wanting, there are no reservoirs in which the gas and oil could accumulate to form pools. It is known that at least two of these shale formations contain oil, which is disseminated through it in small quantity, as where the Niobrara outcrops in the Pembina Mountains, on the western edge of the Red River Valley, it has a strong odor of petroleum, and oil has been distilled from it. The Benton shale also has a strong odor of petroleum.

Farther west these shales, or their equivalents, in Wyoming, Montana, and Alberta contain sandy beds which yield oil or gas. In the Salt Creek field, Wyoming, the principal oil sand is the Wall Creek sandstone member of the Benton shale. Sandstone beds, in some places as much as 80 ft. thick or more, are present in the lower half of the Colorado (Benton and Niobrara) shale throughout much of central Montana. In the same region the equivalent of the Pierre shale contains a group of sandy beds from 250 to 400 ft. thick, which constitute the Eagle sandstone. The strong flow of gas struck at Havre, Mont., comes from this Eagle sandstone. The gas produced at Medicine Hat, Alberta, is also found at about the same horizon. According to Canadian geologists, the gas of the Medicine Hat field is found in sands of the Niobrara. If sand beds similar to those noted were present in the Benton, Niobrara, and Pierre shales of North Dakota, they would be favorable receptacles for the accumulation of oil and gas, and with favorable structural conditions these formations might yield both oil and gas, as is the condition further west.

The Fox Hills sandstone, which overlies the Pierre shale in the western part of the state, is not known to have yielded either oil or gas.

The Lance and Fort Union formations underlie the western half of North Dakota, the former occurring in the south-central and southwestern portion, and the latter occupying the rest of the area. It is the Fort Union formation which carries most of the lignite beds, though there are a few in the Lance. These formations are composed of shales and sandstones, and their aggregate thickness, where both are present and have not undergone erosion, is 1,600 to 2,000 ft., but over much of the region the Fort Union exhibits more or less erosion, so that the full thickness is not represented. Though hundreds of wells have been drilled in these formations in search of water, no oil has even been found, except in small amount, and but little gas. This is true not only for North Dakota but also for the neighboring states of Montana and Wyoming, and for Alberta. It does not seem at all probable, therefore, that the Lance and Fort Union formations will ever yield oil or gas in large quantities.

\*Excerpt from Bull. No. 1, North Dakota Geological Survey.

Several anticlines have been located in North Dakota, and careful search will no doubt disclose the presence of others. The earliest to be discovered was the Cedar Creek anticline, which extends from the Yellowstone River a few miles west of Glendive, Mont., southeast into Bowman County, N. D., in the extreme southwestern corner of the state. Half a dozen wells drilled on this anticline west of Glendive struck gas at 760 to 790 ft., and a well near Baker, Mont., is reported to have found gas at 815 ft. and 1,450 ft. The gas from these wells supplies the above towns with heat and light. One or more companies are preparing to drill on the south end of this anticline which is near Marmarth, N. D.

The Nesson anticline, in Williams County, about thirty miles east of Williston, has recently been described by A. J. Collier. West of Mohall, near the eastern border of Renville County, another quite well-defined anticline has been located, its axis trending north-northwest and south-southeast. Within the area covered by the Mohall anticline a large number of wells yield gas under pressure of over 100 lb., the gas being found in sandstones of the Fort Union formation at a depth of from 200 to 300 ft. A company has been formed to drill on this anticline, the well to reach the Dakota sandstone in search of oil and gas.

#### GAS WELL DEVELOPMENT

Perhaps the most promising gas field in the state is what may be termed the Mouse River Loop field, in northwestern North Dakota. There are between twenty-five and thirty gas wells in this field, and many of the water wells of the region yield much gas. In July, 1907, gas was struck on the Parker farm, nine miles south of Westhope. The North Dakota Gas Co. sunk eight wells, and the gas from five of them was piped to Westhope, where it was used for heating, cooking, and lighting. The village of Lansford, in southwestern Bottineau County, was also for a time supplied with gas piped from wells located five miles to the northeast. The pressure here at first, reported to be from 62 to 74 lb., soon grew less, and for many months remained at about 20 lb. The North Dakota Gas Co. drilled a deep well (the Parker well) nine miles south of Westhope, with the hope of striking gas at greater depth in the Dakota sandstone. Unfortunately, the well had to be abandoned after it had attained a depth of 1,954 ft. and had apparently reached the top of the Dakota. Drilling operations had to cease on account of casing trouble. In La Moure County a number of artesian wells, having depths of 1,150 to 1,450 ft., yield gas.

At present it is not known whether oil occurs in commercial quantity in North Dakota. It is entirely possible that where the structural conditions are favorable oil will be found in the Dakota sandstone in this state as it is in Wyoming and Alberta. Where anticlines or domes are present, it is believed that drilling to the Dakota sandstone is warranted for the purpose of prospecting for oil and gas, and thus testing out the field conclusively.

The Rumanian oil fields are virtually controlled by the Royal Dutch Shell interests. This company controls the Astra Romana, the largest oil-producing company in that country, and has recently acquired 10,000 shares of the Steaua Romana Petroleum Co., which is the second largest producer.

## New Design for Oil Tankage

BY H. T. CARLTON

Written exclusively for *Engineering and Mining Journal*

THE rapid growth of the oil industry and the large increase in oil production during the last decade necessitate efficient and economical storage methods. In the early days of the industry, crude oil was stored in earthen sumps, from which it was pumped to small wooden tanks for shipment. The large leakage and evaporation losses incident to such primitive methods of storage early led to their abandonment as the value of oil increased. Seepage and evaporation were partly taken care of by lining the earthen reservoirs with a three-inch slab of concrete, reinforced with wire mesh, and adding a wooden roof covered with felt roofing and supported on wooden columns.

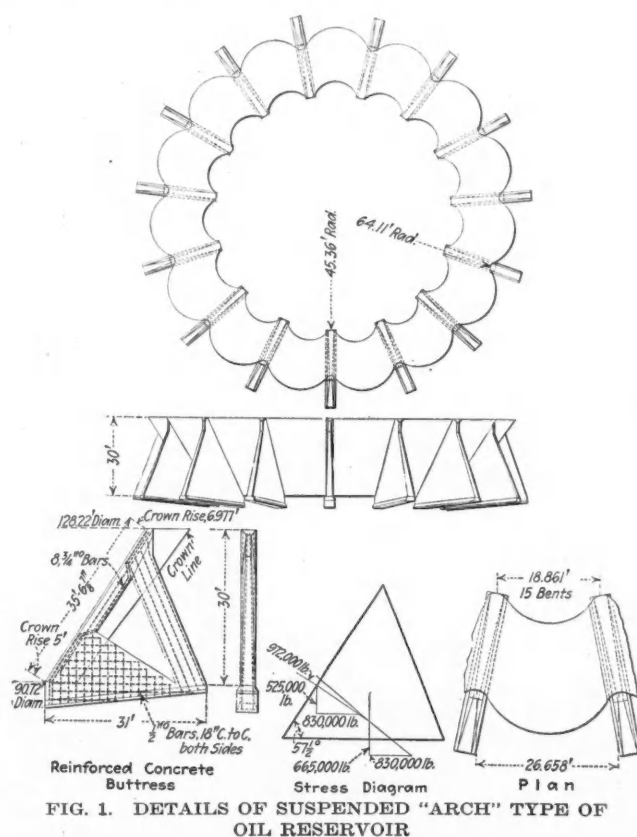


FIG. 1. DETAILS OF SUSPENDED "ARCH" TYPE OF OIL RESERVOIR

These lined reservoirs were not entirely satisfactory, for several reasons, but they are still in use to some extent, owing to the fact that up to the present nothing better has been devised. One of the principal objections to earthen reservoirs of large capacity is that they have no salvage value. When an oil field has been pumped dry, the hundreds of thousands of dollars expended in the construction of these reservoirs is practically lost. Other objections that might be mentioned are the dangers resulting from settlement cracks in the concrete lining; the weakening due to gopher or squirrel holes in the embankment or to poor backfilling. Also, leaks may develop which are not discovered until the reservoir is drained, a condition that does not often happen during the useful period of the reservoir.

The foregoing facts have led to the extensive adoption of steel tankage in nearly all the large oil-producing centers. Steel tanks reach the limit of economy at approximately 55,000 bbl. capacity. In units of larger

capacity the cost is practically prohibitive, because of the heavy plate required. In a cylindrical steel tank the thickness of the plate required is a function of the depth of the oil and the diameter of the tank. The larger the diameter of the tank, the greater the rim tension. Consequently a greater thickness of plate is required.

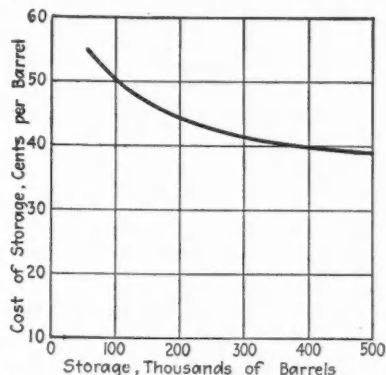


FIG. 2. COST OF STORAGE CAPACITY IN RELATION TO SIZE OF RESERVOIR

D. O'Hara and A. L. Shaw, of San Francisco, have developed a new tankage design involving the suspended steel "arch," which has recently been patented. The design was brought out to meet the demand for steel tankage in large units which would be efficient as well as economical. The important details of this design are of interest. The tank consists of a number of sections or bents, each comprising a suspended steel "arch" on concrete buttresses. The "arch" itself is a section of the surface of the frustum of an inverted cone, which, when the load is applied, assumes a parabolic cross-section normal to the axis of the cone. The buttresses are of reinforced concrete, set on radial lines on the circumference of a circle, thus giving the tank a circular perimeter and also providing an increase of span from the floor line upward.

The true curve for a linear "arch" sustaining a load is a parabola whose maximum tension exists at the point of suspension. The load, in this case being hydrostatic, is uniform across any horizontal plane at any given depth. Hence the thickness of plate required is independent of the diameter of the tank under a constant depth, being only a function of the depth and the curvature and span of the "arch."

These facts make it possible to construct tanks of 37,000-bbl. and 55,000-bbl. units more cheaply than those at present in use, and also to build steel tanks in units as large as the present earthen reservoirs, the cost per barrel of storage varying inversely as the size of the tank. Added to this is the salvage value of a reservoir so constructed.

The particular tank shown in Fig. 1 is a 55,000-bbl. unit, 30 ft. high, the lower 20 ft. being of  $\frac{1}{4}$  in. and the upper 10 ft. of  $\frac{3}{8}$  in. plate, as this is as thin as can be conveniently welded (the preferable method) or riveted to make an oil-tight joint.

At present prices, cylindrical steel tankage in 55,000-bbl. units costs approximately 73c. per barrel storage. In the suspended-"arch" type of construction, the cost in 55,000-bbl. units is estimated at approximately 55c. per barrel storage, a saving of 27 $\frac{1}{2}$  per cent; in 100,000-bbl. units, approximately 50c. per barrel storage; and in 500,000-bbl. units approximately 39c. per barrel storage. The accompanying curve indicates decrease in cost for different sizes. No tanks of this description have, up to the present, been constructed.

## Easily Made Oil-Field Appliances

Inexpensive and Handy Devices of Utility and Comfort to the Drilling Crew Constructed of Odds and Ends Around the Rig

BY ALBERT G. WOLF

Written exclusively for *Engineering and Mining Journal*

IN THE oil fields, as well as elsewhere in the industries, many simple appliances made on the spot are used, which affect a large saving in time or material, or in the actual cash outlay for some manufactured article that is thereby replaced. Three such home-made appliances are here described.

### CASING STRAIGHTENER

In Fig. 1 is shown a casing straightener. This consists of a main member, 12 x 12 in. x 10 ft. long. Mortises, 6 in. deep, are cut across this timber, at right angles to receive two other pieces of 12 x 11-in. timber, one 6 ft. long and the other about 2 ft. long, which are bolted securely in place. The mortises are cut so that the two crosspieces are parallel and 2 ft. 8 in. apart inside. The portion of the main member between these two crosspieces is cut down 4 in. Against the shorter crosspiece is placed an 18-in. screwjack. This is leveled by a block of wood, and held securely by a large staple of  $\frac{1}{2}$ -in. round iron.

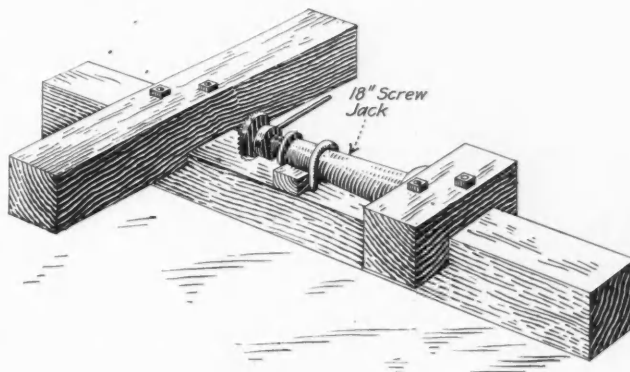


FIG. 1. CASING STRAIGHTENER

The space between the end of the screwjack and the 6-ft. crosspiece is sufficient to accommodate casing up to 8 in. diameter. A crooked piece of casing to be straightened is placed alongside the 6-ft. crosspiece, with the convex side of the bend toward the end of the screwjack. By screwing up the jack slowly the bend is pressed out. Wood blocks may be inserted between the end of the jack and the casing when necessary. Slightly bent casing is easily made straight enough for any purpose, and badly bent casing can be sufficiently straightened to use in shallow holes. A straightener with space enough for larger pipe could be just as easily constructed, but I doubt its practicability on larger-sized pipe.

In the Gulf Coast country in winter, the temperature rarely falls below freezing, but the north wind is decidedly chilly. A little heat, therefore, is quite agreeable to the crew of a rotary drilling rig when everything is running smoothly and there is no work to do on the derrick floor. Fig. 2 shows a cheap but efficient stove for burning fuel oil, or crude oil, the most common fuel around a drilling rig. It is made largely of discarded material, and anything suitable for other purposes can be reclaimed later. The body, or drum,

of the stove is a 5-ft. length of old casing, 6-in. casing being sufficiently large. An opening is cut in this, 12 in. from one end, and 6 in. long x 4 in. wide. About 9 in. above the opening, a 1-in. hole is drilled through the casing. The drum is stood on end on a sand box on the floor, and filled with clay nearly to the level of the lower edge of the opening. This latter serves as a fire

to be cored was extremely heavy. This caused the water to rise in the drill stem, and when "breaking down" (hoisting the drill stem and unscrewing it), the crew would be drenched. The core barrel was 4-in. in diameter. There was no 4-in. rotary back-pressure valve at hand, and as it would take several days to obtain one, an experiment was tried in order to save time and the

feelings of the crew. A 5-in. length of 6 x 6-in. pine timber was cut, and trimmed into a frustum of a cone with a larger diameter of 4 in., and with a very slight taper, as shown in Fig. 2. A  $\frac{3}{4}$ -in. hole was bored on the axis of the frustum. Over this hole, on a smaller end of the frustum, a heavy piece of leather, cut as shown, was fastened by a screw. This leather served as a valve. The valve end of the plug was inserted into the upper end of the core barrel, and the plug driven in flush with the barrel. The heavy leather had spring enough to permit the water, forced down the drill stem by the flush pumps, to pass by it, but it likewise had sufficient strength to sustain the pressure of the ground water when the pumps were turned off, and thereby prevent the water from rising in the drill stem and flooding the crew when lengths of drill stem were unscrewed. The entire job of coring was done with this improvised back-pressure valve.

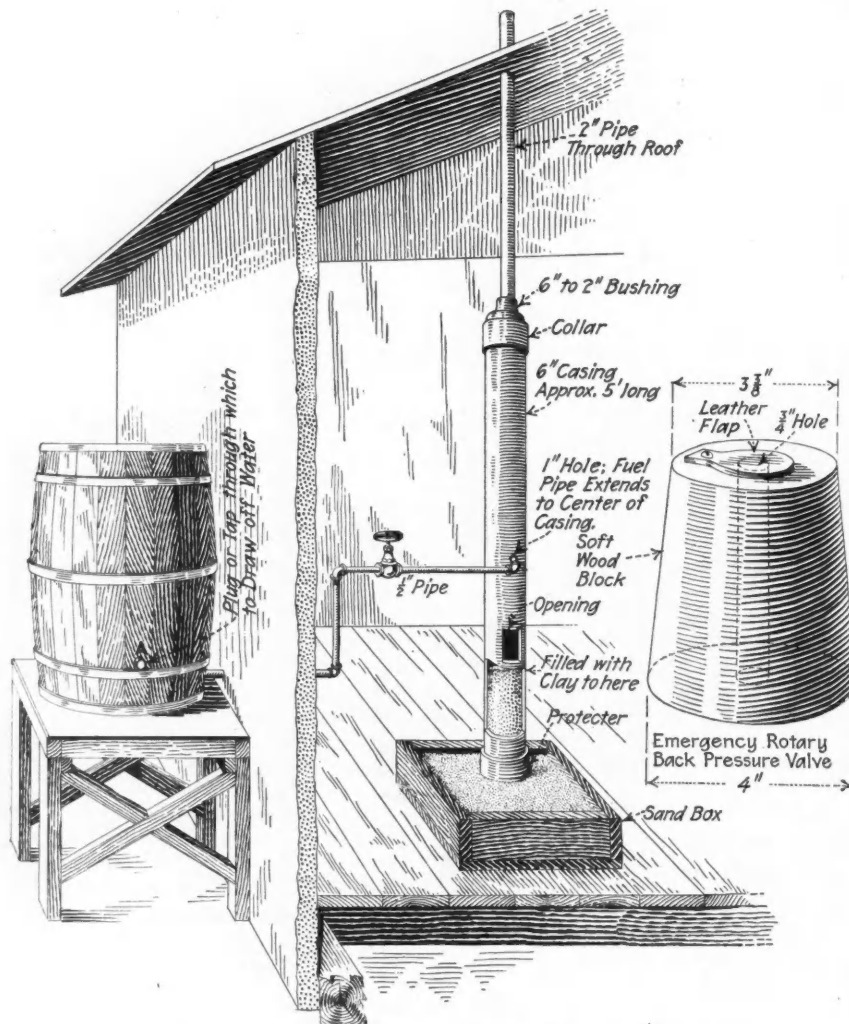


FIG. 2 FUEL-OIL STOVE AND BACK-PRESSURE VALVE

door. The upper end of the casing is fitted with an old collar, which is bushed down to 2 in. Into the bushing is screwed a short length of old 2-in. pipe, which, passing up through the roof, serves effectively as a stovepipe.

The fuel is supplied from a barrel outside of the building, which is elevated just enough to give part of the oil a slight head. A  $\frac{1}{2}$ -in. pipe conducts the oil into the stove through the 1-in. hole, the pipe extending to the center of the drum. A globe valve regulates the flow of oil. In using the stove, a piece of waste, some old rags, or frayed and greasy rope is placed within the drum through the opening, the globe valve is turned on so that the oil feeds in a rapid drip, and the waste is ignited. A comfortable temperature can be maintained in a tool house in quite chilly weather with the consumption of only a small amount of fuel and at a low cost.

On a certain drilling job, where the rotary system was being used, it became necessary to take a core. It so happened that the water pressure in the stratum

### Oil Near Thermopolis, Wyo.\*

The Warm Springs domes of Wyoming are two high places on the east end of the Thermopolis anticline, and the Hamilton dome is a short distance west of its west end. The Thermopolis anticline is a well-known and well-marked arch of the rocks extending about twenty-two miles northwest through Thermopolis. The anticline is not symmetrical, as the dips are about 45 deg. on the south and 7 deg. on the north side.

The rock formations involved belong to the Cretaceous, Jurassic, Triassic, and Carboniferous systems. In the Warm Springs domes about four miles east of Thermopolis the Chugwater, a Triassic formation, is exposed at the surface, and the oil sand is reached in the Carboniferous-Embar group. In the Hamilton dome the rocks exposed at the surface are Cretaceous, and the productive sand is in the Triassic-Chugwater formation. Unlike the light high-grade Cretaceous oils found in Wyoming, the oil from the Warm Springs domes is heavy and dark. Its specific gravity is about 19.1 deg. Bé. That produced in the Hamilton dome is of a little better grade than the Warm Springs oil, having a gravity of nearly 23 deg. Bé. The production of the Warm Springs dome is given as about 1,000 bbl. per day. No production is given for the Hamilton dome, as the oil had been struck too recently to justify an estimate.

