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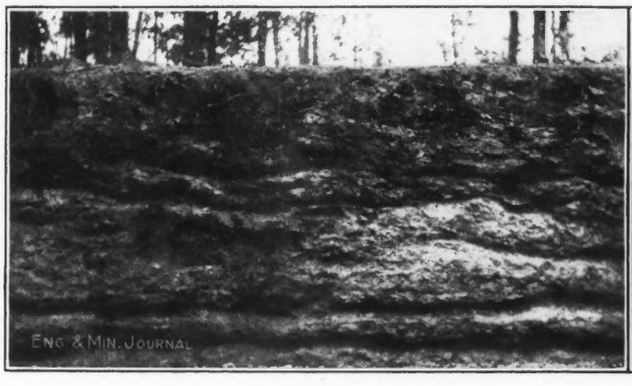
# Texas Iron Ore Deposits

By Robert Linton*

*SYNOPSIS—Iron ore in commercial deposits occurs in about 20 counties in Texas, but the number of mines, while distributed, is not large. The best are found in Cass County and those immediately adjoining. These deposits are described in character, method of working and geology. The grade and physical characteristics are noted in detail.*

Iron ore is found in about 20 counties of east Texas. The areas in which it is known to occur in sufficient thickness and concentration, and of suitable quality to be classed as commercial ore, are, however, comparatively limited. The total tonnage available has been variously estimated, but as no mining has ever been undertaken in Texas on a large scale, and little comprehensive development work done, the figures are based on insufficient data and can only be considered as indicating in a general way the state's iron-ore resources. Estimates made by Mr. Eckels of the iron-ore reserves of the United States, give 600,000,000 tons as the amount that Texas will probably produce. This includes the magnetite and hematite deposits in the central part of the state, but the bulk of the tonnage is made up of east Texas brown ores.




Face of Ore in Opencut


An Opencut in Cass Co.

## Situation of the Ore Deposits

The district that is best known and that appears to contain the best ore deposits, both as regards thickness and quality, is situated in Cass County and adjacent parts of Morris, Upshur and Marion counties. A great deal of active development work has been done in the past few years in this district, the favorable results of which have attracted considerable attention to them as a new source of ore supply for the furnaces along the Eastern Seaboard, where at present the supply is practically all imported, as well as a supply for local furnaces to produce foundry pig and certain finished products for the Southwestern market. Some years ago there were many small cold-blast charcoal furnaces operating in Texas, running on local ores and producing iron of superior quality. As timber became scarce and competition from the large iron-manufacturing centers became keener, these furnaces were gradually closed until the only one left is that at Rusk, owned by the state and operated with convict labor. This has been run only intermittently the past few years.

The surface of the region is rolling, made up of long ridges, generally narrow but widening occasionally into plateaus of considerable area. The intervening valleys are shallow and usually with gently sloping sides. The drainage is through various creeks and bayous into Caddo Lake, a part of the Red River system.

## Geological Character of the Ore

The iron ores lie in the Wilcox or Sabine formation, referred to the Eocene division of the Teritary, and the only member of the Tertiary occurring in east Texas. It consists of a series of siliceous and glauconitic sands, interstratified with clays, the total thickness of the series being 800 or 900 ft. This formation outcrops over all the district above mentioned and the soft sands and clays of which it is made up yield readily to erosion. The ore beds, being harder than these, form the resisting member of the formation and have constituated a most important factor in determining the topography of the region. They

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are ordinarily found capping the hills or following around the sides near the top.

The ore horizon is sharply defined and adheres closely to a fixed level over large areas. The mean elevation is about 350 ft. above sea level and there appears to be little variation above or below this in the Cass County district. As a rule, although not invariably, the largest and best deposits of ore are found near the outcrops on the hillsides. Where the ridges broaden out into wide stretches of high ground, ore is usually continuous over them, but it frequently becomes so thin that it cannot be economically mined. Characteristically the workable ore follows around the flanks of the broader and higher ridges as a persistent belt of varying width, capping entirely the narrow spurs projecting from them when the tops of these lie within the limiting levels of the ore horizon.

Both brown and spathic ore occurs in the formation, the former usually lying in the sand member and the carbonate in the clay. The manner of occurrence of the ore suggests the conditions under which it was deposited. It was laid down on the bottom of bays and lagoons when the region was under water. The currents and eddies circulating in these bodies of water rendered certain localities favorable for deposition and prevented it in others, and the same conditions caused the sand to be washed out of the iron in the case of some deposits and to be allowed to settle and become intermingled with the iron in others. The wide variation in the thickness and silica contents of the east Texas deposits is thus readily accounted for.

### Ore Classification

The brown ores fall naturally into two classes: Nodular and ledge ores. The nodular ores are typically of geode


Nodular Ore from Surface, Cass Co.

strueture, the shell being dense and compact with dark brown or black surface inside and frequently exhibiting a needle-like crystalline structure usually radiated. Both limonite and goethite occur in the nodular ores and occasionally ferrous oxide. The grade is uniformly high for brown ores. A sample cargo of 600 tons that was mined and shipped to Philadelphia in the spring of 1910 by the Texas Iron & Coal Co., had the following analysis:

ANALYSIS OF BROWN IRON ORE

| | Per Cent. |
|---|---|
| Metallic iron | 57.540 |
| Silica | 4.800 |
| Alumina | 0.942 |
| Manganese | 0.314 |
| Sulphur | 0.116 |
| Phosphorus | 0.118 |

Analyses of a number of samples taken from scattered tracts showed as follows:

AVERAGE GRADE OF IRON ORES

| Iron, Per Cent. | Insoluble, Per Cent. |
|---|---|
| 57.6 | 5.0 |
| 62.0 | 2.0 |
| 63.0 | 2.0 |
| 60.0 | 4.0 |
| 54.0 | 9.0 |
| 61.0 | 3.0 |
| 60.6 | 3.0 |
| 59.5 | 3.0 |
| Average 59.7 | 3.9 |

Calcining brings the average grade to above 65%. The ledge ores afford by far the greater part of the available


Lead Ore as Exposed in Opencut, Cass Co.

tonnage. They lie in an irregularly bedded position, there being no continuous stratification, but rather a succession of numerous broad, thin sheets, parallel and overlapping, lying in sand beds with occasional admixture of clay. The workable ore usually lies within eight to 14 ft. of the surface. Considerable variation is noted in both structure and grade. The ore is most frequently laminated or cellular and the iron contents vary from a grade equal to the best nodular ore down through concentrating grade to a point too low to be considered workable. As the iron contents drop, the silica contents, which in the nodular ores rarely exceed 5%, rise in proportion. The proportion of silica in chemical combination is low, the high silica resulting from mechanical mixing of the sand with the iron hydrate. This may be in the form of dissemin-

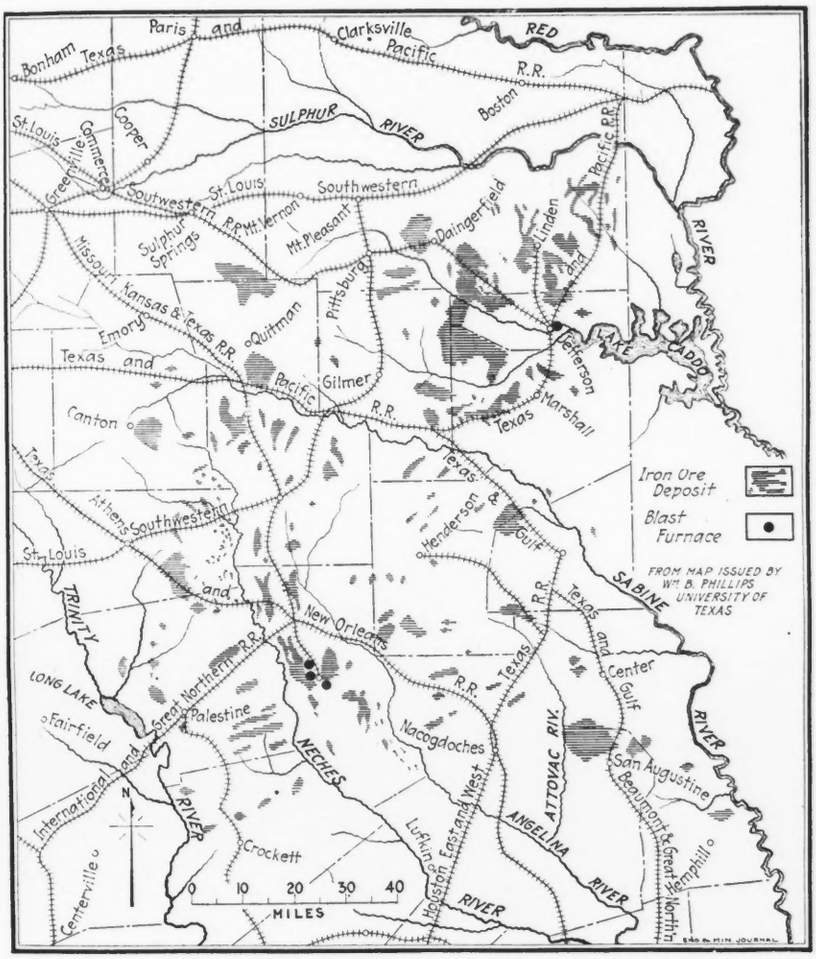
ated grains or as a separate layer termed locally a "sand shield." When in the latter form it peels off in crushing and is readily separated by jigging. In the disseminated form it cannot be separated by any known commercial process.

### Methods of Operation

Obviously, then, it is impossible to give any average grade for the ledge ores. The operating problem is to prospect the territory thoroughly in advance of operations so as to ascertain what portions of the same must be disregarded on account of the high silica and how that portion mined should be treated in order to bring its grade up. To illustrate this, the results of some tests on high-silica ores recently made may be of interest. The material from each pit was screened to separate the coarse lumps from the fines and the latter passed through washing boxes to approximate the action of a log washer and concentrated in a hand jig of plunger type. Calcining tests were run on a portion of the samples and the grade of calcined ore calculated for the other pits from these results. The material fed to the washer averaged about 4½ cu.yd. per ton of calcined ore. The results are shown in the table.

TESTS ON CALCINING BROWN ORES

| Analysis Raw | | Analysis Calcined | |
|---|---|---|---|
| Iron | Insoluble | Iron | Insoluble |
| 48.8 | 20.6 | 56.0 | 19.0 |
| 48.2 | 20.0 | 56.5 | 18.0 |
| 49.0 | 21.0 | 54.8 | 20.5 |
| 47.4 | 20.0 | 55.2 | 20.0 |
| 47.6 | 19.0 | 57.8 | 16.3 |
| Average 48.2 | 20.1 | 56.0 | 18.8 |



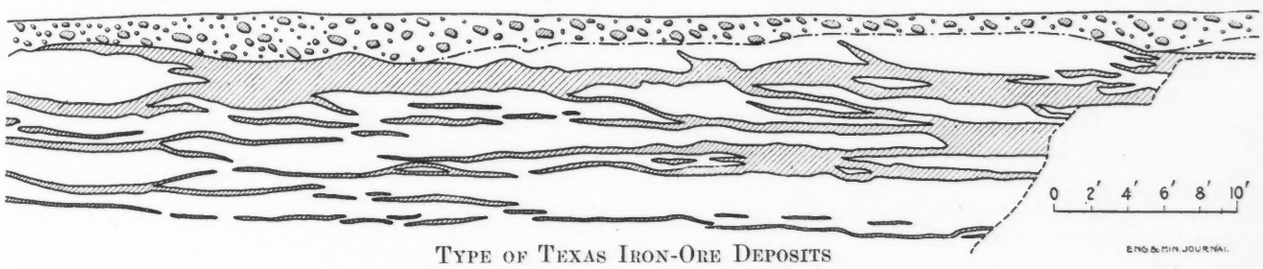

Texas Iron-Ore Districts

It is interesting to note that the silica contents were lowered both by the concentration and the calcining, the latter due, no doubt, to snapping off of small particles of silica which were carried up the stack.

The carbonate ores usually lie at lower horizons. These carbonate ores are nearly pure siderite. The nodular ores and probably a portion of the ledge ores are derived from alteration of the same. When calcined, they afford a very high-grade product, as shown by the accompanying analyses.