\*"Oil in the Warm Springs and Hamilton Domes Near Thermopolis, Wyoming." By A. J. Collier. U. S. Geological Survey Bulletin No. 711-D. Pp. 61-73, with 4 plates and 1 text figure.

## NEWS FROM THE OIL FIELDS

### California Oil in March

Reserve Stocks Show Large Reduction  
—Month's Production Normal  
From 9,135 Wells

Statistics made public by the Independent Oil Producers' Agency at Los Angeles for the month of March continue to show a large reduction of California crude-oil stocks. Reserves were reduced from 25,969,174 bbl., March 1, to 24,866,470 bbl., April 1, a shortage for the month of 1,102,704 bbl., a daily shortage of 35,571 bbl., which is an increase of 3,690 bbl. daily over the February daily shortage of 31,881 bbl.

The March production of 8,583,110 bbl. was about normal. The daily production of 276,875 bbl. for March shows an increase of 947 bbl. over the February daily production of 275,928 bbl. This slight increase in production, however, is more than offset by the large increase in shipments as indicated below.

The March shipments of 9,685,814 bbl., or 312,446 bbl. daily, exceeded the February shipments of 8,926,466 bbl., by 759,348 bbl., an increase in daily shipments of 4,637 bbl. over the February daily shipments of 307,809 bbl.

There were 52 wells completed in March, with an initial daily production of 6,500 bbl., which shows an increase of 18 completions but a decrease of 7,400 bbl. initial daily production when compared with the February completions of 34 with an initial daily production of 13,900 bbl. Seventy new rigs were erected during March, an increase of 20 over the total erected in February. There were 364 wells drilling during March, an increase of 17 strings over the 347 wells drilling in February. There were 9,135 wells producing in March, an increase of 32 over the February figure of 9,103. Abandoned wells in March totaled 27, fourteen more than in February, during which month 13 were abandoned.

### Texas Coastal Crude Raised in Price

The price of coastal crude oil was raised from \$2.50 to \$3 per bbl. on April 13, by the Gulf Refining Co. The raise was immediately met by the Texas Co., Humble Oil & Refining Co., and other large purchasing companies. This raise applies to oil from Batson, Dayton, Goose Creek, Humble, Saratoga, Sourlake, Spindle Top, and West Columbia, in Texas; Vinton and Jennings, in Louisiana, and other coastal fields.

According to the U. S. Geological Survey, the total increase of petroleum production in March was 6,000,000 bbl., as compared with March, 1919. Increased consumption made necessary the importation of 6,500,000 bbl.

### Lincoln G. Valentine Suggests Government Assistance for Oil Industry

Government subsidy, Government tank steamers, the lowering of taxes on incoming oil products and special reciprocity treaties with Latin-American oil-producing countries are among the plans suggested by oil men in this city, according to the *New York Sun and Herald*, to aid in combating British syndicates in Latin-America. Lincoln G. Valentine, former general manager of the Sinclair interests and now chairman of the Central American Petroleum Corporation, is the leading producer in the movement, it is stated.

The decision to ask for Government assistance in the acquisition and protection of America's future oil supply was made as a result of recent British activities, notably the sending of Sir George Cadman, British oil expert, to San Remo to obtain ratification of the Turkish settlement giving Great Britain Batum and the control of the pipe line from the great Baku oil fields.

Recent statements by Sir Edgar Mackay that in ten years Great Britain would control the oil fields of Latin-America and the rest of the world also quickened the decision of American producers. Mr. Valentine said yesterday that a committee will be appointed at once to take up the matter with Congress and the President.

### British Columbian Government To Consider Peace River Oil Investigations

When the Hon. T. D. Patullo, Minister of Lands in the Provincial Government, asked the Provincial Legislature to endorse a vote of \$25,000 to continue the investigations begun last year by government geologists into the oil possibilities of the Peace River district of British Columbia, he stated that the explorations up to the present encouraged the belief that oil would be found in commercial quantities. The government's policy, he said, was to see that this oil wealth, if it existed, should accrue to the people. A reserve had been declared on oil on the crown lands of that district, and if oil was discovered the government would consider the advisability of itself going into the oil-producing business, using the profits to pay off the provincial debt. The vote was passed, although several of the members expressed the belief that private enterprise would make a more thorough exploration and that it would be the wiser policy to let private enterprise undertake the work, it being understood that a royalty would be payable to the government on anything that might be discovered.

### Oil Conservation and Development in California—Cooperation of Producers

Co-operation of every oil producer and consumer in California is needed if the Pacific Coast is to have an ample oil supply with which to carry on the industries in which oil is used. At the annual meeting of the Independent Oil Producers' Agency, the help of everyone in the state in conserving the present supply was asked. Before adjourning the agency elected officers for the ensuing year, a directorate of fifty members, and an executive committee of fifteen. The president is L. P. St. Clair, and Stanley W. Morehead is vice-president.

The Majestic Oil Co., on the recommendation of the Visalia Land Office Receiver and Register, will receive a U. S. patent for 320 acres, comprising the west half of Section 23, 31-22, now operated by the Union and Tumbador oil companies, the Union having acquired its holdings by purchase from the Pinal Dome Oil Co.

In preparation for the development on Section 35, 30-24 the Southern Pacific is building rigs and hauling material to that area. The Standard's 5,500-bbl. gusher on Section 36, outside of the Naval Reserve, is immediately adjoining on the east, in the Elk Hills district.

The Associated Oil Co. has spudded in No. 14 well on Section 28, 28-28, in the Kern River field.

### Sinclair Consolidated Oil Corporation To Seek New Capital

Stockholders of the Sinclair Consolidated Oil Corporation have been informed of the plans of that corporation to issue \$75,000,000, five-year 7½ per cent notes for the purpose of raising capital to increase oil development in domestic localities as well as in foreign countries. At the stockholders' meeting to be held May 19, 1920, the issuance of the notes is to be passed upon, as well as the ratification of the board of directors in authorizing the payment of four quarterly stock dividends upon the common stock on the basis of two shares of no par value common stock each quarter for each one hundred shares of such common stock outstanding at the end of each quarter.

The gross earnings of the corporation for the year ending Dec. 31, 1919, were \$76,970,958; operating and general expense, maintenance, insurance, and taxes, \$54,300,060; net earnings, \$22,670,898, which, after deducting \$3,069,662 for interest, discount, and Federal taxes, leaves \$19,601,235 as income available for surplus and reserves as well as dividends.

# ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

## What Are the Most Important Issues of the Presidential Campaign?

Herbert Hoover Replies "Action, Not Words" Are Demanded by the American People

(Condensed from *New York Tribune*, April 29, 1920)

The Republican platform will doubtless be constructed around two general themes, first, the party view as to the many measures before the country; second, the ideals that the party will represent.

The war has stirred our old concepts of moral and economic issues; it has created anxious distrust of the old methods and has raised a complex of new visions. Our people are groping for something far greater than election platitudes.

All the different party platforms will urge some form of a league of nations, a business reorganization of Federal administration, an economy in government, a national budget, readjustment of taxation, reduction of cost of living, suppression of profiteering, betterment of agricultural industry, improved relations between capital and labor, better distribution of wealth, an American merchant marine, maintenance of civil liberty, extension of education, improvement of waterways and many other items.

I am for all of these things, but the Socialists on one extreme or the special interests on the other could also favor them. Therefore, the Republican party must do something more.

### Policy of Higher Purpose

The people will value a platform as a higher purpose if it is tangible and definite in the proposals for solution of its items. Our people are only secondarily interested in the remedies and adjustments which all sides will promise to promote. . . . They are craving for a demonstration of the moral, social, and economic ideals that are to dominate the solutions of these questions. In defining these great standards, the party must reach into the aspirations of our people and into the social philosophy upon which our national life is founded.

Our people have an ideal of world service. This ideal cannot be ignored by the party.

Its living force will insist upon our joining in the organization of the moral forces of the world, to reduce armament, check militarism and relieve oppression. Our people do not desire to see us pledged to use force in these purposes; furthermore, they have no more sympathy with the growth of militarism at home than abroad.

Failure to support the league of na-

tions, with proper reservations, would be a shock to the spiritual aspirations of the American people.

### The Individual Liberty Ideal

In the ideals and standards to be applied to our economic problems, the Republican party must enunciate a social ideal that does not tolerate either socialism or the centralization of wealth and the domination of capital.

The great ranks of our people are neither radical nor reactionary. Their ideal is individual liberty, the protection and stimulation of individual initiative under the American condition that there shall be equal opportunity to all.

They realize that this is the only protection from frozen class barriers. The domination of any individual or any interest is a negation of our real national faith. They believe that such domination is going on to-day, and they want correction to it.

They recognize that the starting point and safeguards of these ideals is education. Education and the working of public conscience of our community and safeguards of these ideals comprise the freedom of the press, of assembly, and of speech on a pre-war footing, to advancement of ideas through the ballot box, to trial by jury.

Nor are liberal ideals alone sufficient. *They are beginning to realize that words without action are the assassins of idealism.* On the other side, they are equally disgusted with seeking for power by destructive criticism, demagoguery, specious promises and sham.

The maintenance of political parties is vital to the functioning of our democracy, and it is therefore a national duty to inspire faith and confidence in party government. We cannot carry on this government successfully if we have numerous conflicting groups. Disintegration of party will undermine majority rule, and endanger us with minority rule.

This is, therefore, the great opportunity of the Republican party to demonstrate again that it is a party of the people, that it is a party of great and positive ideals and of definitely constructive realism.

### Western Manchurian Copper Report Ready

A report of the investigations made as to certain copper mining properties in western Manchuria by J. Morgan Clements, geologist and mining engineer, serving as American trade commissioner in China, may be had by addressing to the U. S. Bureau of Foreign and Domestic Commerce a request for Confidential Circular F.E. 130.

## New York Long a Great Mining Center

A Survey of the Facts Reveals Many Industries, Schools, Publications and Mining Men Concentrated in the Metropolis

Publishers of mining and engineering journals are sometimes challenged for maintaining publication headquarters in New York City, where no mining is in evidence, and which is far from actual mining fields. These challengers were recently answered by J. Parke Channing, chairman of Engineering Council, in a public letter from which the following extracts, as published in the *New York Sun and Herald*, April 25, 1920, are taken:

"Although mining ranks as one of the important industries of the world, most of it is done in places and under conditions which are not within the everyday view of the average citizen. City dwellers are likely to think of mining, when they think of it at all, as an occupation that does not intimately concern them. They are likely to assume also that the most important mining is confined to the Western and Northwestern States.

### Vast Production in the East

"It is true that the largest copper mines are in Arizona, Montana, and Michigan; that much of the lead and zinc produced in the United States comes from Missouri and neighboring states; that Minnesota, Wisconsin, and Michigan produce most of the iron ore, supplying the blast furnaces and steel works of the middle states. But considering the actual money value of the mineral product of the country, the collieries of Pennsylvania and the iron mines of New Jersey, New York, and Pennsylvania, all within a railroad journey of a few hours from New York City, furnish a large part of the total mineral production of the United States. In addition, there are the petroleum and natural gas deposits of Pennsylvania, the rock salt mines of central New York, and numerous quarries and cement works. New Jersey has the distinction of containing a large mine which produces a unique ore furnishing both zinc and manganese.

"New York City is not only a mining center but a center of mining education. The Columbia University School of Mines was the first institution of its kind to be established in the United States. The first step for the foundation of a faculty of applied science was taken in 1864, when the Columbia trustees formally approved the creation of a school of mines. In 1896 the schools of engineering and chemistry were set off from the School of Mines, the three schools remaining, however, under the



jurisdiction of a single faculty, now headed by Dean G. B. Pegram.

"The aim of Columbia is not merely to produce highly skilled technicians, but educated men, fitted both to work in the field of science and to assume the highest responsibilities of civic leadership. Engineers are gradually coming to play a more important part in the affairs of the state. The war proved the worth of the engineer as a political and civic factor. The reconstruction period reveals him in scarcely less striking fashion.

#### The Smelting Industry

"Within twelve or fifteen miles of the city there are extensive smelting and refining works, the principal ones being those of the American Smelting & Refining Co., Perth Amboy; Balbach Smelting & Refining Co., Newark; Orford Works, of the International Nickel Co., Constable Hook; United States Metals Refining Co., Chrome, all in New Jersey, and the Nichols Copper Co., Laurel Hill, Long Island. The first two mentioned treat complex ores and matter containing most of the metals of commerce; the others handle copper products, chiefly in their smelting and electrolytic refining establishments. Also within easy reach of the city are iron blast furnaces, foundries, steel works and rolling mills and many other similar industries.

"According to Prof. R. Peele, of Columbia, Pennsylvania, New York, and New Jersey in 1918 produced 14,500,000 tons of pig iron, valued at about \$478,500,000, without taking into account the huge production of structural steel. Thus within a radius of not more than 100 miles from New York City may be studied many phases of the best mining and metallurgical practice of the country. The city is, consequently, the headquarters of a large number of mining and metallurgical companies having interests in every part of the United States and in many other countries. It also contains the principal offices of the American Institute of Mining and Metallurgical Engineers and the Mining and Metallurgical Society of America, both of which hold frequent meetings for the discussion of technical papers on mining and on metallurgical subjects.

#### Mining in New York City

"For a number of years New York City has been the center of an enormous amount of varied engineering work, in connection with the system of subways, the twelve subaqueous tunnels under the Hudson and East rivers and the recently completed aqueduct tunnels. Extensions and branches of the subway system are still in progress and new lines are projected. Due to this huge amount of excavation work, the city has been and is likely to be for some time to come, in the language of Prof. Peele, a kind of 'mining camp' on a large scale, affording examples of varied methods of excavation of earth and rock under exceedingly difficult conditions."

### Roper Declares War-Revenue Laws Discourage Production

**They Tax Our Vitality, but Revision Should Not Be Hasty—Future Needs Must Be Considered**

The Greater Production Convention of the United States Chamber of Commerce, meeting at Atlantic City, N. J., early last week, was addressed on April 27 by Daniel C. Roper, president of the Marlin Rockwell Corporation, on the very live subject of "Federal Taxation." From the fullness of his experience as recent Commissioner of Internal Revenue, Mr. Roper reviewed the points of success and of failure shown by our war-revenue laws. He deplored their complexity, with the resultant necessity for disproportionate efforts and expense by every one concerned in administering and in obeying them. He said, among other things:

"The money paid out directly by taxpayers in their endeavor to comply with the law last year amounted, in my opinion, to no less than \$100,000,000.

"Not only are thousands of men and women, already staggering under this burden of the extraordinary problem of reconstruction, further burdened by the brain-fagging intricacies of invested capital and the differentiation between what is income and what is not—what may and what may not be deductible—but in the final analysis they are put to the necessity of employing lawyers, accountants, and engineers at much expense to calculate tax liability. They must employ extra clerical help, install and maintain special records, and in many instances overhaul entire systems and methods of accounting, which may be entirely adequate for ordinary business purposes, but which do not enable facile compliance with the tax laws. I have been appalled during the last two years by the amount of brain power and energy that have been diverted from normal avenues of production to the activities incident to compliance with the tax laws. A great deal of the best brains and ability in the United States is devoted to the work of attempting to solve the insoluble problem of how to make profits that are not taxable, not to mention the less laudable and more rarely encountered attempts to conceal taxable income. Men are heard to boast of losses sustained that may be deducted, but lament gains that are unavoidable and on which tax must be paid.

"Useful enterprises are not organized, and production is discouraged by this condition; mining of minerals, ore, and coal is deferred or curtailed, and timber ready to be cut is left standing because interest charges on such operations appear to be more than offset by the greater net profit to be made eventually under the lesser tax that is anticipated in the future. It would be a long list indeed that would describe the uneconomic, unhealthy and repressive, and often unsavory business practices that are engendered by this con-

dition. This at least enables us to perceive the distinctive and outstanding facts of which cognizance must be taken by every business man. Let us not forget, however, that: First, the war-revenue laws, hastily and imperfectly enacted as they were, drew into the Government Treasury the revenue needed for immediate war requirements. In this respect they were successful. Second, they have created a tremendous administrative agency for verifying returns in the effort to effect equitable distribution of the tax burden. Although the clearing away of this accumulation of work will be costly to the Government and taxpayers, it cannot be avoided. Third, experience has demonstrated the desirability of thoroughly revising the Excess-Profits Law as quickly as possible, and of enacting new legislation which will produce needed revenue without such deterring effects upon industry and thrift, and without such delays in getting the money owing to the Government into the Treasury and that which is overpaid back to the taxpayer."

Mr. Roper warned against a hasty revision of the Excess-Profits Law, pointing out that the situation is complicated, and future Government needs must also be considered, "and proper effort made to encourage productive industry, now much below our imminent needs. After all, the thoroughly ethical, equitable and expeditious administration of heavy tax laws will continue to be the most important problem before the American people, but there must be no preferential treatment either in construction or in administration."

Mr. Roper concluded with a plea for public support of his successor, William N. Williams.

The Engineering Section of the National Safety Council held its spring meeting on April 27 at Engineering Societies Building, New York City. During the morning session, the following talks were given, followed by discussion: "The Relation of Safety to Engineering Efficiency," by L. A. De Blois; "Safety Instruction in Engineering Colleges," by Bruce W. Benedict, and "How To Interest Student Engineers in Safety," by Prof. G. S. Blessing. The afternoon session was given over to the discussion of safety standards, at which David S. Beyer presented a paper on "The Movement for Uniform and Safety Standards and the Engineering Section's Part." In the evening, an informal dinner was held at the Hotel Commodore. C. P. Tolman, chairman of the section, presided as toastmaster. L. R. Palmer, H. W. Forster, and David Van Schaick spoke briefly on the relation of safety to engineering. The address of the evening was given by Lindon W. Bates, who emphasized the importance of the submarine during the war, and predicted its effect on future conflicts. Short talks were given by A. D. Flinn, Frank B. Gilbreth, and Dr. R. M. Little, director of the Safety Institute.

## MEN YOU SHOULD KNOW ABOUT

**George A. Laird** is temporarily making his headquarters in New York City.

**Alfred Alder**, mining engineer, is superintendent of the Nevada Packard Mines Co., Lower Rochester, Nev.

**Henry W. Turner**, mining engineer, Mills Building, San Francisco, is making examinations in central Idaho.

**Raymond Guyer**, of Spokane, consulting engineer of the Boston-Ely Mining Co., was in Ely, Nev., recently looking over the various properties of the company.

**Jay A. Carpenter**, mining engineer, has moved his offices from Tonopah, Nev., to 1006 South Hill St., Los Angeles, Cal., and will now practice as consulting engineer.

**O. C. Davidson**, general superintendent for the Oliver Iron Mining Company on the Gogebic and Menominee ranges, has returned from a three-months vacation in Florida.

**G. A. Joslin**, managing engineer for Ramshorn Mines Co., Salt Lake City, has gone to the company's property at Bayhorse, via Challis, Idaho, where he will spend most of the summer.

**Karl Eilers**, recently of the directorate of the American Smelting & Refining Co., has opened private offices at suite 5004, Woolworth Building, 233 Broadway, New York City ('phone Barclay 7363).

**H. W. Kitson** has recently completed a geological survey of the Iron Cap Copper Co.'s property near Globe, Ariz., and is now doing some field work in central New Mexico. Mr. Kitson's address is 1209 Mills Building, El Paso, Texas.

**Charles H. Nesbitt** has been reappointed chief state mine inspector of Alabama, and **James B. Curlin** has been made an associate inspector in place of **Hugh Lynch**, resigned. Mr. Nesbitt has been at the head of the Alabama mine inspection work for many years.

**J. S. McClenahan**, formerly with the Chile Exploration Co., at Chuquicamata, Chile, is now with the Nichols Copper Co., Laurel Hill, Queens County, N. Y. Mr. McClenahan has charge of the refinery which comprises the anode casting, tank room, and wire bar departments at Laurel Hill.

**Van. H. Manning**, director of the U. S. Bureau of Mines since the death of the Bureau's first director, Joseph H. Holmes, has announced his resignation, effective June 30, next. Dr. Manning will become director of research with the newly organized American Petroleum Institute.

**G. J. Salmon**, mining engineer, of the Copper Range Co.'s Champion mine at Painesdale, Mich., has been called to Washington, and will serve the War-Minerals Relief Board as examiner of properties developed at Government

solicitation during the war. Mr. Salmon left Painesdale for Washington on April 15.

**John V. Richards**, mining engineer, who left his position with Finch & Campbell, of Spokane, Wash., to take a lieutenancy of Pioneers, 363rd Infantry, when the United States entered the war, has returned to professional work and is now manager of Bishop Creek Milling Co., Bishop, Cal. **Stuart E. Elliott** is assistant manager, and **C. O. Moss**, mine superintendent.

**Jesse Q. Betterton**, chief experimental chemist of the A. S. & R. Co.'s plant at Omaha, Neb., has resigned recently to accept the position of chief metallurgist for Rhodesia Broken Hill Development Co., Broken Hill, Rhodesia, Africa. Mr. Betterton, who is a graduate of the South Dakota School of Mines, had been with the Omaha, Neb., plant almost continuously for the last ten years.

**Herbert C. Hoover** was this year's recipient of the memorial gold medal "for eminence in the application of science to the public welfare," presented by the National Academy of Sciences on April 27. In the absence of Mr. Hoover, Dr. A. A. Noyes simply announced that the award was "for his application of science in the conservation, selection, and distribution of food." This is the first award of this medal to a mining engineer.

**Ramon F. Munoz**, mining engineer, has opened an office in Monterey, N. L., Mexico, where he will engage in independent professional work. Señor Munoz is a graduate of the Massachusetts Institute of Technology, and during the last ten years has served in the operating and exploration departments of Cia. Minera de Peñoles, S. A.; Cia. de Minerales y Metales, S. A. (American Metal Co., Ltd.), and associated companies. He may be addressed at P. O. Box 263, Monterey, N. L., Mexico.

**Ross E. Douglass** and **A. H. Lawrence** have organized the firm of Douglass, Lawrence & Co., Santiago, Chile, which offers its services as consulting and supervising mining engineers. Mr. Douglass announces his resignation, on April 1, from the Braden Copper Co. (Mineral El Teniente), while Mr. Lawrence states that, with the permission of his clients, all his professional work will be assumed by the new firm. **Oswaldo Martinez C.** announces his resignation as chief of the Chilean Mining Statistics Service to assume the duties of business manager for Douglass, Lawrence & Co., whose address is P. O. Box 718, Huerfanos No. 1112 (3er piso), Santiago, Chile. Cable address: "Dolaw."

**Waldemar Lindgren**, professor of geology at Massachusetts Institute of Technology, Cambridge, Mass., was in New York City for a few hours on April 28 on his way home from Washington, D. C. The departments of mining and of geology at the institute have recently been reorganized and consolidated, and Pro-

fessor Lindgren is now at the head of the combined departments. Professor Lindgren is well known to our readers also as the geologist in charge of the presentation of the geological evidence for the case of the Utah-Apex Mining Co., Bingham Canyon, Utah, in Utah-Apex vs. Utah Consolidated, hearings in which were recently terminated. On the occasion furnished by this lawsuit Mr. Lindgren seized the opportunity to have made bulk analyses of semi-metamorphosed limestones of the Bingham Canyon district, thereby securing evidence to demonstrate conclusively that large amounts of silica, alumina, and iron were transferred into the limestone while it was undergoing contact metamorphism. He has thus once more controverted that school of geology, formerly more widely accepted than at present, which held that contact metamorphism in limestone involved only the recrystallization of materials already present in that rock.

## OBITUARY

**Charles F. Sloane** of Hollywood, Cal., who died of apoplexy recently at Globe, Ariz., had done much to develop the asbestos industry of Arizona. He had been working on a plan for the combination of several interests for the financing of a large manufacturing plant to be established on the Pacific Coast for the handling of all grades of asbestos. Mr. Sloane was fifty-nine years old, a native of Boston, and held membership in the Lambs Club of New York and the Bohemian Club of San Francisco.

## SOCIETY MEETINGS ANNOUNCED

The Joint Conference Committee consisting of representatives of the A. S. C. E., A. I. M. E., A. S. M. E., and A. I. E. E., has issued an invitation to a number of local and national engineering societies to have their representatives present at an organizing conference to be held at Washington, D. C., on June 3 and 4, 1920. The purpose is to secure co-operation of engineering and allied technical organizations to further the public welfare wherever technical knowledge and engineering training are involved and to consider matters of common concern to these professions.

Although the call is issued by the Joint Conference Committee, the responsibility for perfecting a permanent organization will rest with the delegates to the conference. It is hoped that the delegates will be empowered to take final action for their respective organizations, but representation in the conference in no way obligates an organization to continue its participation.

# THE MINING NEWS

## LEADING EVENTS

### British Empire Steel Corporation Formed in Canada

Nine Steel, Coal, Shipbuilding and Transportation Companies Merged—Half Billion Capital

Consolidation of nine steel, coal, shipbuilding and transportation companies of Canada into the British Empire Steel Corporation, capital \$500,000,000, was announced on May 2 by Colonel W. Grant Morden, a Canadian member of the British Parliament. He said that it was the largest merger of its kind in the British Empire, and second only to the U. S. Steel Corporation.

Colonel Morden declared that the consolidation would associate the iron and coal deposits of the Atlantic seaboard of the Dominion with the steel-making experience and financial resources of Great Britain.

Included in the consolidation are the Dominion Steel Corporation and its subsidiaries; Nova Scotia Steel & Coal Co., Ltd., and its subsidiaries; Canada Steamship Lines, Ltd., and its subsidiaries; Canada Foundries and Forgings, Ltd., and its subsidiaries; Maritime Rail Co. and its subsidiaries; Collingswood Shipbuilding Co., Ltd.; Port Arthur Shipbuilding Co., Ltd.; Halifax Shipyards, Ltd., and the Davie Shipbuilding & Repairing Co., Ltd.

Negotiations are in progress with several other enterprises to enter the consolidation, according to Colonel Morden.

The London advisory board of the corporation, Colonel Morden said, will include Sir William Beardmore, chairman, of William Beardmore & Co., Glasgow; Henry Steel, chairman of the United Steel Companies of Great Britain; Viscount Furness, chairman of the Furness group of English steel industries; Benjamin Talbot, J. P. Managan, director of the Furness companies; Major Gen. Sir Newton Moore, formerly a minister in Western Australia, and Sir Treva Dawson, deputy chairman and managing director of Vickers, Ltd.

The capital stock of the corporation will be divided as follows:

Seven per cent. cumulative preferred, \$50,000,000, of which \$37,000,000 is to be issued; 8 per cent. cumulative preferred participating, \$100,000,000, of which \$25,000,000 is to be issued; 7 per cent. non-cumulative preferred, \$150,000,000, of which \$68,000,000 is to be issued; common, \$200,000,000, of which \$77,000,000 is to be issued.

Great enthusiasm is reported to be displayed in Great Britain over the launching of this new project, the high standing of the board members attracting favorable comment.

### WEEKLY RESUMÉ

*The situation at Butte and in the Tonopah and Divide districts continues to improve slowly as the strikers gradually return to work. At Tombstone, Ariz., a verdict of "not guilty" was returned on April 30 in the trial of the first Bisbee deportation case. The affairs of the Utah Power Co. and the Colorado Power Co. are being investigated as a result of their asking permission to charge more for power. In Canada, announcement is made of the merger of nine companies into the half-billion-dollar British Empire Steel Corporation. Recommendations affecting the mining industry have been made by the Commission for Unification of Labor Laws in session at Ottawa.*

*At Washington, Van. H. Manning has resigned as Director of the U. S. Bureau of Mines. F. G. Cottrell has been nominated to succeed by the President. A rehearing of U. S. Steel Corporation anti-trust case has been refused by the Supreme Court.*

### Heavy Storms Destroy Plants in Joplin-Miami District

Rain, Wind and Lightning Cause Quarter Million Loss on Nights of May 3 and 4

Damage to the extent of a quarter of a million dollars was suffered by the Joplin-Miami zinc and lead district from heavy rain, wind, and electrical storms on the nights of May 3 and 4. The concentrator of the Omaha Lead & Zinc Co., situated east of Picher, Okla., was struck by lightning and burned on May 3, the loss being \$100,000. The Butte-Kansas mine, at Waco, Mo., caved and the larger part of the mill was destroyed the night following. This loss is estimated at \$100,000.

The Victory Metals Co., sustained a loss estimated at from \$20,000 to \$30,000, through damage done by wind at its Blue Bonnet and Central mines. The damage done by the tornado at the Blue Bonnet on April 10 had just been repaired. One-half of the concentrator being moved in two sections across country to the Aztex lease was demolished. The Rogers Foundry Co. lost by tornado its recently completed foundry at Baxter Springs, the damage being placed at \$20,000. Dozens of mills lost tramways, dummy elevators, and tailing flumes, the companies thus suffering including the Eagle Picher Lead Co., the Federal Smelting & Refining Co.'s Lucky O. K., the St. Louis Smelting & Refining Co., and the Huttig Lead & Zinc Co. The total damage is not less than \$250,000.

### Cripple Creek Faces Possibility of Shut-Down of Mines

Position of Gold Forbids Treatment of Ores Formerly Profitable—Portland Has Best Ore in 10 Years

With practically every mining company in the district either entirely suspending payment of dividends, or decreasing the rate, Cripple Creek operators are confronted at the end of the first quarter of 1920 with conditions which, unless relief is soon forthcoming, will result in the practical suspension of mining operations in the district.

With a total production from the Cripple Creek district of more than \$300,000,000 during the past 28 years, it may seem incredible that the mines which produced this vast supply of gold are in imminent danger of closing down, but one has only to scan the reports of the U. S. Geological Survey and note the alarming decrease in production to realize how grave the danger.

According to the figures of the U. S. Geological Survey, the gold production in the Cripple Creek district in 1915 was \$13,693,194; 1916, \$12,119,950; 1917, \$10,394,847; 1918, \$8,119,747, and 1919, \$5,830,000. The 1920 production, unless conditions change, will probably fall to between three and four million dollars.

Under present conditions it costs more to mine gold than the product brings at the mint. Frank G. Peck, president of the Portland Gold Mining Co., in a letter to stockholders announcing the reduction of the quarterly dividend, outlines a situation which likewise has application to many other properties in the district. He says:

"As you doubtless know, the gold mining industry of the United States is facing the most serious crisis which it has ever experienced in its entire history. Many gold mines throughout the country have closed and others are on the verge of it. For many months the Portland Gold Mining Co. has felt the full force of the existing adverse conditions. There has been a serious shortage of labor in the Cripple Creek district ever since the beginning of the war. Wages have almost doubled, fuel and mining supplies have increased in price from 60 to 150 per cent, which has increased the cost of mining operations and the treatment of ores to such an extent as to render valueless a very large tonnage of ores in the Portland mine that formerly yielded a good profit. However, by cutting down development work and reducing expenses wherever possible, the Portland company has maintained dividends continuously throughout the war period

and since, though at a somewhat reduced rate, its officials hoping all the time that conditions would soon begin to improve. In this, so far, we have been disappointed.

"The costs of operation at the Portland mine today are higher than at any period in its history, and there seems little prospect of a reduction in the immediate future. Of recent years a very considerable part of our output has been produced by lessees, and last year the larger part of our net profits came from that source. However, at present lessees have almost disappeared from the mine, because of the high wages that can be obtained elsewhere.

"We wish to emphasize the fact that all our troubles and difficulties are due to conditions brought about by the war, and not through any fault of your mine or mill. In fact, the lower levels of your mine are now producing richer ore than at any time during the last ten years, and your mill has been perfected to an extent that, if operated on the low-grade ores of the mine under the conditions that existed three years ago, would be earning independent of the profits from mining operations, the entire 2-cent quarterly dividend paid during the last two years."

### First Verdict Reached in Bisbee Deportation Cases

#### Harry E. Wootten Not Guilty of Kidnapping—Trial of Blanket Case To Open June 7

The first man to be brought to trial of the two hundred and ten indicted for kidnapping in connection with the deportation of striking copper miners and their sympathizers from Bisbee, Ariz., on July 12, 1917, has been declared not guilty by the jury. This man was Harry E. Wootten, a hardware merchant of Bisbee. The verdict was handed to Judge Samuel L. Pattee, sitting at Tombstone, Ariz., on April 30, after the jury had been out two hours and only one ballot had been taken. The trial began on Feb. 2. The verdict in this case will have no effect on the prosecution of one hundred and fifty-nine other defendants in the blanket case, trial of which will begin on June 7.

### Dock Workers at Ashland, Wis., Return to Work

An agreement has at last been reached by the railroad companies with the striking dock workers at Ashland, Wis. The continuance of this strike has prevented the prompt commencement of shipping from the iron mines of the Gogebic Range. Under the agreement reached, the men are to receive 62½c. per hour for day work and 65c. for night work, with time and a half for overtime. A big movement of ore to the docks will undoubtedly begin at once. The Steel & Tube Co. had already sent its clerks to the docks in anticipation of an early settlement.

### I. W. W. at Tonopah and Divide Demand Shower Baths

#### Want Other Things, Too, Most of Which, Mining Companies Claim, They Already Have

Although no demands were made by the striking I. W. W. in the Tonopah and Divide districts at the time of the walkout on April 22, the following printed demands were mailed to each operating company:

1. The immediate release of all industrial and political prisoners.
2. A six-hour day from collar to collar.
3. A minimum wage scale of \$7 a day for all workers employed in the mining industry.
4. Abolition of all contract and bonus and so-called efficiency systems.
5. Two men to work together on all machines and two men to work together in all workings.
6. Water spray through all drills, and all drifts and stopes in which men are working to be watered down every day, and all drifts which men walk through going to their places of work.
7. We also demand that all mining companies employing men from out of town furnish them with clean sheets twice every week, with springs and mattresses and plenty of blankets; one man to a room, and his bed made up each day and his room to be cleaned of all dust and other things which may accumulate; also shower baths with hot and cold water and dry room to change their clothes; both rooms to be comfortably heated.
8. No discrimination against union men.

(Signed) Strike Committee.

The miners of the district, it is claimed, have been enjoying most of the conveniences mentioned in this list for several years. The demands were not even known of by the majority of the men until published in the local papers the day after the walkout.

The fact that a signed agreement existed apparently did not concern the miners. The crafts, however, were absolutely loyal to their agreement and remained at work. It was later announced, as stated in the last issue of the *Engineering and Mining Journal*, that the I. W. W. leaders had called the strike off, but the mines are running short handed. Possibly 5 per cent of the underground men have left town so that chances for the resumption of normal operations soon seem to be excellent.

### Durham Mines to Reopen

Iron ore mines of the Durham Iron Co., at Durham, Pa., are to be reopened after an idleness of ten years. The mines, together with 1,000 acres of land in Durham, have been purchased by W. P. Young, of Easton, Pa. Samples of the ore from the mines were sent to the Empire Steel & Iron Co., Catasauqua, Pa., recently and after analyzing, a 5,000-ton order was assured.

### Old Golconda Being Reopened Near Chloride, Ariz.

#### Highland M. & M. Co. Developing This and Adjoining Ground—Plans To Erect Mill

BY S. FORD EATON

The Highland Mining & Milling Co., which was incorporated in April, 1919, is actively developing its property about six miles southeast of Chloride, Ariz. Its holdings consist, in part, of thirty claims embracing all the ground of the old Golconda and Middle Golconda companies, the former of which has lain idle since its flotation plant was burned down in 1917. In addition to these two groups it has obtained four outside claims, known as the Stone Cabin, Lane, King and Side Issue. On these latter are located the sites for a mill and for the portal of a deep adit. Eighteen of the thirty claims are patented. The company is well financed, having recently successfully floated a bond issue to cover the cost of preliminary development and installation. The officers are C. B. Bell, president; W. J. Cook, vice-president, and Alexander Rose, secretary and treasurer.

C. B. Bell was the principal owner and manager of the Middle Golconda during recent years. In 1918, he conceived the idea of consolidating the Golconda, Middle Golconda and certain other claims so located as to control sites for proposed adits which would tap at considerable depth the system of ledges passing through both properties.

The Golconda mine was for years one of the active producers along the Cerbat Range. During the earlier period of operation it was distinctly a silver producer. The surface ores were milled on the property in Union Basin. Eventually the sulphides high in zinc were reached, for which the old mill was unsuited. New interests took over the Golconda and the single-compartment 1,400-ft. shaft was sunk. Large bodies of zinc ore were opened up, which also carried gold, silver, copper and lead. The production of zinc alone was about 15,000,000 lb. A flotation plant was built and operated for a number of years until its destruction by fire in 1917. During this second period ore was extensively mined on the Golconda and Tub claims down to the 1,000-ft. level of the Golconda shaft.

Immediately northwest of the Golconda, on the strike of the veins worked in that mine, lies the Middle Golconda. The same system of ledges passes through both properties. There is one important difference. Whereas the Golconda is in Union Basin, a cuplike gulch back in the mountains with a comparatively high floor, the Middle Golconda is in Todd Basin on the rather steep western slope of the Cerbats. This difference makes the latter ideal for development by crosscut adits, in which manner the six veins included have been opened up. As known in their respective order from west to east, they are the Tub, Oro Plata, Prosperity, Golconda, Highland and Black-

foot. The ore mined from the Tub vein on this property was sorted by hand, the high grade shipped and the balance allowed to accumulate for a future mill. In this pile of mill ore there are about 15,000 tons carrying 17 per cent zinc, 10 oz. silver, 0.1 oz. gold,  $1\frac{1}{2}$  per cent lead and  $1\frac{1}{2}$  per cent copper.

The center of operations today is at the portal of what is, at present, the main adit and tramping level on the Big Bethel claim. This adit is now in over 700 ft. and will be driven about 2,000 ft. in all. The Tub vein has been cut 300 ft. below the outcrop and 150 ft. below the lower of the old adits. The Oro Plata will soon be reached and the long bore will eventually tap the Blackfoot at a depth of 1,300 ft. A drift to the south on the Tub vein is well advanced and will be driven in under the old Golconda workings on the Tub claim. At that point the lateral will be 230 ft. below the lowest old development work.

At the same time another drift is

tive tests on the ore were made by several metallurgists with good results. Flow sheets have been submitted and within sixty days contracts will be let for the designing, construction and equipment. Equipment and other supplies for power installation have been purchased.

It is estimated that there is already available sufficient ore of a grade similar to that on the dumps to run the mill for a considerable time. An average sample runs 20.90 per cent zinc, 11.91 oz. silver, 1.75 per cent copper, 1.50 per cent lead, and 0.1 oz. gold.

### Pritchard Creek R.R. Inquiry Delayed in Coeur d'Alenes

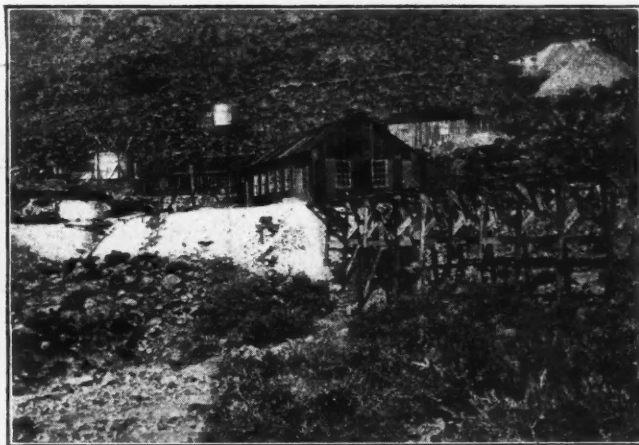
The hearing before the Idaho Utilities Commission at Wallace, Idaho, in which the O.-W. R. & N. Co. was required to show cause why it should not be required to reconstruct the 12-mile stretch of railroad along Pritchard Creek that was washed out two and a half years ago, has been continued for

### Cold Water Thawing Successful in Iditarod District, Alaska

Other Experiments Made in Effort To Reduce Mining Costs—Conditions Bad Last Season

By J. G. RIVERS

During the 1919 season, several experiments were conducted in the Iditarod mining district in Alaska by dredge operators in connection with thawing frozen ground by cold water under pressure. One of the tests, which the writer knows to be authentic, was as follows: An ordinary steam point attached to a hydraulic pipe, which supplied water at 65 deg. F. under a 90-ft. head, was driven to bedrock through 4 ft. of frozen muck and 8 ft. of frozen gravel, this operation taking one man five hours. The point was allowed to remain without attention for 72 hours, when it was pulled up and the hole cleaned out to the frost. The muck capping was found to be thawed 18 in. in every direction from the point, and



LEFT—OLD GOLCONDA PROPERTY, IN CHLORIDE DISTRICT, ARIZONA, NOW UNDER DEVELOPMENT BY HIGHLAND MINING & MILLING CO. MILL SITE IS IN UPPER LEFT CORNER. RIGHT—HIGHLAND COMPANY'S MACHINE SHOP AND TRAMWAY TO MILL SITE

being driven south on the Tub vein from the adit above. These two adits are connected by a 150-ft. raise, which will be used as an ore pass. Ore mined above will be trammed to this raise, drawn out on the main level and hauled to the mill bins. As rapidly as the various ledges are reached laterals will be started north and south on them.