The range in grade of what may be considered workable ores, is shown in the accompanying analyses of samples of ore concentrates taken over a considerable area in Cass and Marion counties.

As far as the manganese, sulphur and phosphorus contents are concerned, the quality of the ore is very satisfactory, although the phosphorus is, of course, above the bessemer limits. The variable elements are iron, silica and alumina, and the limiting factor in preparing and marketing the ore is the silica contents. Ferrous oxide, which occurs in some of the nodular ores, renders them more easily reducible than any ore which contains the iron wholly in the ferric state. The physical character of the ore, being largely of porous or cellular structure, is unusually favorable for furnace operations.




Type of Texas Iron-Ore Deposits

Operating conditions are such as involve no great difficulty, excepting that in some localities the water supply is limited. The fact that the ore deposits lie right on

the surface on the high ridges and plateaus and follow an almost perfectly flat and level plane, makes steam-shovel work and transportation simple and cheap. The light character of the soil in which the ore is imbedded makes

COMPARISON OF RAW AND CALCINED ORES

| Raw Ore | | | Calcined Ore | | |
|---|---|---|---|---|---|
| Iron Per Cent. | Insoluble Per Cent. | Loss in Ignition Per Cent. | Iron Per Cent. | Insoluble Per Cent. | Loss in Ignition Per Cent. |
| 45.2 | 7.0 | 29.0 | 63.8 | 9.0 | ... |
| 51.6 | 4.0 | 23.7 | 66.6 | 4.0 | 0.3 |
| 48.2 | 4.0 | 29.0 | 67.6 | 5.0 | ... |
| 47.4 | 5.0 | 28.0 | 69.0 | 6.0 | ... |
| 49.0 | 4.0 | 27.0 | 64.0 | 4.0 | ... |
| 49.0 | 4.5 | 24.5 | 66.2 | 5.0 | ... |
| 46.0 | 2.0 | 28.9 | 67.6 | 2.0 | 0.2 |
| 48.4 | 4.0 | 26.4 | 64.4 | 4.5 | 0.3 |
| 48.2 | 9.0 | 23.3 | 59.2 | 10.0 | 0.6 |

washing and concentration easy. The proximity of the Caddo oil district to the ore fields offers an abundant, convenient and cheap supply of fuel for calcining. Rail-

ANALYSIS OF ORE CONCENTRATES

| No. | Iron Per Cent. | Silica Per Cent. | Alumina Per Cent. | Manganese Per Cent. | Sulphur Per Cent. | Phosphorus Per Cent. |
|---|---|---|---|---|---|---|
| 1 | 44.6 | 19.2 | 7.6 | 0.23 | 0.165 | 0.104 |
| 2 | 53.0 | 10.0 | 4.2 | 0.20 | 0.055 | 0.126 |
| 3 | 49.0 | 16.0 | 4.6 | 0.18 | 0.068 | 0.069 |
| 4 | 55.8 | 7.0 | 2.5 | 0.20 | 0.063 | 0.072 |
| 5 | 55.2 | 8.0 | 2.9 | 0.28 | 0.051 | 0.063 |
| 6 | 54.4 | 8.5 | 3.4 | 0.26 | 0.061 | 0.079 |
| 7 | 48.0 | 16.0 | 6.7 | 0.17 | 0.068 | 0.083 |
| 8 | 61.0 | 2.0 | ... | 0.22 | 0.086 | 0.040 |
| 9 | 57.0 | 6.5 | 2.1 | 0.23 | 0.151 | 0.078 |
| 10 | 48.1 | 2.5 | 1.7 | 0.20 | 0.096 | 0.043 |

Note:—1, 2, 7, concentrates, No. 10, carbonate ore, balance, clean ledge ores.

road rates to points on the seaboard and the lower Mississippi Valley and ocean freights to Philadelphia and other Eastern points are very low. ($2.30 per ton has been practically guaranteed to one of the companies.)

## Cortez Associated Mines

The report of the Cortez Associated Mines, Jacala and Zimapan, Mexico, dated Oct. 1, 1913, and covering operations during 1912, states that the properties were closed down in April owing to conditions due to the Mexican Revolution. Before closing down the mines, Waldemar Lindgren was engaged to make a report on the properties, an abstract of which follows:

Zimapan is situated 85 miles north of Mexico City and Jacala lies 35 miles by road and trail N-NE of Zimapan. Development has shown that most of the Jacala orebodies are low grade as to copper and carry only one to three ounces silver. Four deposits are mentioned as likely to yield marketable ore. Several places are mentioned as containing low-grade fluxing ore, which would be valuable for smelting siliceous copper ores, such as exist at Zimapan. Under present conditions these ores cannot be mined profitably. Even were the railroad extended to Jacala, they would not justify the building of a smelter at that place. It is stated that some of the silver-lead ore could be sold for a few dollars per ton profit to a smelter in Zimapan if good railroad connections were established. At the Carmen mine, the production of which has probably exceeded $500,000, further development work has been recommended. The Encino Largo mine is stated to have some high-grade ore and some dump ore that could be shipped at a profit if transportation facilities were better. The report also contains a description of the geology of the Zimapan deposits.

Briefly, his conclusions about the Zimapan properties are: The silver-lead properties have little value under present unsatisfactory conditions of marketing ore; the visible resources from ore, dump and slags would probably not net more than $120,000, even if a modern smelter and fair communication were available; the lead-antimony deposit of La Sirena may prove to be the most valuable asset of the company. The final recommendations are that the company build a 500-ton smelter at Zimapan with lead and copper furnaces, and to acquire more property near Zimapan.

During 1912 the company spent $47,285 for exploration and development, $11,447 for local administration and $344 for hospital, aid and indemnity; total, $59,076, or about $7.40 per ft. for 7967 ft. of development work performed. In addition to this, 1287 ft. of core drilling was done at a cost of $1.307 per ft., or $1683, making total expenditure on mining operations, $60,759. A credit of $2726 for ore sold makes the net expenses $58,033 for operations. The company ended the year with $35,038 in cash, loans and accounts receivable; and accounts payable of $583.

## Fuel Oil in the Nitrate Industry

A factor of importance to the nitrate industry, the effect of which will be more apparent by the end of 1913 as far as the value of imports into Iquique is concerned, was the successful use of crude petroleum as fuel for the boilers in the oficinas, the use of oil effects a saving of about 40% and it is gradually being adopted by many oficinas, says consular report from Iquique.

Most of the fuel oil imported into the Province of Tarapaca is brought from Pern in its natural state and is delivered at Caleta Buena, a subport of Iquique, for the Agua Santa Nitrate Co. This company was the pioneer importer of oil into Iquique as fuel, the chief engineer insisting on trying it, much against the wishes of his directors, and ordering a consignment of American oil. The latter differs from the Peruvian oil in that the gasoline, naphtha, etc., have all been extracted before it is delivered, and it is so thick that the storage tanks must have a system of pipes through which steam or hot water is passed to heat the oil enough to make it flow. The tanks at Caleta Buena were not so built and the oil formed a solid mass inside and had to be dug out with spades before the tanks could be used again. As a result the importation of fuel oil for this company, which supplies several other oficinas, and now amounts to over 70,000 tons a year, was lost to the United States.

Although the West Coast Oil Fuel Co. sells California oil in this district, the storage tanks of its agents in Iquique were not completed until the fall of 1912, and only a small quantity (1220 tons) figures in the imports in 1912. The Nitrate Railways Co. lines were not properly equipped with tank cars for the transportation of oil to the pampas by the end of 1912. They may try the experiment themselves of burning oil in their engines. In any case, large quantities of American oil were expected to be imported into this district during 1913.

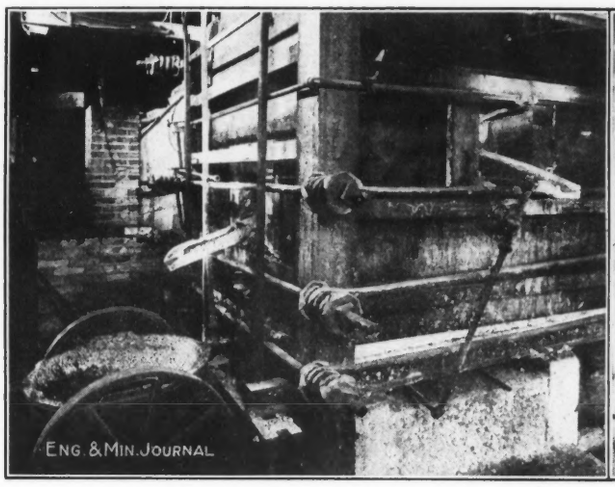
**Rich Gold Placers in Kamtchatka** are reported by Russian prospectors recently returned from Anadyr. Working is difficult, however, as the ground is frozen all the year round, and fuel is very scarce, there being but little timber in the country. Notwithstanding this there are some Russian and some American miners at work who are producing gold, which they sell to American merchants, who visit the country occasionally. It is proposed to send out a well equipped expedition from Vladivostok next season to explore the country and arrange for systematic working, if possible.

# Byproducts in Electric Zinc Smelting

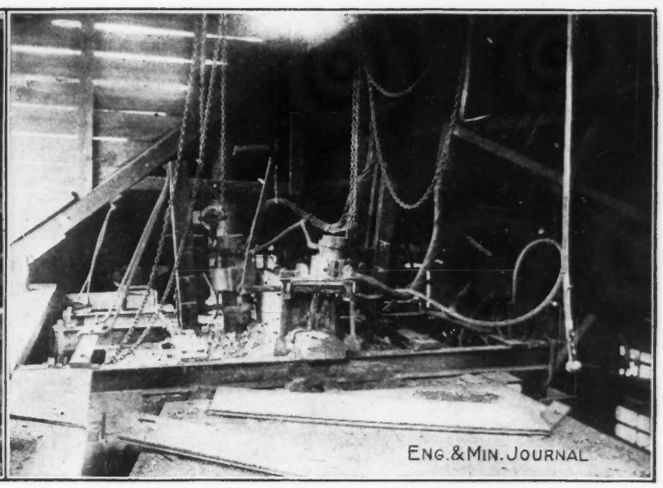
By Woolsey McA. Johnson*

*SYNOPSIS—The field of electric zinc smelting apparently will lie in complex ores of zinc, lead, copper, silver and gold, where close saving of all the metals is needed, and in those ores which are self-fluxing or partially so.*

I started work on the electric smelting of zinc ores on July 2, 1903. I have had considerable practical experience in the smelting of zinc ores in the retort process. I have smelted 200 tons of zinc ore in the electric furnace. I believe that my opinion derived from this experience possesses special worth because of my especial experience. As far as this opinion goes, it is to the effect that the successful electric zinc-smelting process will only be successful if it utilizes to the fullest extent its own innate superiority and competes with the retort in those ways wherein electric smelting is strongest and wherein the retort is weakest.




Continuous Zinc Furnace




Electrode Arrangement

### Electric Zinc Smelting a Slagging Process

Now the retort cannot stand a slag-making charge and the electric furnace must have a slag-making charge. In making a slag under such reducing conditions that 800 lb. of zinc oxide is turned to metal, any lead compound is turned to lead bullion containing gold and silver, and all the copper and part of the iron combine with the sulphur and make a matte.

An analysis of cost sheets of different retort plants of the United States shows that the cost of working Joplin ores with losses included is less than the cost of working ores of a complex nature. My work in electric furnacing indicates that just the opposite will be the case in the process as practiced at Hartford.

Any successful metallurgical process is necessarily correct in three coördinated ways. First, it must be scientifically right. Second, it must be engineeringly right, for a furnace that will not stand up to its duty is useless. Third, it must be commercially right, for a process that does not make a return to capital as high or higher than the capitalist receives in the kind of a business under question, is commercially useless. In this article, regard will be first paid to the commercial side of electric smelting. The scientific and engineering factors will be considered only in so far as they contribute to the more important side.

Now as it is better to treat in the retort plant high-grade zinc ore, say zinc oxide going 72% Zn, or roasted Joplin ore going 68% Zn, than ores from Colorado going 35%, is it good business to try the hard thing instead of the easy thing? Commercially speaking, the smelting of complex zinc ores should be easier, though scientifically and practically harder.

To make its operation easy metallurgically speaking, the Johnson electric zinc furnace needs ore high in lime and iron to make a fusible slag. Such ore is rightfully penalized by the retort plant and, broadly speaking, is not commercially available. The same is true of zinc ore high in fluorspar. The advantage of having a market for such classes of ore should be considerable to the zinc-mining business.

Let us pass over such other points as that power cost for electrometallurgical purposes is higher in this country than in Norway and the fact that I impart one-half of necessary B.t.u.'s by the energy of burning coal and so at a maximum of commercial efficiency. Let us pass over the fact that liability to metallurgically dangerous "hot-spots" in electric furnaces is great when treating Joplin ores and slight when treating Western ores. (The term "Western" ore is used conveniently in the zinc business to denote anything that does not come from Joplin or Wisconsin.) Let us pass over such evident facts that flow of slag, matte, and lead keeps the bottom of the furnace clean.

Passing by all these points let us consider and review some other factors.

Experience in the metallurgy of zinc shows that a difficult part of the operation is the desulphurizing of the

*President, Continuous Zinc Furnace Co., Hartford, Conn.

sulphide ores. This should be done to a "sweet" roast. About 75% of the troubles of roasting are due to trouble in getting the last 60 or 70 lb. of sulphur out of the ton of ore and making a dead-roasted product. My experience in retorting zinc ores has told me that roasting is the most important feature of the operation. At any rate, I was successful in increasing tonnage and recoveries by concentrating my attention on the roasting and mixing of the charge.

Whereas the zinc retort requires ore with sulphur reduced to a metallurgical zero, the Johnson electric furnace requires ore containing sulphur enough to combine with the copper and part of the iron to make a fusible matte. In general, I mix the charge so as to have 4 to 6% of sulphur in it. Care must be taken not to make a matte so metallic as to be difficultly fusible. Pains are taken to avoid formation of "sows" or accretions. For this purpose I add special doses of raw pyrites heated to 800° C.

Provided my claim that in my electric furnace I can smelt ore roasted to 4 to 6% S be so, there are four points of commercial superiority over the retorting process, which I think follow:

(1) Cost of roasting is reduced by a large fraction.

(2) Capital cost of roasting plant is reduced.

(3) Less dust should be made because allowable limits of S as sulphides or sulphates are higher and fine concentrates can be roasted possibly easier in a muffle furnace.

(4) A rich gas high enough in $SO_2$ to increase capacity of sulphuric-acid plant by a good fraction is possible.

The production of slag is a *sine qua non* to the process tried at Hartford. If slagging is a necessity, the production of base-lead bullion containing gold and silver is also a necessity. The aim of the Continuous Zinc Furnace Co. is to turn these necessities into profitable luxuries. No copper or lead is lost by dusting or volatilization, for the apparatus that condenses zinc vapor to spelter catches these in form of dust. Any lead condensed with the spelter is not commercially lost.

The metals lost by slagging are insignificent. In fact, the copper, lead, gold and silver contents of the slag are so low as to excite incredulity. Ledoux & Co. reports on a careful sample of electric zinc-furnace slag, totaling 6000 lb., as follows: Zinc, 0.65%; copper, 0.12%; lead, 0.00%; silver, 0.15 oz. per ton; gold, 0.00. The metallurgical reasons for this are plain to me, but naturally not so apparent to the reader. The causes are several.

### Reasons for Low Slag Losses

First of all, our slags are superheated and well formed. Once a furnace broke out and slags ran 30 ft. through a 3-in. drain pipe on a 1:20 slope. Such liquid slags are a necessity in the Johnson electric zinc furnace.

Secondly, there is no blast going through the slag. Hence it is quiet. Also the oxidizing power of a blast does not exist. Accordingly it must be concluded that there is much less chemical pull on copper and lead on a slag free from oxygen than on one containing oxygen.

Thirdly, as E. N. Morrill, of our staff, pointed out, the furnace "hums" or pulsates 60 times a second, due to action of alternating current. This Mr. Morrill says produces an effect similar to that produced when the assayer taps the assay crucible to settle his button, but more intense.

Fourthly, the reduction effected by the iron sponge in the charge coming from the preheater is ideally powerful to clean the slag.[1] Silver alone does not seem to be phenomenally low. Can it be that the known affinity silver has for zinc plays any role? Certainly the slag is saturated with zinc vapor.

Unfortunately we have never had up to Nov. 1 a furnace in operation that was satisfactory from the standpoint of all the different parts of our process. Accordingly we could not run the furnace six or seven days, soak it up with zinc, lead and copper, then run 25 days with an initial and final "cutoff" so as to make a definite "cleanup." We cared little about actual recoveries; what we were after was not spelter, copper, matte and lead bullion, but a process that could produce these in commercial form when this process was practicalized and commercialized.

It does not seem unreasonable to assume that, as the furnace was kept open and as the slag was low in value, and as there was no loss by dusting, high recoveries can be obtained in a properly conducted campaign. But the new unit now being built will demonstrate this.

The wide range of slags possible in the electric zinc furnace gives it in one point commercial superiority. The driving off of zinc is important in its bearing. If we have an ore going 40% zinc and 10% oxygen combined with zinc or 50% zinc oxide, we are really doubling the values of copper, lead, silver and gold, because this zinc oxide is evolved and condensed as spelter. So if we have 2% Cu, 5% Pb, 10 oz. Ag and 0.5 oz. Au., we really are smelting an ore 4% Cu, 10% Pb, 20 oz. Ag, 1 oz. Au. This is a fact the bearing of which we ourselves did not see for some time.

A consideration of the smelting of the byproduct values as primary values will throw some light. Suppose we have after 50% zinc oxide has been reduced and zinc condensed to spelter, or 1000 lb. of stuff per ton of ore removed, 100 lb. lead bullion formed 200 lb. copper matte formed and 700 lb. of slag formed.

The materials forming these are charged into the electric furnace at 1000° C. and leave it at 1250° C. Call the latent heat of fusion as equal to heat evolved in formation of slag and matte. Such material has an average specific heat of less than 0.25. Then we have

$$\textit{Net heat needed per ton ore} = \frac{1000}{2.2} \times 250 \times 0.250 \textit{ cal.}$$

$$= 28.400 \textit{ cal.}$$

$$\frac{28.400}{860} = 33 \textit{ kw.h.}$$

for smelting 1000 lb. slag makers and byproduct per ton ore at a thermal efficiency of 100 per cent.

This figure is a surprisingly low one, but allowing for all losses in radiation a safe figure is 100 kw.h. for smelting slag and byproducts per ton of zinc ore or 200 kw.h. per ton of slag and byproducts. When the fact that this heat is imparted largely by the cheap heat units of soft coal as against the more expensive heat units of coke of blast furnace, the claims of the electric furnace as a rival to the lead-blast furnace do not seem to be absurd.

A further advantage of the electric furnace is that its stronger reduction reduces lead in copper matte to 2% and sometimes to a trace. This is in accordance with

[1]See W. McA. Johnson's U. S. Patent 868,345, issued Oct. 15, 1907.

theory. The lead bullion contains 1% zinc and 0.50% Cu due, of course, to more intense reducing conditions. A simple drossing removes these impurities, makes a rich scum and a partially cleaned bullion. How this fact will be employed commercially cannot be said.

We have made all sorts of copper mattes at Hartford. Probably the most remarkable was in June, 1913. Here we made out of a charge containing 0.43% Cu a 5.50% copper matte, only 75 lb. per day, to be sure, but regularly with slags analyzing less than 0.05% copper. We have run right along making at 9.5% matte out of 1.5% copper charge for 11 days with slag as analyzed by chemist of General Electric Co. at 0.01%. We have made a 19.8% copper matte out of a charge containing 1.6% copper while we were condensing zinc to spelter. Exactly what will be done commercially in case of slags is another question.

The Continuous Zinc Furnace Co. has made a considerable quantity of lead bullion containing 100 oz. silver and $25 gold, which was made while the furnace was giving off a zinc vapor that was condensed to spelter. It has made a considerable tonnage of copper matte. It has made and sold a considerable amount of commercial spelter.

The unit now in course of erection will make a long run on complex zinc ores, slagging off impurities in a fusible slag and making copper matte low in lead, and base-lead bullion. It will thus show its ability, I hope, to do on a large scale, something about which there is considerable natural skepticism.

The results of our work show what a powerful metallurgical agent is the electric current when its use is understood. Likewise, the commercial effects of the electric current when its use is understood, will be marked and gratifying. The results which we have given are astonishing.

We do not complain much about the general skepticism about our electric zinc smelting, for we ourselves have trouble in getting proper realization of our work. But the month of January, 1914, will show, to a certain extent, the actualities of our ideas.

## New Steam Shovel for Cleaning Up

In stripping off the overburden from a Mesabi orebody which is to be mined as an openpit, it is necessary to do an extremely clean job. The mining company does not want any waste material left to bring down the grade of its ore and neither it nor the fee owner will allow ore to be wasted by removal mixed with the overburden. The last operation in stripping is cleaning up the overburden immediately on top of the ore, and on account of the irregularity of the ore surface, this is exceedingly expensive. The very last of the cleaning is performed with horses and scraper and by hand; but the bulk of the work is done with the steam shovel. It is customary in this work to use the old type of standard heavy shovel, which, however, is at a considerable disadvantage. Butler Bros., for some time, has employed a locomotive crane with a long boom and a clam-shell grab bucket for this work, and in 1913 introduced a further novelty in the turntable shovel of Marion manufacture. The type of shovel is not new, but it has not heretofore been applied to stripping. Its introduction in this case was at the instance of A. J. Conolly, in charge of stripping operations at the Longyear mine. The cleaning up here is especially difficult, both on account of the extreme irregularity of the ore surface and because of the drifts, crosscuts and rooms which are encountered, the property having been previously opened as an underground mine. The shovel has scored a remarkable success and promises to become standard for work of this nature.

It differs from the old-style machine, particularly in the fact that it revolves as a whole, boom, engine and boiler swinging at the same time, instead of merely having the boom and dipper revolve on the front of the frame. A wire rope is used instead of a chain for hoisting the dipper, the boiler is vertical, traction is obtained through gearing instead of chains and only one man on the engine is required, the craneman being unnecessary. The boom and dipper are counterbalanced by a weight attached to the back of the shovel. Rotation is effected by a series of spurs and pinions. The shovel weighs 36 tons,

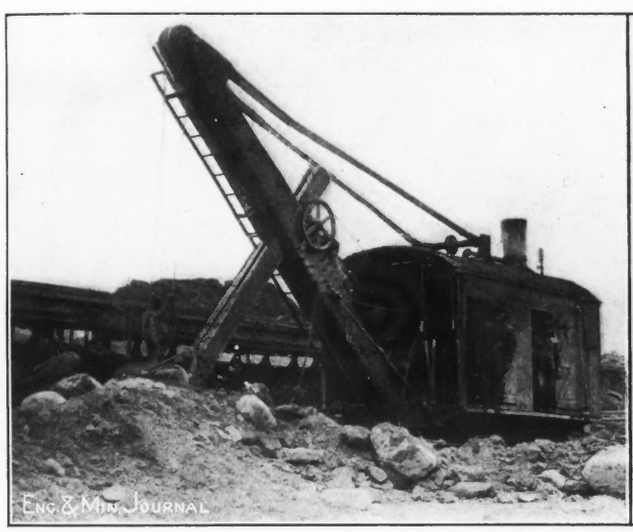



Fig. 1. Shovel in Position for Taking Load


Fig. 2. Shovel Turned Completely Around to Get Out of Difficult Position

has a frame of rolled shapes and is equipped with a 1½-yd. dipper. It will dig 9 ft. below the track and load the large 20-yd. cars in use, thus having a lift equal to the old machines. It will climb a 10% grade, about twice what the big shovels are good for, and will dig satisfactorily on a steep incline.