For the present, power for the drills is supplied by an 80-hp. Fairbanks-Morse gasoline engine driving a 550-ft. I-R compressor. New construction is progressing, and the new blacksmith shop and machine shop are completed. Both are large well-designed buildings. The company has had difficulty in securing equipment. All new machinery for mine and mill is to be driven by electric power obtained from the Desert Power & Water Co., whose line passes near the mill site.

The tramway from adit to mill site is completed and the latter has been cleared for grading, which will start at once. Plans call for a 300-ton mill, which will make two products, lead and zinc. During the last year exhaus-

sion was made on motion of the petitioners. This action was taken in order to give North Side shippers time to prepare a showing of cost and tonnage to combat that made by the railroad company. It is possible that in the meantime the matter may be taken up directly with the company and the desired construction be accomplished by negotiation. At the time the application for the hearing was made, the railroads were under Government control and appeal to the Utilities Commission seemed to be the only recourse. The mining companies which have tonnage available and are urging the rebuilding of the line are the Bear Creek, Paragon, Fidelity, Jack Waite, and the Yukon Gold.

The annual report of the Yukon Gold Co. states that in 1919 the directors decided to allow the charters of the Bullion Hydraulic Mining Co., Caribou Gold Mining Co., and Atlin Consolidated Mining Co. to lapse, as examination and investigation had demonstrated that the properties were of no value.

the gravel had thawed a distance of 7 ft. in every direction from the point. To have obtained the same results with steam, from 36 to 48 hours continuous steaming would have been necessary, which would have added about \$2 for boiler fuel costs with no lessening of labor costs. From this and similar experiments it is believed that, with a sufficient battery of water points of proper construction, water can be made to take the place of steam for thawing the frozen gravels almost exclusively after the month of May, which will result in a direct saving to the dredge operators of 5 to 8c. per sq.ft. of bedrock and in some cases will determine whether or not low-grade gravels can be worked profitably.

Another interesting attempt to reduce the costs of mining low-grade ground has been made by an operator on Willow Creek. This operator installed a Bucyrus drag-line scraper two years ago for use on the creek benches, which were so low that the gravel could not be sluiced off to bedrock. After the overburden is sluiced and piped off,

the scraper is used to hoist the remaining 5 or 6 ft. of pay dirt into the sluice boxes. The scraper dumps into a hopper which is connected with the line of sluice boxes, the whole installation being on wheels and rails so that it can be moved forward along the side of the cut to keep pace with the scraper. This operator worked ground last summer by this machine at a cost of less than 8c. per ft. of bedrock. It is safe to say that this is the lowest cost per sq.ft. ever established in this locality and is probably from 10 to 15c. per sq.ft. less than it would have cost to dredge the same ground under present methods, disregarding depreciation and interest on the much more costly dredging equipment.

The Iditarod district continued to be one of the important producers of the interior during 1919. Notwithstanding that the Yukon Gold Co. failed to resume operations during the season, the camp produced, in round figures, \$700,000, from gold and silver placers, over half of which was taken out by the two small dredges on Otter Creek and the balance from numerous small hydraulic operations. About 250 men were employed continuously through the open season, which lasted from May 1 until Nov. 15, which is unusually long for this part of Alaska.

The increased cost of materials and supplies during the year reached the point where low-grade gravels cannot be worked profitably by present methods. It costs \$2.75 to \$3 to board men, which increase affected operating costs because all operators in the district have their own mess houses always well managed. Wages remained practically unchanged at \$6 and board for 10 hours' work.

The whole future of placer mining in Alaska depends on one of two things: Decreased costs of mining or increased returns for our gold either in a form of a bonus or otherwise. The present condition cannot continue very long. The high-grade ground is exhausted but large bodies of low-grade gravels remain.

### Daylight Saving Plan Rejected on Gogebic Range

The question of adopting "daylight saving" has received some attention on the Gogebic Range lately, and a canvass among the laboring men seemed to indicate that the majority were against the plan. At the Newport mine, however, the opposite was the case and that property is now operating on eastern instead of central time. As the underground men take only half an hour for dinner they now come off shift at 3:30 p.m. standard time.

Most of the towns have officially decided to keep standard time, and the mines have generally followed suit. One of the chief objections was that the railroads would not change their time, and the switching crews refused to work on eastern time unless the companies would pay them for one hour at the overtime rate.

### Old Dominion Co. May Build New Mill

**Matter Not Definitely Decided—If Erected, Plant Will Handle Arizona Commercial Ores**

The Old Dominion Co. is considering the erection of a mill at Globe, Ariz., but has not come to any definite decision as yet. If the mill is built, Arizona Commercial ores will be treated in it. At present, the company is treating these ores, but the new mill, if built, will enable it to handle a larger tonnage for the Arizona Commercial Co., when the copper market justifies the latter in increasing its production. The new mill, if constructed, will adjoin the old one, and there will be no interruption with production during its construction.

### Appraising Property of Colorado Power Co.

Engineers of the Colorado State Utilities Commission are making an appraisal of the property of the Colorado Power Co., on which to base action on the application for permission for a 20 per cent increase in rates. Service by this company is confined principally to the metal mining districts of the state. Current is generated at Shoshone and Boulder by water power, with smaller auxiliary water or steam plants, in various parts of the state which have been acquired in extending the lines of the company.

The power company has made no advance in rates since the commencement of the war, and its officers claim that increased cost of operation and equipment makes such a step imperative. It is thought that the engineers will be able to complete the appraisal some time in July, upon which the Utility Commission will set a date for a hearing, when protesting power users may be heard.

### Utah Power Co.'s Affairs Before Public Utilities Commission

The Utah Power & Light Co. is being examined by the Utah Public Utilities Commission in regard to the increased power rates, which it is seeking to make in order to raise its revenue by \$2,000,000. Utah mining companies, among them the Utah Copper Co., the largest customer supplied by the Utah Power & Light Co., are opposing the proposed increases through counsel representing them at the hearing. The question centers around the matter of the valuation of the property of the Utah Power & Light Co. and the return which should be allowed upon the valuation. The mining companies are seeking to prove that the valuation is high, it being charged that the power company bought property for \$9,500,000, which is listed at \$17,000,000. It is probable that the commission will order a physical valuation of the property of the Utah Power & Light Co. There is intimation on the part of the counsel for the Utah Copper Co. that it desires to terminate its contract.

### Mining Legislation in British Columbia Summarized

**Changes in Placer Mining Act Most Important of Those Made at Present Session**

By ROBERT DUNN

There has already been reference to the amendments made at the present session of the British Columbia Legislature to the Placer Mining Act, but, as the changes are of first importance, it might be well to summarize them for the benefit of the mining men affected.

In respect of the leases now in arrears for more than one year's rental, the lessee may apply before the 1st of January, 1921, for the consolidation of the annual rentals in arrears and arrange for their payment by annual instalments extended over a period not exceeding ten years. Where the arrears are consolidated, the failure to pay the annual instalment or the current annual rental when due will automatically result in a forfeiture of the lease. Where the lessee so in arrears fails to apply for consolidation and fails to pay the arrears before January 1, 1921, his lease is forfeited.

Provision is made for the issuance of leases, beginning July 1, 1920, at a reduced annual rental and reduced annual expenditure for development work. Leases in this new form will contain a provision for automatic forfeiture if the lessee fails to pay the annual rental or to do and record the annual development work. Reinstatement is permitted within thirty days where the fault consisted only of failure to record the work. Excess development work done in any one year may be recorded so as to count on future development work requirements for the following three years only. Cash may be paid to the Crown in lieu of expenditure on development.

In the case of leases in good standing it is provided that the lessees have the option of applying at any time while the regular charges are paid up to have the annual rental and annual expenditure reduced to the rates under which the new leases are to be issued after July 1. If they apply and obtain this reduction the conditions of automatic forfeiture for default, and the privileges of recording excess work and of paying cash in lieu of work, which are applicable to new leases, will also attach to these old leases. If they decide not to apply for a reduction of rental and annual expenditure their leases will continue subject to the same provisions to which they are now subject.

Leases which become in good standing through consolidation of arrears may also be brought under the reduced rates of rental and other provisions applicable to new leases issued after July 1.

Heretofore placer mining leases have been issued by the gold commissioners, who have their headquarters at different central points throughout the province, with the sanction of the

Lieutenant-Governor-in-Council, the authority to issue the same being based on the gold commissioner's report accompanying the application. It is now proposed that the gold commissioners, having full knowledge of local conditions, shall be empowered to issue such leases without reference to the Lieutenant-Governor-in-Council, and as has been indicated, automatic forfeiture is provided for in cases where the lessee fails to observe the covenants and conditions of his lease.

The changes it is intended making in rentals and development work in connection with placer mining leases are as follows:

Hydraulic lease, \$25 per annum and development work \$250 per annum.

Creek lease, \$37.50 per annum and development work \$250 per annum.

Dredging lease, \$25 per mile per annum and development work \$250 per mile per annum.

The value of any new plant or machinery employed is to count as money expended on development. There will also be the usual 50 cents royalty per ounce on all gold recovered.

#### OTHER MINING LEGISLATION

A summary of other mining legislation passed by the Provincial Legislature during the session now drawing to a close follows:

An act to amend the "Vancouver Island Settlers' Rights Act, 1904": This extends the period in which settlers within the Esquimalt & Nanaimo Ry. belt, Vancouver Island, may apply for title to the coal rights within the limits of their individual holdings. They are given to Sept. 1, 1920, to submit their claims to provincial title to any coal measures within their lands.

An act to amend the "Iron Bounties Act": This extends the period during which the government may pay a bonus on pig iron manufactured in the province from the year 1923 to 1925. This bonus amounts to \$3 on pig iron produced in the province from provincial ores and to \$1.50 a ton on pig iron manufactured in the province from imported ores.

An act to amend the "Allied Forces Exemption Act": This extends the further protection of a year to members of the Allied Forces who held mineral claims, or property under the Placer Mining Act, at the time of their enlistment. Thus returned soldiers who are miners are given until 1921 to get on their feet before subject to the obligations of the Mineral and the Placer Mining Acts of the Province.

An act to amend the "Mineral Act": This gives the Lieutenant-Governor-in-Council power to declare a reserve on any iron-ore-bearing area that may not be held at the date of the coming into force of the legislation. William Sloan, minister of mines, has explained that this will be used to prevent speculative holding of iron ore deposits that may be discovered from

this date forth and that the authority will be exercised to a limited extent and only when it is considered necessary to do so in the interests of the development of these resources and the establishment within the province of an iron and steel industry.

An act to amend the "Mineral Survey and Development Act": This provides for the semi-monthly payment of men employed in the development of any mineral claim or the operation of any mine and the advance of security for the payment of such wages. It also affords further protection to the investor by making it obligatory that any joint-stock company undertaking to engage in mining forward to the resident mining engineer of the district in which the company is operating a copy of every prospect or statement issued to the public.

#### Commission at Ottawa Seeks to Unify Canada's Labor Laws Important Recommendations Made Regarding Mining Industry

The Royal Commission for the unification of labor laws throughout the Dominion of Canada, composed of representatives of the federal government, provincial governments and delegates from labor organizations and employers engaged in the various principal industries, has been in session in Ottawa during the week of April 26, and has made a number of important recommendations in relation to mine labor.

The minimum age has been fixed at fourteen for surface and sixteen for underground work; eighteen years for persons in charge of hoisting machinery for moving material, and twenty-one years for those operating hoists in which men are carried. Wherever not already so enacted, nine hours is to be a legal limit to a day's work. Wages are to be paid semi-monthly and not to be paid in hotels. Provision is to be made for miners' liens. Legislation is to be enacted limiting the reasons for which an employee's wages may be deducted without his written consent.

It is provided that examinations for mine managers, pit bosses, etc., shall be conducted by a board composed of a government inspector, a working miner and a mine manager, and that all candidates for such positions shall have five years' experience in mining and produce evidence of ability, sobriety, etc., and be not less than twenty-three years of age, with seven years' experience in the case of mine inspectors.

Greater power is to be given to inspectors with the right of appeal from their decision to a board of arbitration composed of a judge and representatives of interested parties. It is provided that there be examination before men enter a mine and that a record of such inspection be kept, and that first aid and mine rescue work be placed under the jurisdiction of workmen's compensation boards in provinces where such are at present organized and for special provision where such boards are not in existence.

#### Car Shortage Hits Utah Camps Empties Still Scarce as Result of Recent Railroad Strike

Shipments from Utah camps were more affected by car shortage in the week ended April 24 than in the week preceding. Bingham has been less affected than the other camps. Tintic shipments, which average around 150 cars, showed only 55 cars. The Salt Lake Route was unable to furnish any cars, and the Denver & Rio Grande but a small number. The Chief Consolidated, the largest shipper in the camp, being entirely dependent upon the Salt Lake Route, cut down its working force considerably on April 22, but the full crew is expected to be at work again before long. No cars were available for the southern end of the district. In the latter section, the Mammoth and other properties are concentrating on development work until cars are available. A considerable number of cars have been diverted to the coal mines, where the shortage was especially acute.

No shipments came out from Park City during the week. At that camp there is about 2,000 tons of ore either loaded or at the station, which it is expected can be moved in a few days. Almost no ore has been sent out from Ophir, Milford and other points.

#### Cardiff Company, in Utah, Wins Suit Brought by Heirs of Former Owners

The suit brought by the heirs of the former owners against the Cardiff Mining Co., operating in Big Cottonwood Canyon, Utah, to establish the Cardiff merely as a trustee of the rights of the Jones Mining Co. in the Mountain Chief claim, has been decided in favor of the defendant, it being held that whatever rights may or may not have been held by the Jones company would have lapsed through inaction over a period of years. The Mountain Chief claim is considered to have the apex of the main orebody which has been opened in the Mountain Queen claim. The Mountain Chief claim, first located in 1891 with assessment work continued until 1901, was relocated in the fall of 1902 by a director of the Jones Mining Co., it being alleged that a conspiracy was entered into with other directors to defraud the Jones company. Title was later conveyed for certain amounts of stock received by two of the directors of the Cardiff company, which perfected and patented the claim.

#### Recent Production Reports

Union Miniere du Haut Katanga produced 3,229,739 lb. copper in March.

Oriental Consolidated, Unsan, Chosen (Korea), obtained \$116,000 from its March cleanup.

The Rogers Brown Ore Co. has decided to electrify its Meacham and Kennedy mines on the Cuyuna Range, in Minnesota. The Kennedy was the first producer on this range.

## NEWS FROM WASHINGTON

By PAUL WOOTON  
Special Correspondent

### Manning Resigns as Director of U. S. Bureau of Mines

Dr. Van. H. Manning, Director of the U. S. Bureau of Mines, has tendered his resignation, effective June 1, to President Wilson. Dr. Manning is leaving the Government service to accept the position of director of research with the recently organized American Petroleum Institute, the most important body in the United States of men in the petroleum industry.

In his letter to the President, Dr. Manning says: "I hereby tender you my resignation to take effect June 1, 1920, as director of the Bureau of Mines. It will be with reluctance and deep regret that I shall sever my connection with the Department of the Interior after thirty-four years of active service therein, and it is the opportunity of being able to continue, in another capacity, the work for the advancement of purposes fostered by the department that has been the chief factor in determining my decision to resign.

"I take this opportunity to express my sincere appreciation of the confidence that you have reposed in me as a public official and of the cordial cooperation of the departmental executives whom I have been able to serve. Especially I appreciate your constant help in my efforts to develop an organization that has at heart the welfare of the public, the advancement of the mineral industry, and the safety of the two million workers who contribute to the success of that industry.

"In leaving the Government service there comes to me, as it has over and over again, the thought that although this Government spends each year many millions of dollars in useful scientific work for the benefit of the whole people, the monetary recognition of its scientific and technical servants is not sufficient to enable them to continue in the service for the people. This has been especially true within the last few years, when it has been impossible for many men to remain in the Government service.

"With the marvelous expansion of the industry in this country and the growing necessity of science to industry, the scientific bureaus have been utterly unable to hold their assistants against the competition of industry, which is taking their highly trained men at salaries the Government does not pay or even approach.

"I feel very deeply that there ought to be more adequate compensation for the scientific and technical men in the Government service, so that none of them may be compelled to accept positions on the outside."

### F. G. Cottrell Probable Successor to Van. H. Manning

Noted Physical Chemist Nominated by President as Next Director of U. S. Bureau of Mines

Dr. F. G. Cottrell, in all probability, will be the next director of the U. S. Bureau of Mines. He was nominated for the office by President Wilson on May 5. Confirmation by the Senate is necessary but it will be forthcoming without delay.

Dr. Cottrell was born in Oakland, Cal., Jan. 10, 1877. His elementary education was obtained at Norton



F. G. COTTRELL

School, in Oakland. Later he attended the Oakland High School. The next step in his education was obtained at the University of California, where he

was graduated in 1896, with a degree of B.S. The following year he took a LeConte Fellowship at the above university.

From 1897 to 1900 Dr. Cottrell taught chemistry at the Oakland High School. He then went abroad for special study, during which time he worked in the laboratory of J. H. van 't Hoff in Berlin, and in the laboratory of William Ostwald at Leipzig, where he obtained his Ph.D. degree. After leaving Germany, he spent some time in the laboratory of Prof. J. J. Thomson at Cambridge, England.

On returning to America, Dr. Cottrell studied at Harvard and at the Massachusetts Institute of Technology, after which he returned to the University of California as instructor in physical chemistry. He continued a member of the faculty of that university until 1911, when he joined the staff of the U. S. Bureau of Mines as consulting chemical engineer. Later he became physical chemist, then chief chemist, and then chief metallurgist. In the recent reorganization of the bureau he became assistant director in immediate charge of all technical operations of the bureau.

Dr. Cottrell is known best, perhaps, for his system of electrical precipitation. He is also the inventor of an electrical process for the dehydration of crude petroleum. Since he has been so successful in the precipitation of suspended solids of gases by means of high potential electricity, he naturally was much interested in the question of the applicability of the same methods to the precipitation of water in a petroleum emulsion. It was these achievements which resulted in his being presented with the Perkin Medal of the American Chemical Society.

### STATUS OF PENDING MINING LEGISLATION

#### Bills That Have Reached Committee Stage

Subject of Bill	Bill No.	Author	Present Status
Silver in coins.....	H. R. 11,226...	McFadden.	Before House Committee
Met. Min. on Ind. Res. S. 287.....		Ashurst....	On Senate Calendar
Timber for mining purposes.....	S. No. 1.....	Pittman...	Passed Senate Oct. 3, before House Committee
Anti-dumping.....	H. R. 10,918...	Fordney....	Passed House Dec. 9, on Senate Calendar
Laboratory glassware..	H. R. 7,785....	Bacharach..	Passed House Aug. 2, on Senate Calendar
Magnesite.....	H. R. 5,218....	Hadley....	Passed House Aug. 7, on Senate Calendar
Tungsten.....	H. R. 4,437..	Timberlake.	Passed House Aug. 21, on Senate Calendar
Zinc.....	H. R. 6,238.	McPherson.	Passed House Sept. 2, on Senate Calendar
War Minerals Relief	H. R. 13,091.	Garland....	Reported favorably to the House March 25.