For cleaning up, its advantages are manifold, being chiefly the result of its extreme flexibility. Suppose that the shovel is digging along the surface of the ore, when it is discovered that the contact of the ore and the overburden suddenly drops. This indicates a pothole or depression in the ore surface. The shovel can proceed on its course, digging down into the depression on a steep incline, but one probably not steep enough to uncover the ore. Finally, the dipper encounters the ore again, indicating that the other side of the depression has been reached. The shovel can then clean out the whole depression, working from the bottom and can turn 180° to get at that part of the overburden on which it has just made its descent. With the depression cleaned out, if the far side is too steep for the shovel to climb, it can dig a

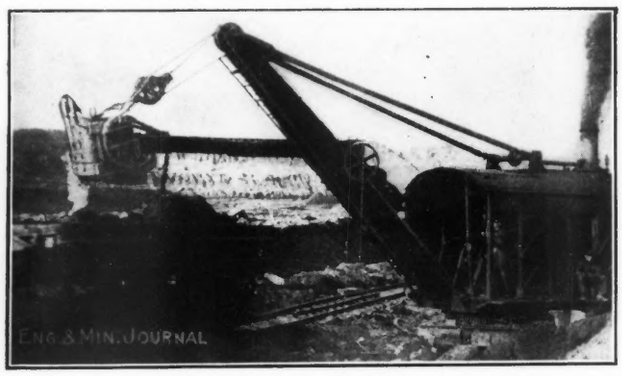



FIG. 3. SHOVEL EMPTYING LOAD INTO A FLAT CAR

grade through the ore itself, swinging 180° and casting the ore behind it out of danger of mixture with waste material. A big shovel in such a case as this would have to be cribbed up to pass the depression, and if it became necessary to turn, would have to be run out on a Y.

In some cases, it is advisable to take a double cut with the steam shovel, that is, the track for the loading train is maintained, while the shovel makes two cuts, one on each side of the track. The big shovel has to back out of the finished side to start the second side; the turntable shovel can run around the end. When it is needed to swing a scraper from the end of the boom, the turntable type can make a complete circle as against only 180° for the old type. These are some of the more noteworthy advantages of the new shovel; many others appear in practice. The photographs of Figs. 1 and 2, taken a few minutes apart from the same position, show the shovel swung completely around. In this case it happened to be working over an old drift and the settling of the ground made moving up difficult. The half-circle swing was part of a maneuver performed to enable the shovel to move up and well illustrates its flexibility.

Served by one train for a short haul, so that it worked about 65 to 70% of the time, the shovel has loaded 1150 cu.yd. in a shift. In 1914 it is planned to substitute a 50-ft. boom and use a clam-shell bucket for extracting material from the old workings, a further illustration of the adaptability of the machine. The elimination of one engineer, and the ability of the shovel to overcome difficult conditions results in a great saving and reduces the chances of loss in cleaning up, the great bugaboo of the stripping contractor. The shovel has come to stay.

## Santa Gertrudis Co.

The report of the manager for the Santa Gertrudis Co., Pachuca, Mex., for year ended June 30, 1913, states that development was carried ahead to a point where it is now possible and convenient to produce 25,000 tons of ore monthly. During the year 263,625 tons of ore, consisting of 111,498 tons of ore from old fills and 152,127 tons of new ore, were produced. The gross value of this ore was $3,430,721, or $13.02 per ton, of which 14.1% was in gold and 85.9% in silver. Exclusive of depreciation, it is stated that the cost of delivering this ore to the mill was $3.16 per ton. In addition to this amount $1.22 per ton was expended for new development and shafts. There still remains $111,829 of deferred development to be charged off.

At the Guadalupe mill 28.605 tons of quicksilver were recovered from the old patio, yielding $26,239.55, at a cost of $8903.94, making a net revenue of $17,355.61 from this source.

The new mill beginning with about 21,000 dry tons in July, 1912, reached a capacity of 27,500 dry tons in June, 1913. During the year there were milled and treated by cyanide 278,596 wet tons or 263,554 dry tons of ore having a gross value of $3,447,864 by assay. The total recover amounted to 89.41%, or $2,082,783, equal to about $11.70 per dry ton. The bullion contained 21,807 oz. of gold and 4,243,932 oz. of silver. The company declared $1,093,500 in dividends during the year.

## Gypsum as a Cement Retarder

Since it is the $SO_3$ that causes hindered setting of a cement, less of plaster paris is required than of raw gypsum, but as calcined plaster costs twice as much as the raw gypsum, the latter is more commonly used (Bull. 11, Oklahoma Geological Survey). It is generally added to the cement clinker before grinding, the amount ranging from 1.5 to 2%. This retards the initial set by 1 to 2 hr., and the final set by 4 to 6 hr.; in large proportions, the addition of gypsum accelerates the setting and reduces the strength of a cement. About 300,000 tons of gypsum per year are consumed in the cement industry of the United States.

## Argentina Mineral Exports in 1912

The following information regarding mineral exports from Argentina is taken from the *Bulletin of the Pan-American Union*, the items being arranged in order of descending value: Bar copper (exported to the United States), 217 metric tons; tungsten ore (to Germany), 637; copper ore, 304; borate of lime (to Germany), 557; plaster, 123; zinc, 72; mica, 3; onyx, 229; tin ore, 16; vanadium ore, 41; lead ore, 40; iron-tin ore, 16 tons; lime, 1213 hectoliters; silver ore, 2 metric tons; iron silver ore, 7 metric tons. The total value of exports was 285,272 pesos against 565,338 pesos in 1911.

# Slimes Agitation For Cyanidation

By Herbert A. Megraw

*SYNOPSIS—Agitation of slimes originated because of the impossibility of leaching the material which usually contained a higher per-ton value than sands, and often amounted to a large proportion of the total ore crushed. Methods have varied greatly, but early schemes are still considered best by some operators. The principal agitators, and their advantages, are discussed.*

Treatment of the slimes involuntarily produced in crushing ores which were to be treated by the cyanide process was not a point of importance for a long time. As a matter of fact, during the early days of the process, slimes were considered an unmitigated nuisance, and little effort was made to treat them. The principal effort was to avoid formation, and the secondary effort was to clean from the sand that which had already been formed. A good many thousand tons of slimes were separated from sand destined to be leached, and lost, regardless of the fact that they contained considerable value.

### High Metal Content of Slimes

Some investigative souls took the trouble to assay the slimes, which were being discarded, over long periods of time, and to calculate the quantity also, discovering eventually that they were throwing away an appreciable percentage of the value of their original ore. In a great many ores, in fact it would be almost safe to say in most of them, the slimes carry a higher per-ton value than the coarser particles, or sand, due probably to the fact that the higher-grade minerals are extremely friable and pulverize very easily when put through the crushing machinery. This is particularly true with silver which occurs in various chemical compounds, such as argentite, proustite, stibnite, and many other well known combinations.

Gold does not often occur in such chemical combinations, but it does occur in an extremely finely divided state, and is often intimately mixed with iron pyrite, which is itself friable and is easily pulverized.

Refusing to continue this loss, operators began to search for some method for treating the slimes. It was early found that the material was unleachable, in fact, that was the reason it was discarded, but so strongly had the leaching process entrenched itself in the minds of the cyanide people that there was much waste of time and trouble searching for some way to leach slimes, or to put them in such condition that they might be leached like sand. Probably one of the most hope-raising efforts was the Sulman soap process, in which the slimes were agitated with a percentage of ordinary soap. This coagulated the slime particles, and when they settled, it was believed that the material could be leached. As a matter of fact, the process did not work out at all, although it is impossible at this time to say just exactly what the difficulty was. It is probable that the soft, coagulated colloids would pack about as tight as the original slime would, and successful leaching was found impossible.

### Beginnings of Agitation

After the failure of leaching, the only recourse was to agitation. The more conservative metallurgists hesitated a long time before undertaking any such process, as they believed it would be entirely too expensive to yield any ultimate profit. The first efforts were made by introducing compressed air into shallow, round or rectangular tanks containing the slime pulp, that is, the colloid material mixed with varying proportions of water. A small pipe connected by a hose to an air-main was introduced into the tank and an operator kept it moving from place to place continuously, thus keeping the material stirred up. The object was to maintain the solids in suspension, allowing the solution to act upon them. This process, while expensive, was a success because it gave a profit over its cost, and because it showed that there was no difficulty in dissolving the gold and silver from the slimes, the only trouble being the mechanical one of keeping the solids in suspension, and after the dissolving process was complete, in separating the solids from the solution. The percentage of extraction, that is, the percentage of metal dissolved by cyanide solution, was considerably higher than had ever been obtained through leaching the granulated portion, or sand.

At the mill of the El Oro Mining & Ry. Co., at El Oro, Mex., the early slime-agitation tanks were flat-bottomed, rectangular steel tanks with rounded corners. In these, slime pulp was kept in agitation by a ½-in. pipe, drawn to a point, connected by hose to an air-main. A Mexican was employed to keep this hose moving about from place to place and in this way succeeded in keeping the solids in suspension successfully and rather cheaply. A good many other plants followed this system and there are plenty of examples where round, flat-bottomed wooden tanks were used in the same way. An interesting feature of the use of the air pipe in steel or iron tanks was that where a little sand was mixed in with slimes and the air pipes allowed to remain in one place for a considerable length of time, the result was a neat, round hole drilled in the bottom of the tank.

A variation of the movable-pipe jet of compressed air was the installation of fixed pipes in the tank, the pipes having a number of holes drilled in them which discharged the compressed air at a number of different points throughout the tank. This worked very well the first time, but the pipes soon got plugged up and the result was that there was very little agitation taking place. These stationary pipes were used in a great many installations, but were not satisfactory in any. The entrance of slime stopped up the pipe so that the air came out at only a very few points, and these were likely to be in scattered sections of a tank, the result being that about four-fifths of the material was without agitation.

### Mechanical Stirring of Pulp

The next forward step was to institute agitation by mechanical means. This was done by using a round, flat-

Note—This is the fifth of a new series of articles by Mr. Megraw. The series deals with comparative details of cyanide practice, discussing points of possible improvement. Preceding articles of this series appeared in the issues of Sept. 6, 1913, Oct. 4, 1913, Nov. 1, 1913, and Nov. 15, 1913. The next article will deal with "Chemicals Used in Cyanidation," and will appear in the issue of Jan. 24, 1914.

bottomed tank in which a central vertical shaft was installed, capped with a crown-wheel and moved by a pinion fixed to a horizontal shaft passing over a series of tanks. The vertical shaft was equipped, near the bottom of the tank, with arms reaching out nearly to the sides, and these arms, revolving at medium speed, kept the contents of the tank in agitation. A little later development of this same idea was that the arms were placed about half way of the depth of the tank, and depending from them were a number of swinging iron rods or pieces of wire rope weighted by chunks of iron at the bottom. The object of this improvement was to avoid the necessity of digging out a tank whenever a long stoppage occurred. In such cases, when the arms were near the bottom of the tank, they become immersed in the settled slime and held so solidly that it was impossible to move them in the regular way without breaking something. By having the arms about half way up the tank and having these swinging iron rods or pieces of wire rope reaching down into the slime, the arms were not so likely to be held firmly but could move freely when the power was applied. The iron rods or wire-rope pieces would pull out of the slime very easily and drag over the top of it, mixing it little by little as agitation progressed. By this method they would dig down into the slime and soon have it all in circulation.

Mechanical agitation in this form was usually assisted by centrifugal pumps, which changed the comparative location of the solid particles. It will be readily seen that a floating particle in cyanide solution making simply a number of revolutions in a tank would not come into contact with any other solution except that which immediately surrounded it. There would be no up or down motion to the particle to any great extent, nor would the comparative location of any particular particle and its surrounding solution be changed. By pumping from the bottom of the tank with a centrifugal pump and throwing the pulp back into the top, a total change of location was assured. By pumping from near the outside of the tank and returning the pulp near its center, a thorough change of location could be obtained.