## More Money Likely for Survey's Mineral Resources Work

Increased Appropriation Bill Just Reported by House Committee

Conforming to a rigid policy of reducing Government expenditures, the House Committee on Appropriations is making reductions in a very large percentage of the appropriations as compared with the amounts which were allowed last year. An exception to this is the appropriation for the mineral resources work of the U. S. Geological Survey. An increase from \$110,000 last year to \$125,000 has been made in the bill just reported. In explaining the need of this appropriation to the committee, Dr. George Otis Smith, Director of the Survey, said:

"When I first became Director, our mineral industry reached the \$2,000,000,000 mark in the production of the country and the year before last production went over the \$5,000,000,000 mark. However, it does not require twice as much work to get returns, for instance, for 2,000,000 tons of iron ore as it does for 1,000,000 tons, but, of course, there are many more operators at work than there were twelve years

ago. The mineral industries are rapidly increasing, and we are trying to meet the increased need for service.

"During the war we learned a great deal regarding the value of what have been called dry statistics. We take and have taken for nearly forty years an annual census of the mineral industry. That, however, is not simply to find out how many ounces of gold or silver and how many pounds of copper are produced each year. It really is a study of mineral resources. We are as much interested, if not more interested, in what is left in the ground and the facilities that are available for getting it out, as we are in the bare fact of the tonnage produced last year."

## Rehearing of Steel Trust Case Refused

A rehearing of the Government's anti-trust case against the U. S. Steel Corporation and its subsidiaries was asked of the U. S. Supreme Court on April 28 but was refused by the latter. The court's decision handed down on March 1 was that the corporation does not form a combination in restraint of trade in violation of the Sherman Law. In a brief filed by Solicitor General

King and Assistant Attorney General Ames supporting the motion to reopen the case, the Government attacked the position of the court taken in refusing to dissolve the corporation.

The Government maintained that if the Steel Corporation was an unlawful combination in 1901, when it was formed, as the court concedes, and in 1911, when the suit was instituted, it is still a criminal combination; that the decision was not rendered by a majority of the court; that the court's position that mere size of a corporation does not constitute a violation of the anti-trust law is untenable, and that the steel trust decision is in direct conflict with the court's decision of Monday dissolving the Reading Railroad coal combine.

The U. S. Bureau of Mines has blown in an experimental furnace on the University grounds at Minneapolis, Minn. The furnace will make spiegeleisen, ferromanganese, and pig iron and is adapted to make experiments not feasible with a larger plant. Necessary materials, including Arizona and Cuyuna manganese ores, are on the ground in quantity.

# NEWS BY MINING DISTRICTS

## ARIZONA

### Deepening of Nighthawk Shaft Completed—Shannon Copper's Plans—Rich Silver Strike Near Ray

**Bisbee**—The work of sinking the Nighthawk shaft from the 650 to the 750 level has been completed. The station was cut on the 750-ft. level and preparations made to drive into the orebodies found above. Forty feet of oxidized ore averaging 6½ per cent was cut recently in a drift on the 550-ft. level.

The Calumet & Arizona is preparing to do some diamond drilling to prospect the zone below the 1,500-ft. level of the Briggs mine.

The Boras lessees, in addition to doing considerable development work, have opened an important orebody on the 528-ft. level at the bottom of the winze. Drifts run 60 ft. in one direction and 30 ft. in another were all in ore. Twenty-three cars of ore were shipped in March.

**Gleeson**—The Shannon Copper Co. has decided to abandon the mining field and undertake the development of oil leases which the stockholders have authorized N. L. Amster, its president, to acquire. Following the sale of the mines at Metcalf, the smelter at Clifton and the railroad connecting the two, the company paid all its debts and had \$431,000 remaining in the treasury. As this would pay but a comparatively small dividend the stockholders were almost unanimous in authorizing the

change in field of endeavor. Mr. Amster has been in Texas inspecting oil properties preparatory to making investment. The company has two mining properties, one at Gleeson and the other at Yeager Canyon. The latter does not promise to develop into a large mine. Expenses, which have been running at the rate of about \$3,000 per month for watchmen and pumping, are being cut down. One salaried official has been retained, J. W. Bennie, general manager. Among its resources the Shannon company counts a claim of \$380,000 against the U. S. Government on account of losses sustained in producing copper during the war period at the urging of Government officials.

**Ray**—An important silver strike has been made a mile and a half from Ray in Rustler Gulch in a 70-ft. shaft on claims owned by Skelton and Crawford, who purchased them recently from George Lob, of Superior. The vein is 4 to 30 in. wide, the ore assaying as high as 2,000 oz. silver. The first ore found consisted of argentite and native silver. In the bottom of the shaft there is a 30-in. streak carrying about \$200 per ton in silver. Several leases have been let on adjacent ground. Shipments are already being made to the railroad at Ray. Claude Duval, of the Hercules company, has the principal leasehold.

**Kelvin**—The Ray-Boston Copper Co.'s diamond drilling operations are progressing more rapidly, though somewhat delayed by the condition of the

ground. At the last measurement the hole was down nearly 600 ft. and entering more solid ground. The first hole will be not less than 1,450 ft. deep.

Frank Gross is hauling out ore by pack train from claims about two miles north of Kelvin. The ores are chiefly lead carbonates running well in silver. They will be shipped to the El Paso smelter.

The Georgia group, near Wooley and owned by Gus Schade, is being reopened. The property has furnished some shipping ore with gold as the chief metal. A shaft will be sunk.

**Morristown**—The Plomo King has purchased a new compressor, a 32-hp. gasoline engine, several drills and other mining equipment for its property west of Hot Springs Junction. The ores are silver-lead.

**Prescott**—Worthington and Hubbel, of Wickenburg, Ariz., have purchased the Monte Cristo silver mine on Groom Creek, 8 miles south of Prescott. The old shaft is 400 ft. deep. The main orebody is 2 to 3 ft. wide with a 15-in. streak of shipping ore. Recently a 10-ft. K. & K. flotation machine was installed in the old mill, which is now making a 95 per cent recovery. A cleaner machine is to be installed which will increase the capacity to 40 tons per 24 hours. The owners have cleaned out the old workings above the 100 level.

The Gladiator and War Eagle gold mines, at Crown King, have been purchased by the Philadelphia mining com-

pany which owns the adjoining ground on the west. A 1,200-ft. tunnel on the older property is to be used in developing the new territory. Flotation is to be installed in the old mill. George Harrington, of Crown King, is the principal in the deal in Arizona.

The Half Moon Copper Co. has made a rich strike of copper glance ore on its 500 level. The property is half a mile south of the Arizona Binghamton mine, in the Copper Mountain district, five miles northeast of Mayer.

**Jerome**—U. V. Extension has entered the orebody on the 1,500-ft. level since the annual report was issued and up to April 9 had driven 560-ft. of crosscuts and drifts. The ore on this level so far has averaged about 5 per cent copper, or less than that on the level above. The ore has not been entered yet on the 1,600 and 1,700 levels. The company's output should soon be increased, though not to full capacity.

**Morenci**—Frank avowal has been made of the reasons for the proposed merging of the interests of the Detroit Copper Co. and Arizona Copper Co., Ltd. According to J. P. Hodgson, manager of the Detroit company, "There is to be an effort to ascertain whether plans cannot be formulated to work the two properties as one large operating unit. In the first place, the orebodies often join and are the same. By joint operation a large amount of money can be saved in mining, milling, and smelting the ores. Large tonnages of low-grade ores have been developed in both properties." In order that a definite and fair agreement can be reached in the basis of values, engineers and samplers have been put at work. It will take several months to complete the plan of investigation.

An issue on which no open statement has been made concerns the manner in which the Scottish owners of the Arizona company's stock have been taxed of all their profits during the war period. The state taxes in Arizona have increased very materially during the last five years; latterly national taxation has been added and, on top of all this, the British government has had a very large share of the money that eventually went to Scotland. Operating costs have increased, as well.

Detroit Copper recently scrapped its smelter. The Arizona Copper Co. has smelting works of the most modern character. With the Shannon, which was recently taken over by Arizona Copper, there came a small smelter and a concentrator.

**Yuma**—B. A. Wyle, J. M. Holmes and W. J. Palenthrope, of Los Angeles, have incorporated the Swansea Stock Administrating Co., with capital stock of \$10,000 and with offices at Swansea, Paris, Lille and Amsterdam. The greater part of the stock of the Swansea Mines Co. was held, before the war, at the European points named. Since the war a considerable proportion of the stockholders cannot be reached. The mine at Swansea is leased by the Clark interests of Los Angeles.

## CALIFORNIA

### Carson Hill Gold To Add 10 Stamps— Plymouth Con. Raises Wages

**Melones**—The Carson Hill Gold Mining Co. plans to add 10 stamps to its 20-stamp mill early in 1920, bringing the capacity to 12,000 tons monthly; also a cyanide plant for treating concentrates. Extension of the main Melones tramway to a rock-breaker station adjacent to the mill and other improvements are also considered. Consequent lowering of costs and increased extraction is anticipated. W. J. Loring, president, states that the developed and probable tonnage of ore in the mines is equal to five years' supply with the present equipment.

**Plymouth**—Plymouth Consolidated has granted a wage increase of 50c. per day to all employees working on company account. This became effective April 16. The high cost of living is given as the reason for this action. Operating costs have risen \$2 a ton in the last two years, it is alleged by the company.

## COLORADO

### Vindicator Consolidated Stops Dividends—Leadville Shipping Manganese Ore to Eastern Steel Mills

**Denver**—After dividend payments extending over a period of twenty-four years and amounting to \$8,532,500, President Wood of the Vindicator Consolidated Gold Mining Co., in a letter to the stockholders under date of April 24, announces the suspension of dividends. The letter states that after fully considering the extreme difficulties of conducting gold mining operations under present conditions, the Board of Directors had unanimously decided that it was inadvisable to make any further disbursements to the stockholders at this time.

After outlining the plan of development of present holdings, President Wood announced that "Our operating staff has suggested that an extensive acreage lying immediately adjacent to our property on the east has attractive development possibilities, and on this recommendation your management is concluding negotiations for this area. A five-year lease has been obtained on the Victor mine property, and five-year leases on all the various groups lying between our property and the Victor group, at satisfactory royalties, accompanied by options to purchase in a portion of the territory. The Victor shaft has a depth of 1,000 ft., and is located about 3,000 ft. northeast of the Vindicator main shaft. Work is already in progress at the shaft and there are several sets of sub-lessees who are shipping. A comprehensive plan of development has been laid out whereby between the Vindicator shaft on one side and the Victor shaft on the other that whole area will be intersected by crosscuts, and the various veins known to traverse this territory, when cut, will be drifted upon. Two other de-

velopment propositions, one in the Cripple Creek District, and one in the San Juan section of the state, are being concluded, and work will be begun in May."

In concluding his letter to the stockholders, President Wood calls attention to the crisis in the gold mining industry and requests as a measure of relief the support of the McFadden Gold Excise and Premium Bill now pending in Congress.

**Leadville**—Shipments of manganese ore to eastern steel mills, which ceased soon after the close of the war, have been resumed. The price now offered for certain grades of ore offers a small margin of profit for mining, and during the last 30 days a considerable tonnage was forwarded to Chicago. Owing to the railroad strike, shipments have been temporarily discontinued, but operators are preparing to make a large output during the summer. Contracts obtained by the various shippers have not called for an excessively high manganese content, and a price is now offered for the crude ore that has resulted in the reopening of several of the manganese-producing mines of the district.

## MICHIGAN

### Quincy Seeks Remedy for Idle Drills— Arcadian Con. Resumes—Seneca Shipping Regularly

**Houghton**—In Quincy's No. 2 shaft at present 25 drills are idle on both shifts. Each machine ordinarily breaks down a skipload, or 13 tons of rock a shift, or 26 tons a day. This means a serious loss of 650 tons in daily output from this shaft. The company is consulting the men on a proposition to increase the pay of the miners \$1 a shift if they will work an additional two hours each shift. If all the miners now employed would put in two hours more each shift they would then break down enough ground to keep the trammers busy and to keep the mills running more nearly at normal capacity. The company has not put the proposition formally up to the miners, but the feelers that have been made have indicated that the latter do not think any too well of the suggestion. Quincy must maintain a high production of ore or lose money. The New York office is now at 52 Broadway.

Arcadian Consolidated has resumed operations. For the present all the men needed are on the property, farmers who are working land under lease from the Arcadian company and who have applied for positions. Most of these have previously worked underground at the Arcadian and are experienced men. The first work is to be undertaken at the New Baltic shaft, where operations were suspended in September, 1918, owing to shortage of cash and labor. The Baltic shaft is down 500 ft., at which point the station was cut. The best showing of copper in this shaft was on the 400 level, which was well opened by means of crosscuts both north and south of the shaft. The north crosscut showed a

34-ft. vein with heavy mineralization from foot to hanging. The vein in the south crosscut was 15 ft. wide.

**Calumet**—Calumet & Hecla is experimenting with a power scraper in No. 15 shaft on the Osceola lode. Experiments are also going forward with a power shovel on the 81st level.

Seneca's south drift from the 13th level of the Gratiot shaft toward the Mohawk is now in 60 ft. and is showing good amygdaloid. It is the plan of the management to continue this southerly drift all the way to the Mohawk line, a distance of 1,100 ft. In previous operations at the Gratiot there was comparatively little lateral work done lower than the 6th level from this shaft, so that this work at twice the depth is going into comparatively new territory.

**MONTANA**

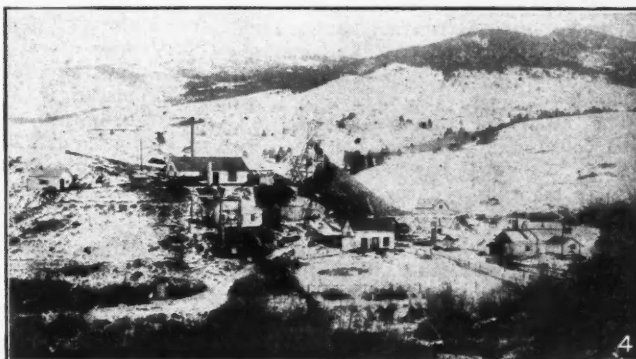
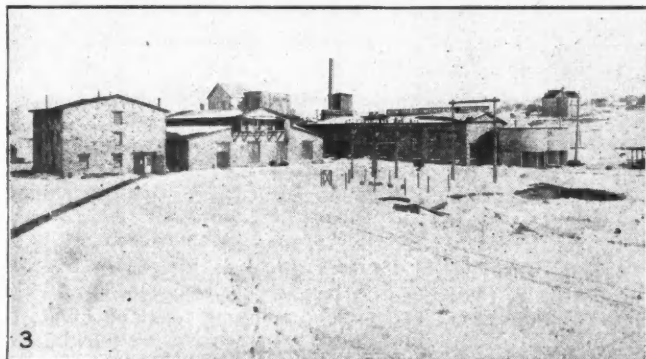
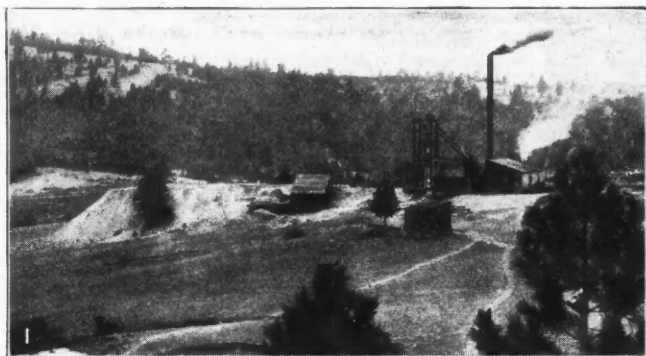
**Situation in Butte 50 Per Cent Normal —Butte & Superior's Silver Dropping**

**Butte**—Recovery from the recent strike of the I. W. W. is proceeding slowly despite the unpopularity of the movement. So many miners were threatened by the I. W. W. that a hesitancy toward returning to work developed in spite of the presence of troops, whose patrols at night continue on the thoroughfares leading to the mines. Each day, however, sees more men returning to their labor and within a week's time it is expected that practically normal conditions will have been resumed. The labor situation is approaching 50 per cent of normal for the

ate, which is shipped to Anaconda's ferro-manganese plant at Great Falls, Mont.

Analysis of the annual statement of the Butte & Superior for 1919 shows a decline in the silver content of its ores. For each dry ton of ore milled the silver content by quarters follows: First, 6.71 oz.; second, 6.47; third, 6.12; fourth, 5.91. The record by quarters of the last year of the silver content in concentrates follows: First, 22.01 oz.; second, 22.11; third, 21.63; fourth, 19.53.

Agents for John D. Ryan and Con F. Kelley, respectively chairman of the Anaconda board and president of the company, have tied up approximately 11,000 acres of land situated in the Cat Creek oil field, the scene of most of the present excitement in Montana.



Leslie Lyle, Helena, Mont.

**PROPERTIES IN HELENA DISTRICT, MONTANA**

1. Free Coinage Mine in Lump Gulch. 2. Another View of Coinage Property, Showing Silver Ore Sacked for Shipment. 3. Plant of New York-Montana Testing & Engineering Co., Helena, at Which Ores from Various Mines in Helena District Are Concentrated Prior to Shipment to East Helena Smelter of the A. S. & R. Co. Plant Is Electrically Operated. 4. Economy Mine in Mitchell Gulch, Operated by Rosenfield Brothers

The present work will take six or seven months and cannot be hurried. It will have an important bearing on the future plans for Gratiot shaft operation, for if the values are found all the way through from the present point to the Mohawk line it will be reasonable indication that they may be found in the levels above as well as those below.

On the main Seneca property four laterals are producing lode rock. Drifts are going forward in both directions from the 3rd and the 4th levels, and the quality is good. Shipments of mill rock, averaging about 200 tons daily, are being made to the Baltic mill as train loads are made up, so that Seneca may be said to have entered the ranks of the regular producers of copper.

district, although many of the mines close in to the city have fairly large forces.

At the Davis-Daly's Colorado mine over 150 tons of high-grade ore is being hoisted per day, despite the shortage of crews.

At the North Butte, the cost of copper at present is close to 13½c. per lb. Development work on the 3,200 and the 3,400-ft. levels is encouraging, showing a come-back of the Edith May vein with depth. This was the show fissure of the company years ago.

Up to the middle of April 6,000 tons of ore had been shipped from the Butte Copper & Zinc Co.'s Emma mine, of which about 1,800 tons was silver-zinc ore and the balance manganese carbon-

The holdings are located on a number of domes. It is in the Cat Creek country that the Frantz Corporation brought in a well several months ago showing oil with a gasoline content of more than 50 per cent

**Philipsburg**—About 2,000 tons of manganese ore monthly is being shipped by the Philipsburg Mining Co., its high-grade character making it available for use in storage batteries.

**Clancy**—Mining operations on the Legal Tender have been suspended.

Seven feet of commercial silver ore is reported on the 700-ft. level of the Liverpool mine.

Ore shipments are continuing regularly from the Amalgamated's Free Coinage mine.

**Wickes**—A large tonnage of milling ore has been shown by drifting operations on the 800-ft. level of the Angelica. Regular shipments are being made to the East Helena plant of the American Smelting & Refining Co.

**Whitehall**—Sinking of a two compartment shaft is under way at the Jefferson Mines property.

**Potomac**—The face of Potomac Copper's No. 4 tunnel is cutting through well mineralized ground. About sixty days more will be required for this work to reach its objective.

**Argenta**—About six inches of high-grade copper ore, showing altered glance with silver, has been opened on the 300-ft. level of the Conda Mining Co.

**Cataract District**—Lessees are operating the Crystal Copper property, with occasional shipments of ore being made.

#### NEVADA

**West End Con. to Report Monthly—Rockland Property Ordered Sold for Debt**

**Tonopah**—The Tonopah Mining Co.'s earnings for March were \$28,000, tonnage milled, 5,050 tons, bullion production, 60,605 oz.

Tonopah Belmont's earnings for March were \$65,322.34, tonnage milled 11,773 tons, bullion production 158,400.15 oz.

The Tonopah Extension shows earnings for March of \$20,789, tonnage milled 6,097 tons, bullion production 68,599.05 oz.

The report of the West End Consolidated for March has not been issued as yet, but it has been stated that regular monthly reports of operations will probably be made in the future.

**Yerington**—Judge Moran has granted a motion to substitute the Bluestone Mining and Smelting Co. as defendant in the case of Martin J. Heller against the late Joseph R. De Lamar. The suit was brought to recover an interest in the Bluestone mine, under an alleged partnership agreement, from the noted mining man, who died since the suit was brought.

**Rockland**—The trustee in bankruptcy has been ordered to sell the property of the Rockland company, 27 miles south of Yerington, to pay an indebtedness of \$55,000 owing for mill and machinery. The stockholders refused to pay the assessment to meet the debt.

#### OKLAHOMA

**Sedalia Mine Near Quapaw Sold; New Owners Will Build Mill—Imperial Development Operating**

**Picher**—Senator O. W. Sparks, of Galena, Kan., with Kansas associates, has purchased the Sedalia mine from J. F. Folmer & Co., of Miami, Okla. The mine is about a mile north of Quapaw, Okla. The new owners will build a mill upon the lease this spring, one shaft already being down into ore.

Operations have been started at the mine of the Imperial Development Co.

located southwest of Quapaw, after one of the hardest water fights in the history of the field. The original shaft was sunk in 1916 and 1917, the workers keeping the water out by careful concreting as they sunk. When drifting began, however, the mine was quickly flooded and continued so until a few weeks ago. In the meantime, the company owning the property had spent \$180,000 in attempting to beat the water, and later the Quapaw Drainage Co. was organized and spent \$50,000 before the water was lowered sufficiently to permit mining to be carried on. C. H. Cleveland, of Skiatook, Okla., has been one of the principal backers of the proposition. Glen O. Spafford, of Miami, is superintendent. For a good part of the time a 16-in. Pomona, another of 12-in. capacity, two smaller steam pumps, and a big Texas centrifugal pump were used in draining the ground.

#### UTAH

**Salt Lake City**—The Bingham & Garfield Railway of the Utah Copper Co., in its report to the Public Utilities Commission, shows a net operating loss for 1919 of \$63,026, as compared with a net income of \$1,236,082 in 1918. In 1918 the road paid dividends of \$1,000,000 to the Utah Copper, and in 1919 \$250,000, being obliged to take this sum from the \$391,551 set aside for excess profits and income taxes, which were not collected. The company operates 36.76 miles of road, its revenue coming almost entirely from freight, of which 98.48 per cent was the product of mines. The tonnage moved was 4,606,532, and of this amount 4,433,988 tons consisted of ores originating on the line of the railroads.

**Alta**—The Michigan-Utah orebins are to be connected by means of a switch, now being installed, with the Little Cottonwood Transportation Co.'s railroad at Tanners Flat. Shipments will begin soon.

The Emma mine is again receiving power from the Utah Power & Light Co., after repairs made to the latter's lines following damage by storms.

**Eureka**—The Eagle & Blue Bell at Tintic is shipping high-grade silver-lead ore from the 1,550 level and vicinity. The deposit is extensive, and in places extends down to the 1,700 and 1,875-ft. levels and up to the 1,350 and beyond. The earnings from this property in the first three months of 1920 were about \$122,841—January, \$29,906; February, \$28,935; March (estimated), \$64,000. Ninety per cent of the stock of this company is controlled by the Bingham Mines Co. At the adjoining Victoria, controlled also by the Bingham Mines, there is 60 ft. of ore on the level below the 1,300 level opened by a winze from the latter.

**Ophir**—The St. John & Ophir R.R., which takes out ores from the Ophir Hill at Ophir over its 8½-mile line, reported to the Public Utilities Commission a loss in net operations during 1919 of \$7,309.

#### WASHINGTON

**Newport**—The proposed mill of the Bead Lake Gold-Copper Mining Co. will have a capacity of at least 100 tons per day. Treatment will be by crushers, jigs, tables, and flotation. Equipment is purchased and paid for with the exception of two jigs. Construction has been delayed for a few months to secure title to the necessary ground. This was secured and filed on April 23. The work will be completed in three or four months.

The company also has a saw-mill in operation. The property is located about eight miles north of Newport, Wash. W. E. Allen, 808 Hyde Block, Spokane, is secretary.

#### WISCONSIN

##### Zinc-Lead District

**Platteville**—The Vinegar Hill Zinc Co. has taken over the Senator mine, at Rewey, under sub-lease, and its producing blende. It has also begun drilling on the Murphy tract at Platteville.

The Wisconsin Zinc Co. is equipping the new Booty property, at New Diggings, and is opening up the Champion-Church, the eastern extension of the Champion range, and is utilizing the old Blackstone shaft and mill.

At the Blockhouse, mining has been resumed in the west-end shaft and development of the Goke lease on the east end is under way.

**Benton**—H. E. Stephens and others are operating the Longhenry mine at Benton.

#### CANADA

##### British Columbia.

**Greenwood**—The Silver Cloud and Skylark properties in the Greenwood mining division are being developed. The operators are considering the installation of a small concentrator.

**Douglas Channel**—The Drum Lummon mine on the northern coast of British Columbia, is reported by C. L. Copp, superintendent, to be showing up satisfactorily on development. Mr. Copp is about to take north some special parts for the mill, which is to be ready for an early start this season. He states that the tunnel is in high-grade milling ore and that a large-tonnage has been taken out during the winter and is ready for treatment.

**Barkerville**—Pickeringite, a hydrous sulphate of magnesium and aluminum, which has not been observed previously in British Columbia, has been found in the Cariboo country. Samples have been brought out by W. H. Brock and analyzed by Dr. V. Dolmage, of the Geological Survey. The mineral, which is of a creamy color, with a silky lustre, was found in considerable quantities, but it is not thought that the deposit goes far beneath the surface. The mineral has been observed in Chili, Argentina, Colorado and Nova Scotia.

**Anyox**—One of the diamond drills which has been in use by the Granby Consolidated Mining & Smelting Co. on the Ecstall River properties is to be sent into the Salmon River section for work to be undertaken this summer.

# THE MARKET REPORT

Published in part in San Francisco and mailed from there to our Western subscribers as a special service without charge pending the arrival of the *Engineering and Mining Journal*

## Silver and Sterling Exchange

April	Sterling Exchange	Silver		May	Sterling Exchange	Silver	
		New York, Cents	London, Pence			New York, Cents	London, Pence
29	388	114	66	3	384	110½	65½
30	384	111½	64½	4	387	109½	64½
May 1	382	110	63½	5	382½	107½	63½

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.

## Daily Prices of Metals in New York

April	Copper		Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.	
29	18.70	60	61½	8.90	8.50	7.85	
30	18.70	59¾	60¾	8.90	8.60	7.85	
May 1	18.75	59½	60¾	8.90	8.65	7.75	
3	18.80	59½	60¾	8.90	8.65	7.75	
4	18.80	59½	60¾	9.00	8.65	7.70	
5	18.80	57½	60½	9.00	8.70	7.70	

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 prompt and nearby deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point. All prices are in cents per pound.

Copper is commonly sold on terms "delivered," which means that the seller pays the freight from refinery to buyer's destination. The delivery cost varies, and it would be confusing to figure net prices on individual transactions. Consequently, an average deduction is made from the "delivered" price. At present the average cost of delivery from New York refineries is 0.15c. per lb., and that deduction is made to arrive at the New York price. When copper is sold f.o.b. or f.a.s. New York, of course no deduction is made.

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 special shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

## London

April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3 M	Spot	3 M	Spot	3 M
	Spot	3 M							
29	101¾	104	111	345½	344¾	41	42½	47	48½
30	101¾	104¼	110	345	344¼	40	41¼	46¾	48½
May 1	102	104¾	110	345	344½	40	41½	46½	49
3	101½	104	111	342½	342¼	40	41½	46¼	48
4	101½	103¾	111	323½	324½	39½	40½	46	47¾

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

## Monthly Average Prices for April

<b>Copper:</b>	
New York Electrolytic	18.660
London Standard	103.025
London Electrolytic	111.500
<b>Lead:</b>	
New York	8.902
St. Louis	8.618
London	39.225
<b>Silver:</b>	
New York	119.779
London	68.848
Sterling Exchange	392.438
<b>Zinc:</b>	
New York	8.534
St. Louis	8.184
London	47.388
<b>Tin:</b>	
99 per cent	61.120
Straits	62.115
London	345.450

## Metal Markets

### New York, May 5, 1920

Copper and lead have shown a firmer tendency during the last week, but zinc and tin have been weaker. Transportation troubles are still much in evidence, and it is almost impossible to get any kind of service from the railroads.

### Copper

The tone of the copper market is decidedly better, and the big producers are again finding it possible to sell a little metal at prices which they consider satisfactory. The export plans have not yet been announced, but it is rumored that some copper has already been booked for France under the proposed arrangements.

The refineries on the Eastern seaboard have been hard hit by freight embargoes, and are in various stages

of inactivity, due to shortage of blister and coal, with no relief in sight. The domestic situation is bad, but as export business looms up, producers are in general optimistic. They also expect gradually increasing prices as a result of decreased production and diminishing stocks.

### Lead

Lead has been stronger the last three days, and a large number of inquiries have been received. Prompt and nearby deliveries continue to be in demand. July and August metal can be had for about ½c. under the prices which we quote, but producers are not anxious to commit themselves for large amounts, as labor conditions are too uncertain.

Considerable desilverized Mexican lead is being sold here, as the present London price is too low to make exportation profitable. So far, no great interruption has taken place in Mexico on account of the revolution.

### Zinc

This metal has become still weaker, though a fair demand exists for the electrolytic article, which still commands about 9½c., New York. There are many small producers who do business from hand to mouth, and their sales at a time when railroad troubles had killed the market have had considerable effect in depressing prices. Sales by the larger producers have been almost negligible. The weakness in the London market of course has its effect, and the immediate future is anything but rosy.

### Tin

Tin has followed the lead of London, as usual, and the declining prices there have not been entirely offset by the movement of sterling exchange. A price in the neighborhood of 60c. has attracted some buying, and there is a fair demand for spot, but the market is sluggish. A drop of £19 in London today is accounted for by the auction of Banca tin which is scheduled for tomorrow and which dealers are discounting.

Producers of electrolytic tin have been practically out of the market. What little business has been done has been at about 61c.

Straits tin for future delivery: April 29, 60½@60¾c.; April 30, 60½@60¾c.; May 1, 60@60¼c.; May 3, 60@60¼c.; May 4, 59½@59¾c.; May 5, 57½@58c.

Arrivals of tin in long tons: April 28, China, 25; Penang, 50; April 29, London, 50. Total for April, 3,133. May 3, London, 880; Liverpool, 25; Batavia, 50; Penang, 150.

### Gold and Silver

Gold was quoted in London on April 29 at 106s. 6d.; April 30, 107s. 6d.; May 3, 108s.; May 4, 107s.; May 5, 107s. 6d.

**Foreign Exchange**—No outstanding features in this market were in evidence during the last week. Sterling has about resumed its figure of a week ago, on rumors of further shipments of gold to this country. Francs and lire have strengthened slightly, being quoted yesterday, in units to the dollar, at 16.56 and 21.84 respectively. German marks have risen another 10 points to 1.78c. New York funds in Montreal were held at \$103.75 premium per \$1,000.

**Silver**—Owing to the decline in the Eastern exchanges, silver has been weak, with a declining tendency. There has been some buying by the Indian Bazaars and China, but not sufficient to sustain the market. India currency returns for April 7 show the amount of coin and bullion to be 17,429 in lacs and rupees.

Mexican dollars at New York: April 29, 86½; April 30, 84½; May 1, 82½; May 3, 83½; May 4, 82; May 5, 81½.

### Other Metals

**Aluminum**—Ingot is quoted at 33c., with 31½@32c. open market for 98@99 per cent virgin; steady demand, firm market and demand exceeding supply.

**Antimony**—Spot metal is quiet at 10@10½c. for ordinary brands; W. C. C., 11c. and Cookson's "C" grade, 16c. Futures are pretty quiet and decreasing slightly. Chinese and Japanese brands, spot, 10c. Market easy, with little business being done.

**Needle Antimony**—The market for Chinese needle antimony in lump form is firm at 9½c. per lb., although demand continues quiet. Standard powdered needle antimony (200 mesh) is quoted at from 12@15c. per lb., according to quantity.

**Bismuth**—Unchanged at \$2.70 per lb. for 500-lb. lots.

**Cadmium**—Quoted nominally at \$1.40 @ \$1.50 per lb. Some metal may be had as low as \$1.20 per lb.

**Cerium Metal**—There has been no change from the price of \$8@9 per lb. in ingot form.

**Cobalt**—Prices remain unchanged at \$2.50@3 per lb. Black oxide sells at \$2 per lb.

**Iridium**—Quoted nominally at \$300; unchanged; metal extremely scarce.

**Magnesium**—Metallic, 99 per cent or over pure, \$1.60@1.85 per lb. Unchanged.

**Molybdenum Metal** in rod or wire form, 99.9 per cent pure, is still selling at \$32@40 per lb., according to gage.

**Nickel**—Ingot, 43c.; shot, 43c.; electrolytic, 45c. No change.

**Osmium**—Open market prices, \$150@165 per troy oz. Dealers are willing to pay \$50@75 per troy oz., according to purity.

**Palladium Metal**—Unchanged at \$105 @ \$115 per oz. 99 per cent pure. Little business being done.

**Platinum**—Plenty of metal available, but small business done. Quoted at \$110@115 per oz.

**Quicksilver**—Market quiet and steady at \$97@100 per 75-lb. flask. San Francisco telegraphs \$93@100; firm.

**Ruthenium**—Market value, \$200@220 per troy oz. Unchanged.

**Selenium**, black, powdered, amorphous, 99.5 per cent pure, continues to be quoted at \$1.75@2 per lb., depending on quantity.

**Thallium Metal**—Selling at \$18@20 per lb., ingot, 99 per cent pure, depending on quantity.

### Metallic Ores

**Chrome Ore**—Business dull, with prices ranging from 65 to 75c. per unit, according to quality.

**Iron Ores**—Lake Superior ores, per ton delivered at Lower Lake ports, remain at prices fixed last year, as follows: Old Range bessemer 55 per cent iron, \$7.45; Old Range non-bessemer, 55½ per cent iron, \$6.70; Mesabi bessemer, 55 per cent iron, \$7.20; Mesabi non-bessemer, 51½ per cent iron, \$6.55. Railroad and mine schedules for the Lake Superior ore region estimate shipments at seventy million tons this season.

**Manganese Ore**—Considerable business done for early shipment, 80c. having been paid for material for shipment from Brazil. As high as 95c per unit has been paid for Caucasian manganese. Chemical ore (MnO<sub>2</sub>) quoted at \$80@90 per gross ton.

**Molybdenite**—Without change. Quoted at 75@85c. per lb. of contained sulphide for 85 per cent MoS<sub>2</sub>, but may be obtained on long-time contracts at 50@60c.

**Tantalum Ore**, guaranteed minimum 60 per cent tantalic acid, is still selling at 65@70c. per lb. in ton lots.

**Titanium Ores**—Ilmenite, 2c. per lb. of 52 per cent TiO<sub>2</sub>. Unchanged. Rutile, standard imported Norwegian grade, carrying a minimum of 95 per cent titanium dioxide, in the form of concentrates, is quoted at 11c. per lb.

**Tungsten Ore**—Little actual business has been done. Sellers of Chinese wolframite have asked \$7 per unit, but only \$6.75 is offered. High-grade Bolivian ore is offered at \$7.50 per unit.

**Uranium Ore (Carnotite)**—\$2.75@3 per lb. for 96 per cent of the contained oxide (U<sub>3</sub>O<sub>8</sub>). Ores must contain a minimum of 2 per cent U<sub>3</sub>O<sub>8</sub>.

**Vanadium Ore**—For grades averaging 3 to 5 per cent V<sub>2</sub>O<sub>5</sub>, \$1.50 per lb. of V<sub>2</sub>O<sub>5</sub> contained. Vanadium pentoxide, c.p., of highest grade and best quality, sells at \$14 per lb.

**Zircon**—Washed, iron free, continues to be quoted at 10c. per lb. Zirkite—In carload lots, \$90@100 per ton is quoted. Pure white oxide, 99 per cent, is quoted at \$1.15 per lb. in ton lots.

<sup>1</sup>Furnished by Foote Mineral Co., Philadelphia, Pa.

### Zinc and Lead Ore Markets

**Joplin, Mo., May 1.**—Zinc blende, per ton, high, \$49.65; basis 60 per cent zinc, premium, \$46; Prime Western, \$45@42.50; fines and slimes, \$42.50@40; calamine, basis 40 per cent zinc, \$20. Average settling prices: Blende, \$48; calamine, \$37.20; all zinc ores, \$47.90.

Lead, high, \$111.70; basis 80 per cent lead, \$110; average settling price, all grades of lead, \$109.62 per ton.

Shipments the week: Blende, 11,639; calamine, 111; lead, 1,950 tons. Value, all ores the week, \$771,170.

Buyers were severely limited in quantity of blende purchases, and sellers of small tonnage were seeking offers today without avail. Under 8,000 tons were purchased, and then buying ceased, with sellers offering more ore. There are unsold 27,000 tons of blende, and the total bin supply is 40,000 tons. About 10,000 tons, however, is sold ahead of production.

The lead-ore market continues active on the \$110 basis, with bins cleaned of stock and buyers anxious to secure advance tonnage.

**Platteville, Wis., May 1.**—Blende, basis 60 per cent zinc, \$52.50 for high grade. Lead ore, basis 80 per cent lead, \$105 per ton. Shipments for the week: Blende, 1,068; calamine, 60; lead, 170; sulphur ore, 65 tons. Shipments for the year: Blende, 26,573; calamine, 1,350; lead, 2,239; sulphur ore, 350 tons. Shipped during week to separating plants, 1,751 tons blende.

### Non-Metallic Minerals

**Asbestos**—Quoted per short ton f.o.b. Thetford, Broughton and Black Lake mines, Quebec, Canada. Freight rate from mines to Sherbrooke, Quebec, over Quebec Central R.R., 20c. per cwt; from Sherbrooke to New York, 27½c., carload lots. Crude No. 1, \$1,800@2,500; crude No. 2, \$1,000@1,300; spinning fibres, \$300@600; magnesia and compressed sheet fibres, \$300@400; single stock, \$100@150; paper stock, \$55@75; cement stock, \$17.50@30; floats, \$8.50@15 per short ton. Crude No. 1, f.o.b. Thetford Mines; freight to New York \$8.45 per ton in carload lots, to which must be added the 5 per cent Canadian royalty export tax. Foreign demand is brisk. A good trade in paper stock and cement stock has been developed in France, Belgium, and Norway.

**Chalk**—English, extra light, 5@7c. per lb.; light, 4½@6c. per lb.; dense, 4@5c. per lb. f.o.b. New York. Unchanged.

**China Clay (Kaolin)**—Imported lump, \$25@35 per ton; imported powdered, \$30@60 per ton; domestic lump, \$10@20 per ton; domestic powdered, \$25@40 per ton f.o.b. New York.

**Feldspar**—Situation remains unchanged with \$13.50@18, ground grade, f.o.b. New York State still holding firm.

**Fluorspar**—Gravel, 85 per cent, f.o.b. Kentucky and Illinois mines, is quoted

at \$25 net ton. Ohio district, prompt, per ton, \$28.

**Fuller's Earth**—Remains firm at \$25 @ \$30 per ton for domestic and \$35 @ \$40 for foreign, with little material available at these prices.

**Graphite**—Present quotations for crucible flake are: 85 per cent carbon content, 7½c. per lb.; 86 per cent, 8c.; 87 per cent, 8½c.; 88 per cent, 9½c.; 89 per cent, 9½c.; 90 per cent, 10½c.; 91 per cent, 10½c.; 92 per cent, 11c.; over 92 per cent, 12½c. per lb. delivered. Mexican amorphous graphite is being sold at \$55 @ \$60 per short ton; Korean, 3½c. per lb.; Madagascar, 9c.; Ceylon, 4¼ @ 16c., according to quality. Unchanged.