Mechanical agitation did not continue popular because operators believed that its costs were too high compared to the work it did. It has been supplanted in most cases by a variety of simple and complex devices, all destined to remove the troubles that agitation is heir to. At the last report, however, we find that a recent cyanide plant, one of the most modern in the country, has built its new agitation tanks on the mechanical system. They have passed by the newer and more fashionable devices and returned to the round, flat-bottomed tank with agitating arms, and the whole assisted by centrifugal pumps. The designers of this mill claim that while mechanical agitation, as they use it, may not be absolutely perfect, neither is any other system perfect, and no one of them can show any substantially lower costs than are obtained by this system. While this statement may require modification, it probably is sufficiently true to give rise to serious thought on the part of modern cyanide-plant designers.

### Varied Forms of Mechanical Agitation

Mechanical agitation, during the time it has been used by American metallurgists, has taken a great many different forms. The simplest is that which has already been described—horizontal arms revolving within a flat-bottomed round tank. A form which has been largely used in Mexico, particularly in Guanajuato, where it was devised and first installed, is one in which the central vertical shaft and the horizontal arm are both hollow, compressed air being introduced at the head of the vertical shaft and conducted through the arm to various outlet points, so that while the mechanical agitation was taking place, the air would be forced out through the nozzles into the pulp in the tank. By this means it was attempted to obtain aëration in addition to mechanical agitation, the air assisting in the agitation as well as adding its oxygen to the charge.

Another system more or less well known is that devised by Hendryx in which the tank is usually provided with a cone bottom and in its center is a rather large tube extending from near the bottom to near the top of the tank. Within this tube is placed one or more turbines or propeller wheels, which are revolved upon a central shaft. The movement set up takes the material from the bottom of the tank, forces it up through the tube and discharges it at the top, thus obtaining a circulation from bottom to top throughout the tank. There is very little doubt that this gives good agitation, the principal objection which has been raised to it and one which has apparently been maintained is that its cost is more than is incurred by any one of several other systems. In fact, only recently a large installation has dispensed with its Hendryx agitators because of their high cost in competition with other machines. On a small scale, or in laboratory work, however, this agitator is particularly good as it gives an efficient direct agitation which is very sure to keep all the solids in suspension.

### The Air-Lift Agitators

Probably the most notable development in agitation devices is the Brown or Pachuca tank, which was introduced eight or nine years ago. It was invented and first used in New Zealand where it proved an economical success and was promptly transferred to Mexico, where its use has become widespread. The Pachuca agitator is nothing more or less than an extremely tall cylinder with a cone bottom fitted with an air lift in its center. The transferring of pulp from the bottom to the top is, in effect, very much like the operation of the Hendryx tank, but is accomplished by compressed air in place of mechanical movement. The tank is made tall and narrow and with a cone bottom in order that the influence of the air lift may extend to all parts of it, which would not obtain if its area were large in comparison to the size of the air lift, and also to prevent any settling upon the bottom. For this purpose, the cone bottom required is exceedingly steep as the tendency of slime, particularly of the light and flocculent variety, is to settle on any surface flat enough to hold it. Even with the steepest construction possible, however, there is very likely to be some settlement in the tank, and often there is a great deal of it.

The hold which the Pachuca tank took upon the metallurgical profession immediately after its introduction, was remarkable. It spread rapidly into plants, going to a large majority of the plants which were planned or under construction, and also into a large number of them which had already been built, displacing agitators of other types. Unfortunately, it seems that enough study had not been given to the matter to decide abso-

lutely just what its advantages were. It is, moreover, quite probable that only by the practical experience following the continued use of this device could its disadvantages have been discovered. The principal drawback is that it takes more power by far than was originally claimed for it, which means that the cost runs higher than it should to procure satisfactory agitation. Another difficulty is that it is almost impossible to avoid settling of solids. If there is any sandy material in the pulp, it will settle on the bottom and build up on the cone sides no matter how steep they are, and leave only a small channel to one side through which the circulation takes place. This not only reduces the capacity of the tank, but misleads the operator as to agitation. At the top of the tank no notice of this reduced agitation can be obtained because the surface of the tank is usually covered with pulp and agitation is apparently going on as usual. If one, however, probed the tank with a long stick he would be likely to find a very solid deposit of sandy material in the tank which occupies a goodly portion of it.

### Additional Drawbacks of Air Agitation

Some operators have claimed that the carbon monoxide generated by the compressing of air through the lubricating oil used and heat developed, is deleterious to cyanide solutions, also that compressed air cooled the solution to a great extent. All of these objections may have some weight, but the two principal ones, its cost and the tendency toward settling, have been decisive in putting a rather sudden halt to the installation of Pachuca tanks. It is quite likely that fewer of them will be installed in the future.

Other machines have been installed to accomplish the same result, and the first success of the Pachuca encouraged many inventors to proceed with that device as a basis. Among the well known instances of this may be mentioned one of the hydraulic agitators which is a good deal like the Pachuca, in fact almost identical, except that the compressed air in the elevating central tube was replaced by a hydraulic jet. This tank has some advantages, but probably does not overcome either the item of cost or the propensity to settling. Some of these tanks are used but they are not extremely popular at the present time.

The Parral tank has had considerable application and may be regarded as one of the standard appliances. It is simply the installation of several air lifts in a flat-bottomed tank, the discharges being set tangentially so that a rotary flow of pulp is secured. The tank is well known among operators.

A machine which has been widely used and which was original in its idea, is the Trent agitator, about which much has been said for and against. Discussion about this machine has been particularly acrimonious, those in its favor becoming violent partisans, and those against it being with equal heat, opposed to its use under any circumstances.

### Combination Devices

The Trent agitator is essentially an arm agitator corresponding to the mechanical devices now in use, but the arms are hollow and the pulp is circulated through them. The great and essential difference of this machine is that the arms are not moved mechanically by any direct means, but are moved by the pulp itself, which is forced out of them by means of a centrifugal pump. The intake of the centrifugal pump is near the top of the same tank, where it can have practically clear solution, or at least solution which contains very little coarse, granular, or sandy pulp, while its discharge is through the bottom of the tank by the use of a special gland. The hollow arms, which are arranged to discharge the pulp all in one direction, act after the manner of a garden-lawn sprinkler, the reactive force of which causes the revolution of the arm. The pump is connected with a small air compressor for supplying oxygen to the solution, or a small valve is inserted in the suction through which it is allowed to take air from the atmosphere. The advantages claimed for the Trent agitator are, that it does not make expensive installations; that it gives satisfactory agitation at a low cost; and that it thoroughly aërates the pulp by adding air in minute particles to the whole pulp charge. It is also claimed that somewhat better extraction is obtained by the use of this machine. As far as these claims are concerned, that referring to the distribution of finely divided air to the charge is decidedly true. The Trent agitator in operation shows clearly that there is a very large volume of air mixed in with the charge. If one starts a tank which has not been under agitation with a Trent agitator, within a short time after it has been started, the volume of the pulp will be seen to have increased appreciably. This is due to the air which it gives to the charge in such finely divided particles that it is not rapidly liberated.

The latest applicant for honors in the field of slimes agitation is the Dorr machine. This device is an adaptation of the original Dorr thickener. It has a central shaft carrying two arms, which are set at an incline toward the center of the bottom of the tank, these two arms carrying rakes which move the settled material toward the center of the bottom of the tank. In the agitator, the arms are arranged identically, but the central shaft is inclosed by an air-lift tube, or the tube itself may constitute the shaft. The tube terminates just below the upper level of the tank and discharges into a launder, which again distributes the pulp over the surface of the tank area. The launder is, of course, optional and the device can be operated without it. When used, the launder has discharge openings at various points along its length so that the pulp will be dropped at different points in the tank. The air pipe for operating the lift is usually put in through the bottom of the tank, this being a simple operation, as there is no step bearing for the central shaft, its weight and that of the agitating mechanism being carried on a truss above the tank. In this machine there is mechanically no possibility of settling of solids on the bottom of the tank, and the agitation is positive. The slimes discharged at the top of the tank settle through the solution, to a large extent, and are scraped to the center of the tank again, and again elevated through the air-lift tube. The advantages of this tank are that the air-lift distance is low, the tank being of large area and low height, cheap to construct, and requiring little air at low pressure for the agitation. The arms are operated at low speed, and rake the slime gently toward a central tube. The arms probably do not take more than ¼ hp. in a large tank, while the air-lift works under practically ideal conditions, requiring little power, the amount depending upon the depth of the tank. These tanks have been installed in a

number of mills, and reports of them up to the present time are favorable.

A recent patent shows the use of a principle somewhat similar to the Trent, or garden-sprinkler idea, the difference being that air alone is pumped through the arms, and escaping through the suitably-arranged arm openings, causes revolution. The whole mechanism is supported in a step bearing in the tank, the air entry being from above. The machine is known as the Hafer agitator.

### Objects of Agitation

It would serve no useful purpose at this time to enumerate the great number of agitating devices which have been tried from time to time, even those which may have been more or less successful, as those which have already been mentioned include the most important and are the ones which have received widest application among the operating plants of the world. It may, however, be of interest to discuss the principles of agitation from a general point of view.

Almost from the time of the inception of the cyanide process, oxygen has been believed to be indispensable in the reaction of dissolving gold and silver in cyanide solution. The truth of this having been demonstrated theoretically, and to a large extent, practically, operators went to extreme lengths to find means of furnishing this oxygen to their working solutions so that dissolution might be rapid and complete. Various chemicals have been used to supply oxygen, but these have all, or nearly all, been set aside as more expensive than the additional benefit derived through their use. Not having secured good results from chemicals, the next turn was to use air as a cheap source of oxygen. Air has been used for a number of years and great benefits have been claimed from it. However that may be, it is by no means certain that air is a good thing to use for oxidizing slime pulp under agitation. In many cases it can be said that the agitation itself is all that is necessary, and agitation is only necessary in order that the particles of ore in an extremely fine state may be free so that solution may act upon them at all times. When slime is settled, it forms an impervious mass through which solution cannot pass, and, therefore, solution is not at liberty to act upon the covered particles. The object of agitation is to keep these solids in suspension, so that the solution has an opportunity to act upon each particle continuously. Of course, if additional advantages could be obtained while this movement is going on and without additional expense, it would be undoubtedly advisable to make an effort to obtain them. For this reason, oxygen has been so widely used together with agitating processes.

Air is not a very unstable chemical compound, and it is somewhat unreasonable to suppose that by simply passing air into solution any great quantity of oxygen will be absorbed. It is true that some will be, but the extent of the change is not great, and no dependence can be placed upon it as a hastener of dissolution. Air under compression will give up its oxygen much quicker, as it has already been explained in an article in the Journal.[1]

Recently, Morris Green[2] has shown that indiscriminate oxidation is not an advisable operation. However that may be, it is true that our ideas of oxidation will have to be somewhat revised, and in the meantime agitation had better be confined to the cheapest method of keeping fine particles of ore in suspension in solutions so that they can be acted upon with the greatest rapidity.

### Cost of Agitation

Agitation, like a good many other details of the cyanide process, defies reduction into concrete cost figures capable of reasonable comparison. Like crushing and grinding, agitation depends a good deal on the character of ore handled, and in addition, upon the specific gravity of the pulp handled, that is, the degree of dilution. It is clear that high cost at any one plant does not necessarily indicate poor work, but all data must be considered to make a fair conclusion.

At the Goldfield Consolidated mill, it is said that 75 cu.ft. of free air per minute is required to agitate a tank containing 85 dry tons. The installation consists of Pachuca tanks. The cost is stated to be 2c. per ton agitated for power and under 1c. for repairs and maintenance, a total of less than 3c. per ton, not including labor.

At the Liberty Bell mill, with Hendryx agitators, the cost was 5.4c., including the cost of settling in Dorr thickeners. At the Hollinger mill, cost is said to be 2.9c. per ton with Dorr agitators. Experiments at the Liberty Bell mill showed that the new Dorr tanks, holding 35 dry tons of ore, required 0.4 to 0.5 hp. for operating the arms and 40 cu.ft. free air, compressed to 8 or 10 lb., for the lift. At the West End mill, Tonopah, it is stated that a tank holding 88 dry tons of ore at a pulp sp.gr. of 1.25c., required 6.5 hp. to operate the pump, and about 1.5 hp. additional for air for aëration. The McNamara mill agitates 97 tons at 1.26 sp.gr., with an expenditure of 9.5 horsepower.

Costs are exceedingly elusive data with which to make comparisons, and cannot be depended upon unless all the factors leading to them are available for consideration. For comparing agitation systems, such items as cost of power, labor, and all other factors; specific gravity of the dry slimes, specific gravity of the pulp, percentage of sand in the slimes, etc., are required. Knowing all of these, a fair inference may be drawn.

[1] "Eng. and Min. Journ.," Oct. 2, 1909.

[2] "Journ." Chem., Min., Met. Soc., S. A., February, 1913; and "Eng. and Min. Journ.," June 21, 1913.

## Mineral Production of Italy in 1912

According to official reports, there were 656 producing mines in Italy in 1912, which were divided as follows: Sulphur, 358; lead and zinc, 94; coal and oil shale, 42; graphite, 31; salt, 31; iron, 27; asphalt, 15; pyrites, 11; mercury, 8; petroleum, gas, etc., 9; borax, 7; copper, 7; manganese, 5; all others, 11.

The output of principal minerals was as follows, the items being arranged in order of descending value: Sulphur, crude, 2,504,408 metric tons; zinc ore, 149,776; iron ore, 582,066; lead ore, 41,680; lignite, 660,491; iron pyrites, 248,612; mercury ore, 88,200; asphalt and bitumen, 181,397; copper ore, 86,001; petroleum, 7479; borax, 2309; salt, 18,775; rock salt, 39,954; copper pyrites, 28,973; graphite, 13,170; mineral waters, 36,750 metric tons; natural gas, 6,800,000 cu.m.; antimony ore, 1878 metric tons; tin ore, 350; manganese ore, 2641; silver ore, 27; gold ore, 2366; bituminous coal, 1911; bituminous schist, 1410 metric tons.

Quarry products were: Bauxite, 6702 metric tons; pumice, 17,386; talc, 16,240; barytes, 13,420; quartz and feldspar, 33,944; marble, 522,088 metric tons.

# Carnotite—I

By Thomas F. V. Curran*

*SYNOPSIS—Carnotite, the principal source of radioactive substances, is an ore of vanadium and uranium, named for a president of France. Its principal occurrence in the United States is in Colorado, where much ore is mined and milled. Some carnotite occurs also in Utah.*

Carnotite is probably an alteration product of pitchblende, and is the mineral whence the major portion of our radium supply is derived. It was discovered by Charles Poulot, late in 1887 or early in 1888, in the Roc Creek (or possibly La Sal Creek) district of western Montrose County, Colo. In the beginning small lots were shipped to a little wooden shed near the east end of Champa St., Denver, where the ore was treated by Poulot and E. Cumenge, both chemists who were associated with M. Voilleque in the rare-metals business in Denver.

### First Operations on Small Scale

Poulot traveled extensively through Colorado and acquired a pitchblende deposit in Gilpin County, which he sold to the Roman Catholic Bishop Machboeuf, of Denver; the latter died in 1890 and bequeathed it to his successor, Bishop Matz, who sold it in 1912 to Yale College, for $10,000. Poulot was interested also in the tungsten deposits of Boulder County.

The uranium-vanadium mineral was named carnotite in 1888 by Mr. Poulot, at the suggestion of Mr. Cumenge, in honor of Marie Francois Sadi Carnot, president of France.

The ore was treated in such manner as to produce a crude form of combined oxides of uranium and vanadium, and shipped to France. There the vanadium was extracted and used in the South of France for coloring fine silks, while the uranium content was used in tinting porcelains, glass, etc. It is supposed that the Rothschilds, of St. Denis, France, were in some way connected with the business.

In the spring of 1899, Poulot built a small three-stage mill in the McIntyre mining district of San Miguel County, along the Dolores River, and operations were placed in charge of M. M. C. Freidel and E. Cumenge. The upper stage of the mill contained a large floor for storing ore, also the feeder of a 10-ton Krupp ball mill. The second stage held three low leaching tanks, each about 10 ft. in diameter, a Krupp ball mill, a 30-hp. upright boiler and a 10-hp. upright engine. The lowest stage contained one low and three high precipitation tanks and a small chemical laboratory. The total cost of the mill was about $8000. The ore milled aggregated about 355 tons; the output of uranium oxide, 15,000 lb. Work was abandoned in the summer of 1901. In the fall of 1902, experiments were conducted on several tons of low-grade ore, but discontinued a few months later, and not resumed.

In the spring of 1903, a concern known as Western Refining Co. used the Engle-Haynes extraction process and milled about 140 tons of ore, obtaining about 2500 lb. of uranium concentrates. The same process was employed in 1905 by the Dolores Refining Co., which erected a plant about a mile from the old mill. Its period of operations was brief. Recently this process, only slightly modified, has been patented in this country, but not by its originators.

Thereafter the carnotite industry was dormant until the fall of 1909, when the General Vanadium Co. of America, of Baltimore, purchased and began operating a number of prospects along the south side of the East Paradox Valley; among these were such well known producers as the Jodandy, Canary Bird, Blackburn, Rummer and Valley View lodes; initially, all were operated for the vanadium value of the ore. Early in 1910 I indueed radium makers in England, France and Germany to experiment earnestly with carnotite, and a strong and steady demand soon was developed for it.

### Carnotite Principal Radium Mineral

Carnotite is a canary-yellow powder, or slightly cohering mass or yellow stain in rock crevices or in sandstone, and is composed principally of potassium-uranyl vanadate and small quantities of barium and calcium. Potassium has a specific radio activity, although it seems to emit only *beta* rays, of penetrating power about equal to those of uranium, but of electrical effect of only about 0.001 of the uranium *beta* rays. Sometimes the uranium values are in the form of finely pulverulent carnotite filling the interstices of soft gray sandstone; at others, it may be encountered as an impregnation permeating even the sand particles. The sandstone varies in texture and hardness, from extreme coarseness to the opposite; sometimes it is very hard, though usually it is soft and friable.

Here a word may be said as to uranium, the most important constituent of carnotite. Uranium is silver-white when fused, gray-black when powdered, somewhat malleable and nearly as hard as steel. It oxidizes in air, more vigorously upon heating and is soluble in dilute sulphuric acid and hydrochloric acid. Its principal oxide is $U_3O_8$, which is soluble in hydrochloric, sulphuric and nitric acids and contains 84.85% uranium, sp.gr. 7.193. Uranium compounds were first isolated by Klaproth in 1789 out of pitchblende and autunite. The metal was isolated in 1840 by Peligot. Radio activity in uranium was discovered in 1896 by Becquerel. Radium was isolated in 1908 by Professor and Mme. Curie.

### Best Carnotite Deposits in Colorado

The Dolores, or red beds, are the lowest formation visible in the cañons, which are followed by La Plata sandstones, above which occurs a series of thin bedded sandstones with shales, this strata being practically horizontal and contains the carnotite. Sometimes conglomerates are found in this strata, though rarely, and apparently they are foreign to the strata. The elevation above sea level of the highest determined mine is 6700 ft. It may be noted that the carnotite deposits along the Atkinson Creek, only about eight miles north from this mine, are only 5400 ft. above sea level, and there are mines in Utah as low as 4500 ft. above sea level.

So far as investigation has progressed, it is safe to say that the best carnotite deposits are in Colorado, and are found in western Montrose County, in Long Park, Bull

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Cañon, Jodandy Hill, Club Ranch, Hydraulic, Atkinson Creek, Tabequache Creek, Lion Creek, Roc Creek. Deposits occur also in Mesa County, near Gateway, in San Miguel County, in the McIntyre mining district near Cedar and also in Dolores, Routt and Rio Blanco Counties. In Utah, the ore is found in Grand, Emery and San Juan Counties. It occurs also at Radium Hill, near Olary, in the Flanders Range of South Australia and in Central Turkestan and is reported in Spain and near Guarda, Portugal.

The extent of the American carnotite field is very large, probably several thousand square miles. I have examined much of this large region, but generally have found the ore in small patches only, and of grade less than 1% $U_3O_8$, with the exception of a small section bounded on the north by La Sal Mountains, along La Sal Creek, and on the south by Big Cañon, which is about three miles north of "The Glades" ridge, in San Miguel County, which latter contains a very thick deposit of bituminous coal. The commercially important deposits in this small area, which is only about 50 miles long and not over 15 miles wide, are not numerous, and it is obvious that the practice of skimming off and shipping only ores running over 2% $U_3O_8$, cannot continue long.

### Paradox Valley a Producer of Carnotite

Paradox Valley, closely associated with the recent history and occurrence of carnotite, is a basin, which may have been the bed of a sunken lake, about three miles wide and 28 miles long, nestling at the bottom of the jagged, scarred and eroded mesa ranges reaching above the valley about 1700 ft. The entrance is made as the stage road turns over the western brow of Coke Ovens Hill, six miles west of Naturita. Two or three miles from this entrance point, the wagon road to Long Park debouches northwesterly, ascending the mesa's foothills five miles, thence Long Park stretches in a shallow basin six miles, merging into the series of corrugated ridges and cañons, beginning with Hieroglyphic Cañon and ending at Saucer Basin, that continue until the Dolores River is reached, seven miles west, at its juncture with the Rio San Miguel.

Bisecting the Paradox Valley, the sluggish Dolores River wends its serpentine way in a northerly direction, following the course of the high, snow-clad La Sal Mountains that form the western end of the valley. Since the valley proper runs easterly and westerly, or at right angles to the course of the river, the valley is called "Paradox." In passing, it may be observed that the general direction of Paradox Valley is practically the same as the San Miguel River, which empties into the Dolores near Hydraulic. Many theories are advanced as to the formation of this valley, one being that the mesa at one time extended from Long Park across what is now the valley to the top of Jodandy mine hill or the Monogram flat, that internal gases caused it to raise into a low ridge and upon the subsidence of these gases, the ridge became a valley with abrupt, sheared sides. The upward tilt of about 10°, to the sandstone formation toward the valley, from both its north and its south side, is pointed out. Another theory is that tremendous erosion resulted in the valley, but the formation makes this improbable. In the McIntyre district there are evidences that the old bed of the Dolores was about 800 ft. above its present bed, and as a rule, 800 ft. is the mean elevation of carnotite beds above the existing river beds. No topographical map has been made of the carnotite ore belt, and without it, little progress will be made in the study of this formation.

### Ore Extraction Accomplished with Difficulty

The ore extracted from the carnotite deposits on the south side of the valley is packed on burros to the stage road, at a cost of about $2 per ton. Here are situated the Monogram claims, owned by a Pittsburgh concern. This group consists of possibly 30 claims; the ore is found under a cap rock, usually not more than 10 ft. thick, and this is below a few feet of surface soil. The quality of the ore is fairly good, and the quantity satisfactory. The ore must be hand picked carefully to yield an average shipping grade of 2% $U_3O_8$. However, this observation can be made truthfully of all other deposits, except for some solution-enriched pockets of ore that may be encountered here and there in the carnotite region. To the east is found the Jodandy group of about 10 claims, and the Thunderboldt group, all of which show the effect of the skimming and gophering mining policy that has been followed. Indubitably, under a wise trade policy, practically all the ore found on these mine dumps would have been shipped and yielded the shipper a fair profit.

As has been said before, the north side of the Paradox Valley is the flat basin known as Long Park, which latter is inclosed in saw-tooth hills that rise 300 ft. above the basin floor. The south border of this basin is the upper ridge of the northern wall of Paradox Valley. The northern boundary merges into the sloping south cañon walls of the San Miguel River, one of the swiftest streams in the West. Running stringer-like from the south rim of Long Park basin in a northeasterly direction, are the hogbacks that contain the carnotite. Practically all these have strata of the yellow ore, dipping toward the San Miguel River, about three miles northeasterly and 1000 ft. below. The prominent carnotite claims are the Maggie C., which is patented, the Swindler, Cripple Creek, Hope, Media, Jack Angle, Park, Nos. 1, 2 and 3, the Great Western, Honeymoon, Vanadate, Bryan, North Star, Sunday and Nucla; all are connected by wagon road to the Paradox Valley stage road. The trip may also be made by automobile.