**Gypsum**—Wholesale price, plaster of paris in carload lots, is \$3.75 per 250-lb. bbl., alongside dock New York.

**Magnesite**—Dead burned, for refractory (see Refractories).

**Mica**—It is reported that a large quantity of mica of good quality was imported about a week ago from Brazil and India. Prices per lb. for sheets slightly stained and for clear mica according to grade: No. 6, 50c.; No. 5, \$1.20 @ \$1.40; No. 4, \$2 @ \$3; No. 3, \$4.25 @ \$5; No. 2, \$5.50 @ \$7 and No. 1, \$8; all prices f.o.b. New York.

**Calcined Magnesite**—High-grade caustic calcined, in lump form, is selling at \$35 @ \$40 per ton in carload lots f.o.b. California points. The price of freshly ground calcined, suitable for the flooring trade, is \$65 @ \$75 per ton f.o.b. Eastern points.

**Monazite**—Product carrying a minimum of 6 per cent thorium oxide, \$42 per unit is quoted, duty paid.

**Nitrate**—Supplies are becoming less tight, although quotations remain at \$3.90 per cwt., ex vessel, Atlantic ports. Futures are quoted \$3.90 @ \$4.10.

**Phosphate Rock**—Prices quoted per long ton at Florida ports are: 68 per cent tricalcium phosphate, \$6.85; 70 per cent, \$7.35; 74 to 75 per cent, \$10; 75 per cent minimum, \$10.50; 77 per cent minimum, \$12.50. Unchanged.

**Pumice Stone**—Imported, 3 @ 6c. per lb.; domestic, 2½c. per lb. Unchanged.

**Pyrites**—Domestic pyrites, fine, is selling at 16½c. per unit f.o.b. mines.

**Sulphur**—No change. There is still a fair demand, with prices averaging \$18 per ton for domestic, and \$20 for export, f.o.b. Texas and Louisiana mines.

**Talc**—Powdered, carload lots, \$12 per ton; less than carload, \$15, f.o.b. cars, Glendon, N. C. Freight to New York, 5½c. per cwt. carload lots; less than carloads, 9½c.

#### Ferro Alloys

**Ferrocobalt**—For 15-18 per cent material, \$200 @ \$250 per ton f.o.b. Niagara Falls, N. Y. Unchanged.

**Ferrocobalt**—Conditions abroad continue to cause a reduction in price of the American goods, and this alloy is now selling at \$12 @ \$15 per lb.

**Ferrocobalt**—Carload lots, spot and contract, 60 to 70 per cent chro-

mium, 4 to 6 per cent carbon, 18 @ 19c. per lb. of chromium contained.

**Ferromanganese**—Domestic, 76 to 80 per cent, delivered, \$200 per ton for futures; car lots, spot, \$250 per ton. Small lots, \$275; English, c.i.f. tide-water, \$195 last half delivery.

**Ferromolybdenum**—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, are quoted at \$2.25 @ \$2.75 per lb. of contained metal.

**Ferrosilicon**—\$85 @ \$90, 50 per cent, delivered, spot and contract. Electrolytic, delivered Pittsburgh Valleys, Cleveland: 50 per cent, \$81; 75 per cent, \$140. Bessemer, f.o.b. Jackson and New Straitsville, Ohio, 10 per cent, \$62.50; 11 per cent \$65.80; 12 per cent, \$69.10.

**Ferrotungsten**—70-80 per cent W, 85c @ \$1.15 per lb. contained tungsten.

**Ferro-uranium**—35-50 per cent U, \$7 per lb. of U contained. Unchanged.

**Ferrovandium**—Basis 30-40 per cent, \$6.50 @ \$7 per lb. of V contained.

**Spiegeleisen**—Sharp advance to \$72.-50 @ \$75 for 19 to 21 per cent, prompt delivery.

#### Metal Products

**Copper Sheets**—No change since Jan. 7 price of 29½c. per lb.; wire, quoted 22½ @ 22¾c.; strong.

**Lead Sheets**—Full lead sheets, 12½c.; cut lead sheets, 12½c. in quantity prices, mill lots. Unchanged.

**Nickel Silver**—Unchanged at 39½c. per lb. for 18 per cent nickel.

**Yellow Metal**—Dimension sheets, 26½c.; sheathing, 25½c.; rods, 1 to 3 in., 23½c. Unchanged.

**Zinc Sheets**—\$12.50 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 12c. per lb. Unchanged.

#### Refractories

**Chrome Brick**—Unchanged at \$70 @ \$75 per net ton, f.o.b. Chester, Pa.

**Chrome Cements**—Unchanged at \$45 @ \$50 per net ton, f.o.b. Chester, Pa.

**Clay Brick**—First-quality fire clay, \$45 @ \$50 per 1,000, f.o.b. Clearfield, Pa.; second quality, \$40 @ \$45 per 1,000, f.o.b. Clearfield, Pa.

**Magnesite**—Dead burned, \$48 @ \$55 per net ton, f.o.b. Chester, Pa.; brick, 9 x 4½ x 2½ in., \$90 @ \$95 per net ton, f.o.b. Chester, Pa. Dolomite is selling at \$12.50 per ton, f.o.b. Ohio.

**Silica Brick**—\$50 @ \$55 per 1,000, f.o.b. Mt. Union, Pa.

#### Iron Trade Review

##### Pittsburgh, May 4.

There has been material improvement in conditions in the iron and steel industry as regards the influence of the rail strike. Though week by week there has been an increasing movement of freight in solid trainloads, it is only in the last week that the railroad classification yards in western Pennsylvania

<sup>1</sup>Furnished by Foote Mineral Co., Philadelphia, Pa.

and the Valleys have been functioning to any extent. The situation is still embarrassing, particularly in certain spots, and at best a complete restoration of normal shipping conditions will be a matter of several weeks.

The Valleys are now operating at about one-half normal, in both pig iron and steel; in the Pittsburgh district there is scarcely any idleness, and the Chicago district is doing better than one-half normal. Roughly speaking, production of pig iron and steel in the country at large is about 90 per cent of the rate just before the rail strike.

Shipments of finished steel have been curtailed much more than production, but in the past few days they have been increasing. At some plants that were shipping little two or three weeks ago shipments yesterday were approximately equal to production. The distribution of steel, however, is poor. There is much curtailment in consumption of steel, by reason of shortage not merely of steel but also of coal and other commodities.

Steel prices show no general change, despite the quietness of the market. The policy of the independents, with their prices ranging various amounts above the Steel Corporation or Industrial Board schedule, is to hold to these prices and offer only as much material as buyers will take at the premiums involved, though in two or three cases independents have sold at corporation levels.

**Pig Iron**—The market is extremely quiet. Consumption of foundry iron is decreased further by stocks of pig iron or coke running out, the consumers involved being shut out by embargoes. Pig Iron is piling at many furnaces at a rapid rate, more furnaces having resumed through receiving coke in solid trainloads. Prices are easily maintained, as there is no selling pressure, and we quote: Bessemer, \$42.50; basic, \$43; foundry, \$43 @ \$45, Valley basis, freight to Pittsburgh being \$1.40.

**Steel**—The billet market is stagnant, and sheet bars are less active. Billets are nominally \$60 @ \$65, with sheet bars at about \$70 for contracts and \$75 @ \$80 for odd lots. The Steel Corporation subsidiaries continue their prices of \$38.50 on billets and \$42 on sheet bars, but can take care of regular customers only.

#### Charcoal and Coke

**Charcoal**—Large quantities sell as follows: Willow, 7c per lb.; hardwood, 4½c. per lb., in 250-lb. bbl.

**Connellsville**—Prompt furnace, \$11 @ \$12; prompt foundry, \$12 @ \$13; contract foundry, \$10 @ \$12 per net ton at ovens. Production this week in Connellsville region said to have been three-fourths of average before the strike.

**New River**—Furnace, \$10 @ \$11, and foundry, \$11 @ \$12 per ton.

**Pocahontas**—Furnace, \$10 @ \$12 per ton.

**Wise County**—Furnace, \$10 @ \$12 per ton; foundry, \$11 @ \$12 per ton.

## COMPANY REPORTS

### Tonopah Divide Mining Co.

Silver; Nevada

The annual report of the Tonopah Divide Mining Co. for the year 1919 shows a net profit of \$64,205.59 on the \$1,012,800 capitalization of the company, comprising 1,012,800 shares of capital stock outstanding. Total gross earnings were \$258,614.42, but deductions of gross expenses amounting to \$194,408.83 give profit indicated above. The company does not operate its own mill. Shipments of ore to a custom mill in Tonopah for treatment were valued at \$282,107.83. Mining expenses amounted to \$84,896.57; ore transportation and treatment, \$79,068.80; general expense, \$22,417.97; taxes, \$2,330.25; examinations, \$1,606.88. Total expenses were \$190,677.97. Production in 1919 amounted to 9,611.45 tons of ore, with an average value of \$29.35 per ton, compared with 787.69 tons in 1918, with an average value of \$20.89 per ton. During the year 1919, the development work totaled 4,605 ft., of which 3,517 ft. comprised drifts and crosscuts, costing \$11.89 per ft.; 871 ft. raises, costing \$8.58 per ft.; and 217 ft. shaft advances, costing \$37.88 per ft. The ratio of silver to gold in the ore is normally 250 to 1. The report of the president of the company states that "so far the lower levels have failed to encounter the high-grade ore exposed above." The probable reserve of first-class ore is estimated at 52,000 tons, having a gross value of \$1,385,000 and an average content of 20 oz. silver and 0.08 oz. gold.

### Tonopah Belmont Development Co.

Silver; Nevada

The annual report of the Tonopah Belmont Development Co. shows a profit of \$569,806.65 for the year 1919, compared with a profit of \$1,018,124.55 for 1918, the decrease being due to the unsatisfactory labor conditions that prevailed during the period of operation.

The following were some of the average costs of operations at the Belmont mine per ton: Mining, including stoping and development, \$4.729; milling, \$3.198; marketing, \$0.286; general expense, \$0.877. The total net operating costs were \$9.044 per ton, compared to \$8.58 in 1918. The average value of the 79,687 dry tons of Belmont mine ore milled was \$15.442 per ton, of which \$14.102 per ton was recovered. The average metal content of the ore was 0.116. The Tonopah mill operated with an extraction of 93.63 per cent of the gold and 91.11 per cent of silver, and also treated 53,645 dry tons of custom ore, of an average value of \$21.499 per ton, realizing therefrom \$5,092.90. Net earnings from the Belmont mine ore were \$405,428.42, and from the treatment of "sweepings," \$13,895.95. The surplus balance at the end of 1919 stood at \$2,408,698.47, and dividends paid to shareholders amounted to \$375,000.

### Eden Mining Co.

Gold; Nicaragua

The second annual report of the Eden Mining Co., of Philadelphia, Pa., states that \$416,683.83 in gold was produced during 1919, or \$11.53 per ton in the 36,159 tons of ore from its mining property in Nicaragua. Silver production amounted to \$26,715.93, or \$0.74 per ton of ore produced. Extraction of gold during the year 1919 amounted to 94.5 per cent. The net profit from operations amounted to \$83,017.27, or \$2.30 per ton, but net losses after deductions for depletion and depreciation amounted to \$21,009.54. Costs of mining per ton were \$4.461; milling, \$3.618; bullion expense, \$0.652; indirect expense, \$1.236. Total cost of operation for the year was \$9.967 per ton. This company is affiliated with the Tonopah Mining Co. of Nevada, and is capitalized at \$1,000,000. Loans and advances from the Tonopah Mining Co. amounted to \$2,024,100.

### Belmont Surf Inlet Mines, Ltd.

Gold, Silver, Copper; British Columbia.

Reports covering the operations of the Belmont Surf Inlet Mines, Ltd., at Surf Inlet, B. C., for the year 1919 show a profit of \$320,384.46. The average per-ton content of the 103,927 dry tons of ore milled during the year was 0.4808 oz. gold, 0.2843 oz. silver, and 6.954 lb. copper, representing an average per-ton value of \$11.383, with copper calculated at 15.71c. per lb. and silver at \$1.082 per oz. The ratio of concentration was 10.79 to 1, and the average per-ton metal content of the concentrates was \$113.485. Smelter deductions were \$1.015 per ton; shipping and marketing costs, \$0.808 per ton; mill tailing losses, \$0.865 per ton. The company had a surplus in Dec. 31, 1919, of \$318,884.69. Dividends to shareholders amounted to \$250,000.

### Jim Butler Tonopah Mining Co.

Silver; Nevada

The annual report of the Jim Butler Tonopah Mining Co. for the year 1919 states that 5,711 dry tons of ore was produced from the company's properties in Nye County, Nev., against 27,688 tons in 1918, the decrease being due to depletion in ore reserves. Most of the ore was produced from the Wandering Boy mine. Average metal content per ton was 0.200 oz. gold and 17.79 oz. silver, with an average combined value of \$23.48. Mining costs were \$9.33 per ton, of which \$6.65 per ton was for stoping and \$2.68 per ton was for development. Transportation costs were \$0.63 per ton, general expense was \$1.19 per ton, and taxes were \$0.29 per ton. Total mining, transportation, and milling charges were \$15.08 per ton. The net earnings from the Tonopah operations for the year were \$40,288.28, as compared to earnings in the previous fifteen months of \$296,525.07. The entire tonnage was shipped to the Tonopah Belmont Development Co., at a treatment charge of \$5.52 per ton. The net profit of the year amounted to \$28,563.21. During the year, 167 ft. of drifts, 493 ft. of crosscuts, and 499 ft. of raises were driven in the course of development work at the Wandering Boy mine.

### April Mining Dividends

The following is a partial list of mining dividends paid during April, 1920:

U. S. Mining and Metallurgical Companies	Situation	Per Share	Totals
Am. Smelt. Sec., pfd. A.	U. S.-Mex.	\$1.50	\$146,071
Am. Smelt. Sec., pfd. B.	U. S.-Mex.	1.25	39,855
Arizona Silver Mines Co.	Nev.	.03	13,500
Caledonia Mining Co., l. s.	Idaho	.01	26,050
Daly Mining Co., s. l. g.	Utah	.10	15,000
Daly West Mining Co., s. l.	Utah	.15	37,500
Dragon Consol, s. c.	Utah	.01	18,750
Eagle and Blue Bell Mining, g. s. l.	Utah	.10	89,316
Eastern Talc Co.	Vt.	.15	10,434
Great Northern Iron Ore.	Minn.	2.00	3,000,000
Inspiration Consolidated Copper.	Ariz.	1.50	1,772,951
Iron Blossom Consol, s. l. g. c.	Utah	.02	25,000
Judge Mining & Smelting, s. l.	Utah	.12	60,000
Phelps Dodge Corp.	U. S.	2.50	1,125,000
Portland Gold Mining.	Col.	.01	45,000
Tonopah Extension Mining Co., g. s.	Nev.	.05	64,140
United Eastern Mining Co., g.	Ariz.	.21	286,230
U. S. Sm., Ref. & Min.	U. S.-Mex.	1.50	526,673
U. S. Sm., Ref. & Min., pfd.		.87	425,555
Vanadium Corp. of Amer.	Col.-Peru	1.50	560,001
Canadian, Mexican, South and Central American Companies	Situation	Per Share	Totals
Alvarado Mining & Milling, s. g.	Mex.	\$0.50	\$17,500
Asbestos Corp. of Canada, Ltd.	Quebec	1.25	37,500
Asbestos Corp. of Canada, pfd.	Quebec	1.50	60,000
Consol. Mining & Smelt., Canada	Br. Col.	.62	263,342
Dome Mines Co., Ltd., g.	Ont.	.25	100,000
Hollinger Consol., g.	Ont.	.05	246,000
Howe Sound Co., c.	B. C.-Mex.	.05	99,208
McKinley-Darragh-Savage, s.	Ont.	.03	67,431
N. Y. & Honduras Rosario Mining Co., s. g.	Honduras	.50	100,000
Nipissing Mines Co., Ltd., s.	Ont.	.25	300,000

Shattuck Arizona, Tonopah Mining Co., and the Wolverine Copper Mining Co. passed their dividends.



# METAL STATISTICS

## Monthly Average Prices of Metals

	Silver			London		
	1918	New York 1919	1920	1918	1919	1920
January	88.702	101.125	132.827	44.356	48.438	79.846
February	85.716	101.125	131.295	42.792	48.027	85.005
March	88.082	107.125	125.551	43.620	48.171	74.194
April	95.346	101.125	119.779	47.215	48.886	68.848
May	99.505	107.135	.....	48.980	52.104	.....
June	99.500	110.430	.....	48.875	53.896	.....
July	99.625	106.394	.....	48.813	54.133	.....
August	100.292	111.370	.....	49.077	58.835	.....
September	101.125	114.540	.....	49.500	61.668	.....
October	101.125	119.192	.....	49.500	64.049	.....
November	101.125	127.924	.....	48.969	70.065	.....
December	101.125	131.976	.....	48.492	76.432	.....
Year	96.772	111.122	.....	47.516	57.059	.....

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

## Copper

	New York Electrolytic		Standard		London (b) Electrolytic	
	1919	1920	1919	1920	1919	1920
January	(a) 18.918	18.918	92.238	118.095	106.619	123.238
February	16.763	18.569	78.700	120.188	95.700	126.950
March	14.856	18.331	76.821	109.533	82.071	118.348
April	15.246	18.660	77.300	103.025	82.200	111.500
May	15.864	.....	77.767	.....	81.227	.....
June	17.610	.....	83.062	.....	85.900	.....
July	21.604	.....	99.576	.....	103.046	.....
August	22.319	.....	97.300	.....	106.429	.....
September	21.755	.....	100.767	.....	.....	.....
October	21.534	.....	103.418	.....	.....	.....
November	19.758	.....	98.894	.....	.....	.....
December	18.295	.....	103.708	.....	.....	.....
Year	18.691	.....	90.796	.....	.....	.....

(a) No market. (b) See note on page 1095.

## Lead

	New York		St. Louis		London	
	1919	1920	1919	1920	1919	1920
January	5.432	8.561	5.316	8.300	37.227	47.095
February	5.057	8.814	4.784	8.601	28.675	50.256
March	5.226	9.145	4.992	8.894	27.952	46.054
April	4.982	8.902	4.722	8.619	24.888	39.225
May	5.018	.....	4.773	.....	23.852	.....
June	5.340	.....	5.070	.....	22.544	.....
July	5.626	.....	5.408	.....	23.457	.....
August	5.798	.....	5.583	.....	25.330	.....
September	6.108	.....	5.853	.....	28.473	.....
October	6.487	.....	6.249	.....	34.731	.....
November	6.808	.....	6.649	.....	41.202	.....
December	7.231	.....	6.955	.....	.....	.....
Year	5.759	.....	5.530	.....	28.590	.....

## Tin

	New York				London	
	99%	1919	99%	1920	1919	1920
January	67.702	.....	61.596	.....	248.557	376.512
February	66.801	.....	58.466	59.932	223.963	395.750
March	67.934	.....	61.037	61.926	236.843	369.489
April	72.500	.....	61.120	62.115	225.275	345.450
May	72.500	.....	.....	.....	234.398	.....
June	71.240	.....	.....	.....	238.263	.....
July	68.000	.....	.....	.....	253.272	.....
August	57.226	.....	.....	.....	273.625	.....
September	54.482	.....	.....	.....	280.102	.....
October	54.377	.....	.....	.....	279.239	.....
November	53.307	.....	.....	.....	283.556	.....
December	53.870	.....	.....	.....	314.113	.....
Av. year	63.328	.....	.....	.....	257.601	.....