The west border of Long Park is, as has been stated, Hieroglyphic Cañon, which ends at the San Miguel River near Club Ranch. Various claims are scattered along the Cañon walls, and upon the flat bench overlooking the south side of the San Miguel River, is situated the Yellow Jacket group, that shows apparently abundance of the yellow ore under a cap of rock and earth of usually not more than 4 ft. Again, the ore must be hand-sorted to yield an average of 2% $U_3O_8$. On the north side of the San Miguel River are several prospects that should be of the same character as the Yellow Jacket group, but very little work has been done.

About a mile further down the river and on the same or north side, is Atkinson Creek, and here considerable prospecting has been done. The Big Mitt, that lies for 1500 ft. along the bench above the west bank of the creek, has had the ore exposed in eight places. The Ruth Ellen shows in the location shaft several feet of ore averaging much higher than ordinary shipping grade. The Club No. 2 also shows excellent ore along the outcrop for several hundred feet. Further south and west, across the San Miguel River, is Saucer Basin, which is at the juncture of the Dolores and the San Miguel. Here is the Cliff claim,

one of the best producers in the whole carnotite region, with apparently not another carnotite claim within several miles of it.

Across the Dolores River are a number of claims that are being developed and from which several carloads of ore have been shipped. On this side also is Roe Creek, along the top of which is Carpenter Flats, where the ore may be found at the very grass roots in the Park Belle claim. Along Lion Creek are the Confusion and others which have all been developed enough to show them as of importance. Along La Sal Creek is the Yellow Bird group, famous in the early Poulot days, and further south the Kent and Bonanza claims, the first named in honor of the great English vanadium authority, J. Kent Smith, and which shows a tunnel 70 ft. long cut the entire distance through a 3-ft. vein of carnotite.

Bull Cañon has about 40 claims. This region is much eroded, the sandstone is very hard, and the ore strata quite irregular and pockety, but with good bunches of ore showing occasionally. The Batchelor group and the Black Fox may be mentioned, as also the Wedding Bell and the Sunrise.

A few miles south of Bull Cañon are the Stephens mines, which are on flat benches akin to the Yellow Jacket bench along the San Miguel River. From one of these benches several carloads of carnotite of grade averaging more than 3½% $U_3O_8$, has been taken. The occurrence seems to be in the bed of an ancient creek bed, and in a pay-stratum about 1 ft. thick. Overlying this was a blackish-gray stained sandstone layer 3 ft. thick, and a continuation of the same layer, but not stained, of about 2 ft., this latter being at the surface. Three miles south is Big Cañon, along which are some 40 claims belonging to the American Rare Metals Co., and to a number of individual owners. The ore here seems much mixed with carbon from the immensely thick deposits of coal in the Glades, a portion of which would naturally drain into this region. In uranium content, this ore will average not quite 1 per cent.

### Some Utah Carnotite Deposits

Sixteen miles west and north of Monticello, San Juan Co., Utah, is the Dry Valley district, in which a number of claims have been located. This region is especially arid and conflicting tales are told by prospectors, the most glowing being that the region is about like Paradox in the quality and quantity of the ore, but that water is very scarce and the railroad 100 miles away, while in the Paradox the average distance from the railroad is about 60 miles. Little space need be taken in describing the Green River deposits, or those of Temple Rock, Utah, 45 miles south of Green River. Torn and disheveled as the Colorado carnotite fields undoubtedly are, they are regular and orderly compared with the tumbled masses of lava, mud, rock and alkali that compose the Utah deposits. Ten miles from Green River station one of these deposits is found, with the ore in a coarse, iron-specked sandstone, not in horizontal beds as in the Paradox, but in tiny stringers running from the surface to a depth of 6 or 10 ft., and ending abruptly. Very little systematic exploration work has been done. The Cisco deposits are even worse. Those below Thompson, Utah, should offer better promise of stratum uniformity, hence of finding profitable carnotite deposits.

(*To be concluded.*)

## The Placer Situation at Fairbanks

Alaska Correspondence

Sluicing in the Fairbanks district, Alaska, ended in October when heavy snowstorms were followed by cold weather. The placer season of 1913 was not prosperous for miners, merchants or anyone else, although an auspicious start was made during the first part of May. An unprecedented period of dry weather from the latter part of May to the first of August handicapped operations on many creeks. Many operators were forced to cease work until more water was available, and many men thus temporarily thrown out of employment joined in the rush to new diggings on the Chisana. The stampede took much of the ready money of the camp. When the rains of August permitted a general resumption of activity, the operators found themselves short of laborers. This condition lasted for only two or three weeks, however, for the closing down of many mines because of the inability of the operators to make ends meet released more than enough men to supply the demand of those who could operate. A heavy fall of snow in the first week of September threatened to bring sluicing to an end, but warmer weather followed. By the middle of the month, however, only a few plants were working, and these closed down for the winter early in October.

While many factors combined to make the last season a failure, the underlying cause of the general financial failure was the poverty of the ground being exploited. Practically all of the better ground of the Fairbanks district has been worked out, and there remains only "side" pay and other ground that was passed up in the boom days as too poor to be worked at a profit. The events of the last season would indicate that, though working costs have decreased slightly, the gold tenor of the gravel has not increased while it has been lying idle.

The Fairbanks district occupies an unfortunate position among placer camps in that its comparatively large deposits of low-grade gravel are not so situated as to be amenable to treatment by mechanical means. Scrapers have been used with marked success on certain of the shallower creeks, notably Pedro, Gilmore and Fairbanks. On the deeper creeks, however, they have no commercial application. The same applies to dredging. There is, unquestionably a small amount of dredgable ground near the heads of the creeks, where the depth to bedrock is slight and the valueless material overlying the "pay" is not of great thickness. But there is too little of such ground available at any one place for dredging to be a profitable enterprise, though it is possible that a small dredge that could be dismantled and moved from place to place would prove successful. The largest quantities of gold-bearing gravels, however, lie buried beneath from 30 to 200 ft. of muck and barren gravel. Only the lower four or five feet of the gravel, on the average, and the upper foot of the bedrock carry gold in important quantities. To remove the worthless material, many times greater in quantity than the pay, would, of course, be much too expensive to render dredging or scraping feasible. Hydraulic methods, obviously, are even less applicable.

The only hope for the future lies in improving the present methods of drift mining. While there is undoubtedly much room for improvement, yet it is questionable

if any sweeping reduction in working costs can be made; and only a sweeping reduction can render much of the remaining ground profitable.

In the large territory of which Fairbanks is the political and commercial center, including the Chena River and its tributaries, the Salchaket, the Kantishna, the Totatlanika, Wood River, and many other similar districts, there is probably considerable ground suitable for dredging, hydraulicking and scraping. In the opinion of many competent observers, these districts offer more promise for lode mining, also, than does the territory immediately adjacent to Fairbanks.

## Fires in Michigan Iron Mines

By P. B. McDonald*

Attention of iron-mining companies on the Western Menominee Range has lately been directed to the increase of burning rock in underground workings caused by oxidation of sulphur compounds associated with the ore. Serious fires are now burning in the Fogarty mine of the Verona Mining Co. in the Iron River district and in the Bristol mine of Oglebay, Norton & Co., at Crystal Falls. The sulphur compounds oxidize underground when exposed to friction and the air, and smoulder in the cracks of the rock, being practically impossible to put out. The sulphur occurs in the black slates of the walls and also in the ore; some of the commercial iron ores of this district contain as much as 3% sulphur. In the past, rock piles on surface have burned for years, but not much trouble was encountered underground although the Youngs mine and the old Sheridan mine had some trouble. The fires now burning are causing serious inconvenience and it is feared the tendency to fires will increase as greater depth is attained and more sulphur is struck; the fire in the Bristol mine is in the new workings and may cut off a valuable portion of the orebody. The method of fighting such fires is to bulkhead up all underground openings in the vicinity to shut off the air supply; in the case of the Youngs mine a small shaft over the affected portion was left open and a stack added at surface in order to let the fire burn itself out, which it is believed it did, although the workings have never been reopened.

## Nevada Wonder

The annual report of the Nevada Wonder Mining Co., Wonder, Churchill Co., Nev., for year ended Sept. 30, 1913, states that 39,118 dry tons of ore were mined and treated. The total gross value of this ore was $572,359, made up of 630,606 oz. of silver and 9248 oz. of gold. A total recovery of 93.1% of the metal contents, or $535,661 of the gross value was made. The mine was worked continuously during the year, although no ore was hoisted for 38 days in November and December, 1912, on account of construction work and for 32 days in January and February, 1913, on account of water shortage for milling. The main shaft was sunk three compartments wide from the 700-ft. level to a depth of 1030.5 ft. and enlarged to three compartments from the 700-ft. level to the surface. The 318.5 ft. of sinking was done at a cost of $34.26 per ft. This includes the cost of enlarging and fitting up the 700-ft. station for the electric sinking hoist, and cutting stations 12 ft. from the shaft on the 800- and 900-ft. levels, and 15 ft. from the shaft on the 1000-ft. lever. The shaft was timbered with 8x8-in. Oregon pine. General development work consisted of 6831.5 ft. of drifting, raising, and crosscutting. The entire surface equipment at the mine, both of buildings and machinery, was remodeled for the purpose of providing facilities for handling a greater amount of work in the mine.

Apparently the total cost of mining, milling, etc., was about $12.80 per ton milled; of this about 16% was for metal deductions. The milling costs averaged $3.092 per ton, made up of $3.249 for direct charges and $0.157 for indirect charges. On May 29, 1913, the company declared its first dividend, the rate being 10% on the capital stock.

*Mining engineer, Gouverneur, N. Y.

## Mineral Production of Belgium in 1912

According to official reports, there were 13 zinc smelters and 10 zinc-rolling mills operated in Belgium in 1912. These employed a total of 9186 workmen. All of the zinc ore produced in Belgium (840 tons) was consumed by these works and 488,030 tons of foreign ore in addition; the coal used amounted to 997,740 tons. The production of spelter was 205,940 tons, as compared with 198,238 tons in 1911. (In this and following paragraphs where "ton" is used, the metric ton is meant.)

Five lead works were operated, which employed 1826 workers. These treated 73,605 tons of ore, coming almost exclusively from foreign countries, 123,370 tons of plumbiferous, argentiferous and auriferous byproducts, and 47,080 tons of work lead. The production of refined lead was 54,940 tons, exclusive of work lead from foreign countries, which was treated in Belgium. There were 279,960 kg. of gold and silver produced and 550 tons of copper matte as a byproduct.

In 1912 there were 17 works operating blast furnaces. Fifty furnaces were in blast, which employed 5282 workers. The consumption of coke was 2,451,320 tons, and of ore, 6,311,850 tons, of which 89,860 tons were domestic. Pig-iron production amounted to 2,301,290 tons, 2,137,730 tons of this amount being used for steel making.

Considering the stock on hand at the beginning and end of 1912, and also taking into account the imports and exports (780,365 and 14,062 tons, respectively), it appears that the domestic consumption of pig iron in Belgium was 3,067,593, as compared with 2,727,878 tons in the previous year.

## Osmiridium in Tasmania

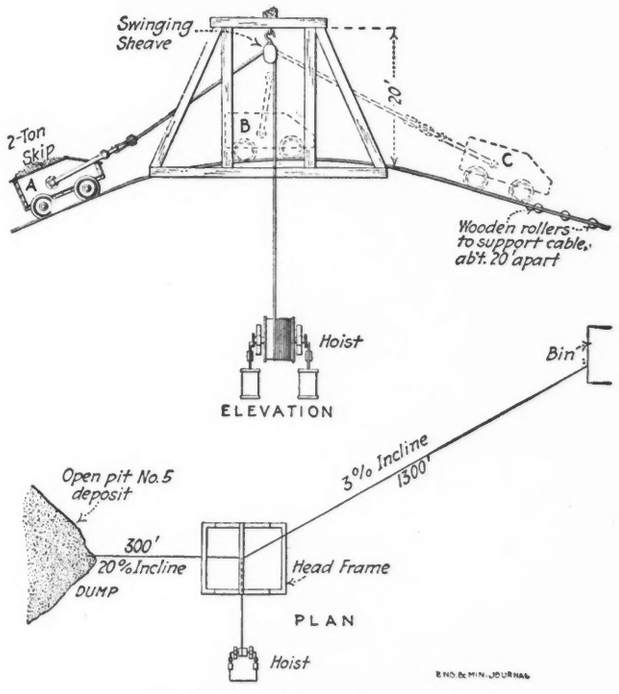
The report of the Tasmanian Geologist, W. H. Twelvetrees, on the Bald Hills osmiridium field vouches for the existence of the precious metal *in situ* in the serpentine rock, samples of which he had crushed and assayed yielded up to 59 oz. to the ton. He says: "It must be understood that it is irregularly disseminated in the rock. It is rarely visible in the stone, and this is partly due because of its covering of oxide of iron, a dull black coating making the grains of metal indistinguishable from those of magnetite or chromite." The occurrence is one of extreme interest, for osmiridium in undisturbed rock has hitherto been recorded only from Russia.