## Zinc

	New York		St. Louis		London	
	1919	1920	1919	1920	1919	1920
January	7.272	9.483	6.922	9.133	56.045	58.643
February	6.623	9.058	6.273	8.708	46.150	61.338
March	6.500	8.881	6.150	8.531	38.500	53.467
April	6.465	8.534	6.114	8.184	36.118	47.388
May	6.429	.....	6.079	.....	35.477	.....
June	6.901	.....	6.551	.....	36.763	.....
July	7.873	.....	7.523	.....	41.815	.....
August	7.789	.....	7.160	.....	39.338	.....
September	7.510	.....	7.473	.....	40.955	.....
October	7.823	.....	7.827	.....	43.630	.....
November	8.177	.....	8.350	.....	46.588	.....
December	8.700	.....	8.350	.....	53.101	.....
Year	7.338	.....	6.988	.....	42.879	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

## Pig Iron, Pittsburgh

	Bessemer †		Basic †		No. 2 Foundry	
	1919	1920	1919	1920	1919	1920
January	\$33.60	\$40.47	\$31.40	\$39.88	\$32.40	\$39.86
February	33.60	42.954	31.40	42.61	32.40	43.40
March	32.54	43.40	31.40	42.90	29.12	43.40
April	29.35	43.72	27.15	44.22	28.15	43.90
May	29.35	.....	27.15	.....	28.15	.....
June	29.35	.....	27.15	.....	28.15	.....
July	29.35	.....	27.15	.....	28.15	.....
August	29.35	.....	27.15	.....	28.15	.....
September	29.35	.....	27.15	.....	28.15	.....
October	29.35	.....	27.15	.....	28.15	.....
November	31.60	.....	31.56	.....	28.30	.....
December	36.57	.....	35.32	.....	32.16	.....
Year	\$31.11	.....	\$29.26	.....	\$28.35	.....

† As reported by W. P. Snyder & Co.

## Monthly Copper Production

The table which appears herewith represents the crude-copper content of blister copper, in pounds.

### MONTHLY CRUDE COPPER PRODUCTION, 1919-1920

	December	January	February	March
Alaska shipments	6,032,677	7,909,682	5,121,609	4,897,088
Arizona:				
Arizona Copper	2,900,000	3,000,000	3,000,000	3,000,000
Calumet & Arizona	5,778,000	5,034,000	5,268,000	4,428,000
Cons. Ariz. Smelting	615,000	690,000	910,000	1,250,000
Inspiration	7,200,000	7,200,000	7,200,000	6,500,000
Magma	719,800	707,585	729,546	830,235
Miami	4,519,910	4,461,247	4,089,520	4,091,535
New Cornelia	2,640,000	2,456,000	2,872,000	3,408,000
Old Dominion	2,534,000	2,504,900	2,103,000	2,358,000
Phelps Dodge	5,061,000	5,622,000	5,535,500	6,145,000
Ray	3,860,000	3,16,970	340,384	344,938
Shattuck Arizona	260,284	3,899,073	3,885,000	3,900,000
United Verde	5,450,000	6,350,000	6,490,000	5,900,000
United Verde Extension	3,740,024	3,676,312	2,977,898	3,977,898
Michigan:				
Calumet & Hecla	8,931,567	9,690,671	8,660,052	9,880,577
Other Lake Superior	6,420,000	6,420,000	6,420,000	6,420,000
Montana:				
Anaconda	3,300,000	18,100,000	18,500,000	18,450,000
East Butte	1,844,540	1,738,840	1,460,360	1,909,720
Nevada:				
Nevada Cons.	4,500,000	4,181,938	3,850,000	3,700,000
New Mexico:				
Chino	3,388,524	3,081,937	3,176,489	4,413,329
Utah:				
Utah Copper	9,005,591	8,693,589	9,211,806	8,894,596
Eastern Smelters	1,500,000	1,610,000	1,600,000	1,610,000
Total reported	89,740,633	107,544,744	103,401,164	106,309,316
Others, estimated	13,257,000	14,359,000	14,049,000	14,000,000
Total United States	102,997,633	121,903,744	117,450,164	120,309,316
Imports: Ore and concentrates, etc.	7,135,731	13,372,187	10,848,782	.....
Imports in blister, etc.	21,453,007	20,852,050	28,319,347	.....
Grand total	131,586,371	156,127,981	156,618,293	.....
British Columbia:				
Granby Cons.	1,544,446	1,975,439	2,180,000	2,095,508
Mexico:				
Boleo	933,097	1,054,550	911,051	1,193,416
Cananea	3,600,000	3,000,000	3,400,000	3,700,000
Phelps Dodge Mexican properties	2,397,000	2,340,000	2,050,000	1,786,000
Other foreign:				
Cerro de Pasco	4,644,000	4,616,000	4,718,000	5,658,000
Chile	6,016,000	7,508,000	.....	9,256,000
Katanga	473,989	4,519,430	4,133,625	3,229,739
Baekus & Johnston	1,862,000	716,000	926,000	958,000

Production of the United States by months since the beginning of the year and the corresponding figures for 1918 and 1919 were as follows:

	1918	1919	1920
January	165,431,568	135,733,511	121,903,744
February	160,011,364	111,649,512	117,450,000
March	185,525,168	102,040,460	120,309,316
April	163,207,096	98,808,998	.....
May	181,070,350	92,652,975	.....
June	166,723,599	95,856,570	.....
July	159,329,031	100,369,247	.....
August	165,550,799	107,994,040	.....
September	157,992,487	108,703,075	.....
October	168,638,775	115,143,143	.....
November	159,217,588	117,289,735	.....
December	161,801,916	102,997,633	.....

# MINING STOCKS

Week Ended May 1, 1920

Stock	Exch.	High	Low	Last	Last Div.
<b>COPPER</b>					
Adventure.....	Boston.....	*95	*95	*95	
Ahmeek.....	Boston.....	67½	65	67½	Mar. '20, \$ .50
Alaska-B.C.....	N. Y. Curb.....	1½	1½	1½	
Allouez.....	Boston.....	32½	31	31	Mar. '19, 1.00
Anaconda.....	N. Y. Curb.....	59½	56½	56½	Feb. '20, 1.00
Ariz. Com'l.....	Boston.....	12	11	11	Oct. '18, .50
Big Ledge.....	N. Y. Curb.....	3½	3½	3½	
Bingham Mines.....	Boston.....	10½	8½	10	Sept. '19, .25
Calumet & Ariz.....	Boston.....	62½	61	61	Mar. '20, 1.00
Calumet & Hecla.....	Boston.....	34½	330	330	Dec. '19, 5.00
Can. Copper.....	N. Y. Curb.....	1½	1½	1½	
Centennial.....	Boston.....	12	11	11	Dec. '18, 1.00
Cerro de Pasco.....	N. Y. Curb.....	49½	45	45½	Mar. '20, 1.00
Chief Consol.....	Boston Curb.....	4½	3	3	Feb. '20, .10
Chino.....	N. Y. Curb.....	17½	16½	16½	
Con. Ariz.....	N. Y. Curb.....	34½	31	32	Mar. '20, .37½
Con. Copper M.....	N. Y. Curb.....	4½	4	4½	Dec. '18, .05
Cop. Range.....	Boston.....	42	39	39½	Mar. '20, .50
Crystal Cop. (new)	Boston Curb.....	*28	*26	*26	
Davis-Daly.....	Boston.....	10½	9½	10	Mar. '20, .25
East Butte.....	Boston.....	13½	12½	13	Dec. '19, .50
First Nat'l.....	Boston Curb.....	1½	1½	1½	Feb. '19, .15
Franklin.....	Boston.....	3½	2½	3	
Gadsden Copper.....	N. Y. Curb.....	1	1	1	
Granby Consol.....	N. Y. Curb.....	40	40	40	May '19, 1.25
Greene-Can.....	N. Y. Curb.....	32	30½	30½	Feb. '19, 1.50
Hancock.....	Boston.....	5	5	5	
Houghton.....	Boston Curb.....	*80	*55	*55	
Howe Sound.....	N. Y. Curb.....	4	4	4	Jan. '20, .05
Inspiration Con.....	N. Y. Curb.....	55½	52½	52½	Apr. '20, 1.50
Iron Cap.....	Boston Curb.....	12	10	10	Feb. '19, .25
Isle Royale.....	Boston.....	31½	29½	29½	Sept. '19, .50
Jerome Verde.....	N. Y. Curb.....	1	1	1	
Kennecott.....	N. Y. Curb.....	29½	27½	28½	Mar. '20, .50
Keweenaw.....	Boston.....	1	1	1	
Lake Copper.....	Boston.....	4	4	4	
La Salle.....	Boston.....	3	3	3	
Magma Chief.....	N. Y. Curb.....	39½	32	33½	Jan. '19, .50
Magma Copper.....	N. Y. Curb.....	*20	*17	*17	
Majestic.....	Boston Curb.....	2½	2½	2½	
Mason Valley.....	N. Y. Curb.....	2½	2½	2½	Nov. '17, 1.00
Mass Con.....	Boston.....	8½	7½	7½	Feb. '20, 1.00
Mayflower-O. C.....	N. Y. Curb.....	23½	20½	21	Feb. '20, .50
Miami.....	Boston.....	5½	4½	4½	
Michigan.....	Boston.....	64	60½	61	Feb. '20, 1.50
Mohawk.....	N. Y. Curb.....	5½	5½	5½	
Mother Lode (new)	N. Y. Curb.....	14	13½	13½	Mar. '20, .25
Nev. Con.....	Boston Curb.....	*17	*15	*16	
New Douglas.....	Boston.....	3½	3	3	
New Arcadian.....	Boston Curb.....	3	3	3	
New Baltic.....	Boston.....	20½	18½	18½	Nov. '18, .25
New Cornelia.....	N. Y. Curb.....	21	18½	18½	Oct. '18, .25
Nixon Nev.....	Boston.....	21	18½	18½	
North Butte.....	Boston.....	21	18½	18½	
North Lake.....	Boston.....	21	18½	18½	
Ohio Copper.....	N. Y. Curb.....	2½	2½	2½	
Ojibway.....	Boston.....	31	28½	29	Dec. '18, 1.00
Old Dominion.....	Boston.....	*70	*40	*40	
Oneco.....	Boston Curb.....	45	45	45	Mar. '20, .50
Oscola.....	Boston.....	45	45	45	
Phelps Dodge.....	Open Market.....	230	220		Apr. '20, 2.50
Quincy.....	Boston.....	59	57	57	Mar. '20, 1.00
Ray Con.....	N. Y. Curb.....	18½	17½	17½	Mar. '20, .25
Ray Hercules.....	Boston Curb.....	*75	*75	*75	
St. Mary's M. L.....	Boston.....	45	40	40	Dec. '19, 2.00
Seneca.....	Boston.....	13½	13	13½	
Shannon.....	Boston.....	13½	13	13½	Nov. '17, .25
Shattuck-Ariz.....	N. Y. Curb.....	10½	10	10	Jan. '20, .25
South Lake.....	Boston.....	10½	10	10	
South Utah.....	Boston.....	*15	*15	*15	
Superior.....	Boston.....	6	5	5	Apr. '17, 1.00
Superior & Boston	Boston.....	4½	4½	4½	
Tenn. C. & C.....	N. Y. Curb.....	11	10½	10½	May '18, 1.00
Tuolumne.....	Boston.....	*75	*75	*75	
United Verde. Ex.....	Boston Curb.....	*35½	*33	*33	Feb. '20, .50
Utah Con.....	Boston.....	7½	7	7	Sept. '18, .25
Utah Copper.....	N. Y. Curb.....	73	68½	69	Mar. '20, 1.50
Utah M. & T.....	Boston.....	2	1½	2	Dec. '17, .30
Victoria.....	Boston.....	3	3	3	
Winona.....	Boston.....	*100	*99	*100	
Wolverine.....	Boston.....	18	18	18	Jan. '20, .50
<b>LEAD</b>					
Hecla.....	N. Y. Curb.....	4½	4½	4½	Mar. '20, .15
St. Joseph Lead.....	N. Y. Curb.....	15½	15½	15½	Mar. '20, .50
Stewart.....	Boston Curb.....	*16	*16	*16	Dec. '15, .05
Utah Apex.....	Boston.....	2½	2	2½	Nov. '18, .25
<b>ZINC</b>					
Am. Z. L. & S.....	N. Y. Curb.....	17	15½	15½	May '17, 1.00
Am. Z. L. & S. pf.....	N. Y. Curb.....	51	50	50	Feb. '20, 1.50
Butte C. & Z.....	N. Y. Curb.....	10	8½	8½	July '18, .50
Butte & N. Y.....	N. Y. Curb.....	25	22½	23½	Sept. '17, 1.25
Butte & Superior.....	N. Y. Curb.....	25	22½	23½	Sept. '17, 1.25
Con. Interst. Cal.....	N. Y. Curb.....	16	13½	14	Mar. '20, .50
New Jersey Z.....	Open Market.....	285	280		Dec. '19, 2.00
Success.....	N. Y. Curb.....	*6	*4	*4	July '16, .03

\*Cents per share.

Stock	Exch.	High	Low	Last	Last Div.
<b>GOLD</b>					
Alaska Gold.....	N. Y. Curb.....	1½	1½	1½	
Alaska Juneau.....	N. Y. Curb.....	2½	2½	2½	
Carson Hill.....	N. Y. Curb.....	28	26	26½	
Cresson Gold.....	N. Y. Curb.....	4½	4½	4½	Mar. '20, .10
Dome Ex.....	Toronto.....	*28	*24	*24	
Dome Lake.....	Toronto.....	*8	*7	*7	
Dome Mines.....	N. Y. Curb.....	10½	10	10	Apr. '20, .25
Golden Cycle.....	Colo. Sprgs.....	*186	*99	*99	Mar. '20, .03
Goldfield Con.....	N. Y. Curb.....	*11	*8	*8	Dec. '19, .05
Hedley.....	Boston.....	4½	4½	4½	June '19, .10
Hollinger Con.....	Toronto.....	6.35	6.25	6.25	Apr. '20, .05
Homestake.....	N. Y. Curb.....	66	66	66	Sept. '19, .50
Kewanas.....	N. Y. Curb.....	*3½	*2	*2½	
Kerr Lake.....	Toronto.....	5.00	5.00	5.00	Sept. '19, 1.00
Kirkland Lake.....	Toronto.....	*56	*53	*53	
Lake Shore.....	Toronto.....	1.13	1.02	1.02	Oct. '19, .02½
McIntyre Porcupine	Toronto.....	2.06	2.00	2.00	Jan. '20, .05
North Star.....	Boston.....	*6	*5	*5	June '19, .40
Porcupine Crown.....	Toronto.....	*31	*29	*29	July '17, .03
Portland.....	Colo. Sprgs.....	*60	*59½	*59½	Apr. '20, .01½
Reorgan. Booth.....	N. Y. Curb.....	5	4½	4½	
Silver Pick.....	N. Y. Curb.....	*11	*8	*8½	
Teck-Hughes.....	Toronto.....	*17	*16	*16	
United Eastern.....	N. Y. Curb.....	3½	3½	3½	Apr. '20, .21
Vindicator Consol.....	Colo. Sprgs.....	*20	*20	*20	Jan. '20, .01
West Dome.....	Toronto.....	*9½	*8	*8	
White Caps Min.....	N. Y. Curb.....	*12	*10	*11	
Yukon Gold.....	Boston Curb.....	1½	1	1	June '18, .02½
<b>SILVER</b>					
Arizona Silver.....	Boston Curb.....	*87	*65	*65	Apr. '20, .03
Bailey.....	Toronto.....	*6	*5½	*5½	Apr. '16, .05
Beaver Con.....	Toronto.....	*49	*48	*48	
Coniagas.....	Toronto.....	3.00	2.90	2.90	Feb. '20, .12½
Crown Reserve.....	Toronto.....	*34	*28	*28	Jan. '17, .05
Kerr Lake.....	Boston.....	4	4	4	Sept. '19, 1.00
La Rose.....	Toronto.....	*45	*40	*40	Apr. '18, .02
McKinley-Dar.....	N. Y. Curb.....	*60	*60	*60	Apr. '20, .03
Mining Corp.....	Toronto.....	2.00	1.90	1.90	Sept. '19, .12½
Nipissing.....	N. Y. Curb.....	10½	9½	9½	Apr. '20, .25
Ontario Silver.....	N. Y. Curb.....	7	7	7	Jan. '19, .50
Ophir Silver.....	N. Y. Curb.....	7	7	7	
Peterson Lake.....	Toronto.....	*17	*16	*16	Jan. '17, .01½
Sil. King Ariz. (new)	N. Y. Curb.....	*43½	*42	*42	Jan. '20, .04
Temiskaming.....	Toronto.....	*40	*35	*35	Jan. '19, .05
Trethewey.....	Toronto.....	*40	*35	*35	
<b>GOLD AND SILVER</b>					
Atlanta.....	N. Y. Curb.....	*2½	*2	*2	
Bost. & Mont.....	N. Y. Curb.....	*91	*60	*89	
Cashboy.....	N. Y. Curb.....	*8	*6½	*8	
El Salvador.....	N. Y. Curb.....	2½	2½	2½	
Goldfield Merger.....	N. Y. Curb.....	*3	*2	*2	
Jim Butler.....	N. Y. Curb.....	*20	*17	*18	Aug. '18, .07
Jumbo Extension.....	N. Y. Curb.....	*7½	*6	*6	June '16, .05
Louisiana Con.....	N. Y. Curb.....	*10	*8	*8	
MacNamara.....	N. Y. Curb.....	*10	*8	*8	
Nev. Packard.....	Boston Curb.....	*25	*18	*18	Apr. '19, .02
N. Y. Hond.-Rosar.....	Open Market.....	15½	14		Apr. '20, .50
Rochester Mines.....	N. Y. Curb.....	18	18	18	Oct. '18, .02
Tonopah-Belmont.....	N. Y. Curb.....	2½	1	1	Jan. '20, .05
Tonopah-Divide.....	N. Y. Curb.....	1½	1½	1½	
Tonopah Ex.....	N. Y. Curb.....	1½	1½	1½	Apr. '20, .05
Tonopah Mining.....	N. Y. Curb.....	1½	1½	1½	Oct. '19, .15
West End Con.....	N. Y. Curb.....	1½	1½	1½	Dec. '19, .05
<b>SILVER-LEAD</b>					
Caledonia.....	N. Y. Curb.....	*32	*29	*31	Apr. '20, .01
Consol. M. & S.....	Toronto.....	4½	4½	4½	Apr. '20, .62½
Daly-West.....	Boston.....	4½	4½	4½	Apr. '20, .15
Eagle & Blue Bell.....	Boston Curb.....	1½	1½	1½	Apr. '20, .10
Electric Point.....	Spokane.....	*45	*45	*45	Dec. '19, .03
Fed. M. & S.....	N. Y. Curb.....	15	15	15	Jan. '09, 1.50
Fed. M. & S. pf.....	N. Y. Curb.....	39½	36	36½	Mar. '20, .75
Florence Silver.....	Spokane.....	*48	*45	*45	Apr. '19, .01½
Iron Blossom.....	N. Y. Curb.....	*19	*17	*18	Jan. '20, .02½
Marsh Mines.....	N. Y. Curb.....	*19	*17	*18	Nov. '17, .02½
Prince Consol.....	N. Y. Curb.....	1½	1½	1½	
Rex Con.....	N. Y. Curb.....	*19	*19	*19	Feb. '19, .01
Rambler-Cariboo.....	Spokane.....	*19	*19	*19	
Simon S. L.....	N. Y. Curb.....	1½	1½	1½	Oct. '17, .05
Stand S. L.....	N. Y. Curb.....	2.75	2.50	2.75	Dec. '19, .03
Tamarack-Custer.....	Spokane.....	*7½	*6	*7½	Nov. '17, .10
Wilbert.....	N. Y. Curb.....	*7½	*6	*7½	
<b>NICKEL-COPPER</b>					
Internat'l Nickel.....	N. Y. Curb.....	21½	19½	19½	Mar. '19, .50
Internat'l Nick. pf.....	N. Y. Curb.....	87	86	86	Feb. '20, 1.50
<b>QUICKSILVER</b>					
New Idria.....	Boston.....	7	7	7	Jan. '19, .25
<b>TUNGSTEN</b>					
Mojave Tungsten.....	Boston Curb.....	*10	*7	*7	
<b>VANADIUM</b>					
Vanadium Corp.....	N. Y. Curb.....	85	74½	76	Apr. '20, 1.50
<b>MINING, SMELTING AND REFINING</b>					
Am. S. & R.....	N. Y. Curb.....	64	58½	59	Mar. '20, 1.00
Am. S. & R. pf.....	N. Y. Curb.....	94	92½	92½	Mar. '20, 1.75
Am. Sm. pf. A.....	N. Y. Curb.....	80	79½	79½	Apr. '20, 1.50
Natl. Lead.....	N. Y. Curb.....	82½	76	77	Mar. '20, 1.50
Natl. Lead. pf.....	N. Y. Curb.....	107	104½	104½	Mar.