# DETAILS OF PRACTICAL MINING

## A Gravity Haulage System

By Frank C. Rork*

The scheme here described was devised to hoist and transport ore from a deposit in the Moose Mountain mine to the mill bins, situated about 1500 ft. from the ore. A headframe about 20 ft. high was erected at the highest point between the ore and the bins. Instead of fastening the sheave in the usual way, it was suspended, so as to swing and turn according to the pull on the cable. The bail on the skip was constructed so that it would turn over as the car went by the headframe.




Details of Haulage System

In the position *A*, the skip is shown coming up the incline. At *B*, the momentum carries it by the highest point of the track, the bail turning over as it passes. The hoistman then releases the friction and allows the loaded skip to pull the cable out as it goes down the incline to the bins. It is necessary to support the cable on wooden rollers, otherwise the drag of the cable would stop the skip.

On the return trip, the momentum of the empty skip is sufficient to carry it past in the same manner. By speeding the hoist on the return trip the round trip can be made in about four minutes, which would limit the capacity to 300 tons per 10-hr. shift, but there is no reason why 4- or 6-ton skips could not be used.

The hoist is belt-driven from a motor. There are two drive pulleys on the motor which are connected by two belts to two pulleys on the hoist countershaft, one 60 in. and one 30 in. in diameter. By means of two friction clutches the 30-in. pulley drives the hoist on the return trip at double the regular hoisting speed.

This scheme has been in operation for about six months, and is proving satisfactory for the purpose for which it was designed.

*Mine superintendent, Moose Mountain, Ltd., Sellwood, Ont.

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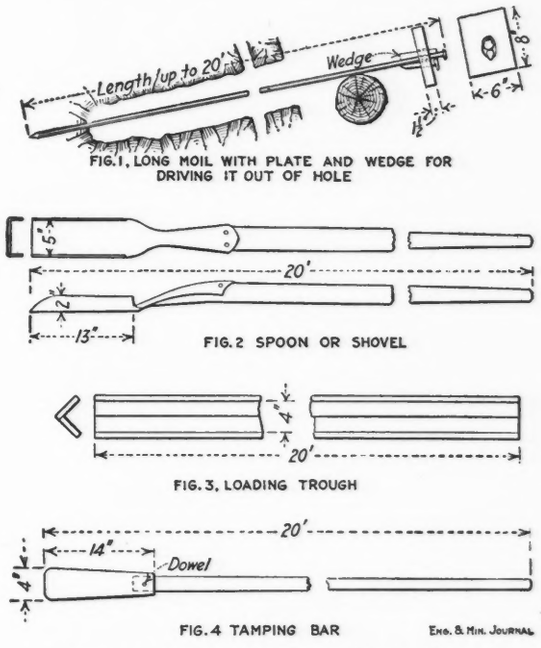
## Drilling Mesabi Gopher Holes

Blasting in the Mesabi openpits is necessary in stripping if the overburden is somewhat consolidated, and rather generally in mining unless the ore is unusually




Typical Set of Gopher-Hole Tools

soft. Two methods of drilling and blasting are in use. One consists of drilling deep down-holes at the top of the bench, using a jumper drill, often with several men, chambering the bottom with dynamite and blasting with black powder; the other is given the wholly indefinite name of "gopher-holing," a term which has a different signification in every mining region.

Gopher-holing here consists of working out an inclined hole about 16 to 20 ft. deep, beginning at the bottom corner of the bank and extending in at an angle of 10 to 20° below the horizontal. This is accomplished in various manners. In the cases observed, a set of tools similar to that illustrated, was employed. In addition to these, an ordinary hand auger was used to start the hole and take out the first few feet; this hole was blasted with a stick or two of dynamite, the effect being to leave a long bootleg of 8 to 14 in. in diameter. The auger being unwieldy

in deep holes, a long moil-pointed bar usually of 1¼-in. steel was next brought into service, shown in Fig. 1. This was driven into the bottom of the bootleg for a foot or two, by two men with doublejacks. When progress became slow, a perforated plate about 1½x6x8 in. was slipped over the end of the moil and wedged to it, either with two small wedges or with one wedge and a track spike as illustrated. By hitting the head of the wedge with the two doublejacks, the moil was extracted. During this process, it was usually supported on a log as shown, to keep the plate off the ground.

The moil hole was then blasted by inserting a stick or two of powder and exploding with an electric cap. These alternating processes were continued until the desired depth of hole was obtained, the average diameter being perhaps 12 in. This intermediate blasting was done with a single dry cell. It was somewhat surprising at first to see the miner load his hole, step a foot or two to one side of the collar, connect his battery, and set it off. As a matter of fact, material was not even shot out of the mouth of the hole, the sole effect being to shatter the ground adjacent to the charge. To remove the broken material, the long-handled spoon shown in Fig. 2 was used. It is made of an ordinary No. 2 shovel by bending the sides up straight so as to give a depth of about 2 in. and opening the socket to take the large 2- or 3-in. end of a peeled sapling.

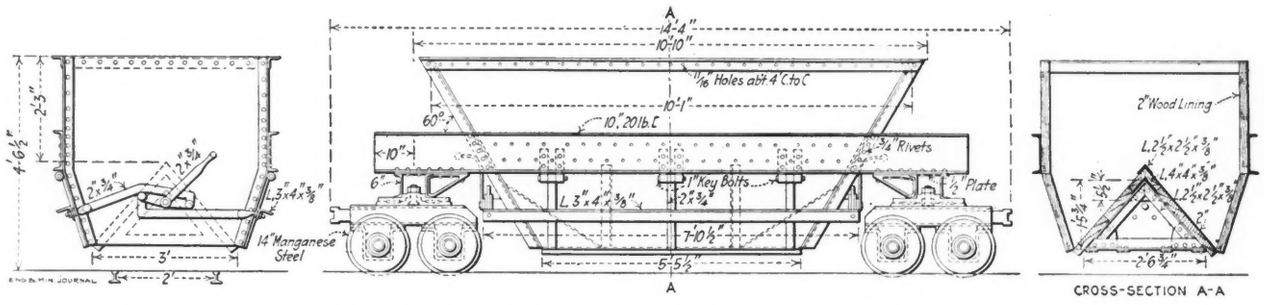
When the hole was sufficiently deep, a larger charge of dynamite, 10 to 15 sticks, was exploded in a bottom to give a good chamber. Black powder to the extent of about three kegs was charged into the chamber by shaking it down the launder shown in Fig. 3. A dynamite primer was inserted in the middle of the powder charge and the whole tamped tight with the tamping bar shown in Fig. 4. The remainder of the hole was then also tamped with lean ore.

The tamping bar consists of a round, tapered wooden head about 4 in. in diameter at its big end and 14 in. long, with the smaller end bored to permit the insertion of a 2-in. sapling which is fastened with a wooden dowel pin. No nails are used and in the construction of the trough, copper nails are considered advisable. It is an obvious rule of safety not to bring iron and rock into contact in the presence of black powder.

The holes were blasted in groups and for this purpose the battery was discarded and a push machine used. It is customary to move some distance off for this blasting but if well carried out, one might stand on top of the blast without injury, since there is rarely any discharge of material, the whole bank being lifted and allowed to drop, thus effectually shattering the material.

## Double Truck Gable-Bottom Car

The drawing illustrates a car recently designed for use on the stock-pile trestle of the Kennedy mine on the north Cuyuna range. The car will hold 100 cu.ft., about six tons of ore. The electric locomotive in use on the trestle will handle one car per trip. The body of the car is hopper-shaped with a gable through the center and two side doors swinging out and up. The ends of the hopper are pitched at 60° and the gable is about 50°, these steep pitches being necessary from the fact that the ore is sticky and hangs to a flat slope. It is possible also that in the coldest weather the ore may freeze slightly which would cause it to stick to the car. The inside of the body is protected with a 2-in. lining of wood. The two side gates give an extremely fast discharge, since they provide about a maximum opening for the passage of the ore. It is extremely important that the cars dump quickly, as it will tax the capacity of the system to handle the ore as fast as it is hoisted at best, the trestle being unusually long considering the size of the mine; it is considered unsafe to stock-pile near the shaft over the mine workings and only the outer half of the trestle can be used. The double trucks make it possible to swing the entire body in between and thus keep it lower and more stable. The company itself manufactures everything but the trucks.




RAPID-DUMPING 6-TON CAR FOR STOCK-PILE TRESTLE

## Safety of Shaft Hoisting Ropes for Great Depths

For a number of years it has been more and more painfully recognized as a great difficulty to modern mining that with growing depth and increasingly heavy hoisting loads the diameter of hoisting ropes must, under prevailing safety provisions, grow to such an extent that the ropes become too unwieldy for practical work, says the *Mining Journal*. The latest German contributions to the voluminous literature devoted to remedies for this state of affairs come from Doctor Speer and F. Baumann, and are published in *Kohle und Erz*, No. 35, and *Glückauf*, No. 40, respectively. The remedies proposed by both authors, in common with most of their predecessors, are either the use of wire ropes of increased tensile strength, or the reduction of the now prevailing safety coefficient, or the combination of both. As regards the first, it is pointed out that the tensile strength of 180 kg. per sq.mm., which may in present circumstances be regarded as about the maximum in practical work might, and probably will, within measurable time

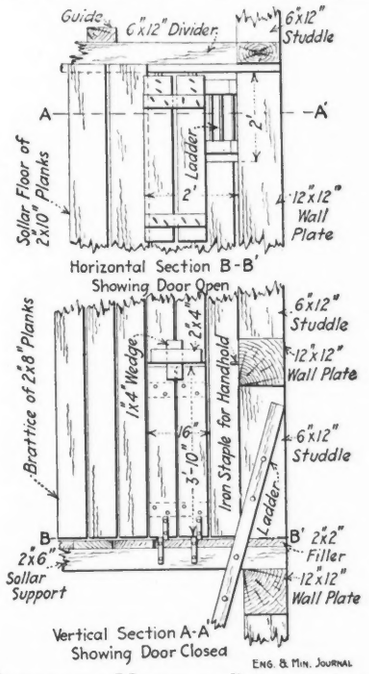
be raised by the use of improved wire in the manufacture of ropes to 210, or, according to Dr. Speer, even to 240 kg. per sq.mm. As regards the safety coefficient, both authors arrive, on the basis of most exhaustive and detailed calculations, at the conclusion that the figure at present imposed by the mining regulations might, without any danger, be considerably modified. In fact, Mr. Baumann sums up his computations by stating that with a rope whose tensile strength is equal to 210 kg. per sq.mm. the minimum safety coëfficient, applied to the combined weight of rope and loaded skip, ought to be fixed as follows:

Up to 10 tons hoisting load and to 1500 m. depth, coefficient = 6
Up to 20 tons hoisting load and to 1000 m. depth, coefficient = 6
Up to 20 tons hoisting more than 1000 m. depth, coefficient = 5
Up to 30 tons hoisting load and to 1000 m. depth, coefficient = 5
Up to 30 tons hoisting more than 1000 m. depth, coefficient = 4

❖

## Manway and Skipway Door

The Bennett shaft near Keewatin on the Mesabi range is divided into a combination manway and pipeway and two skipways, arranged in a row. A vertical partition or brattice of 2-in. planks separates the manway from the adjacent skipway. The shaft sets are spaced 5 ft. and on every third set a sollar is built of 2-in. planks laid on



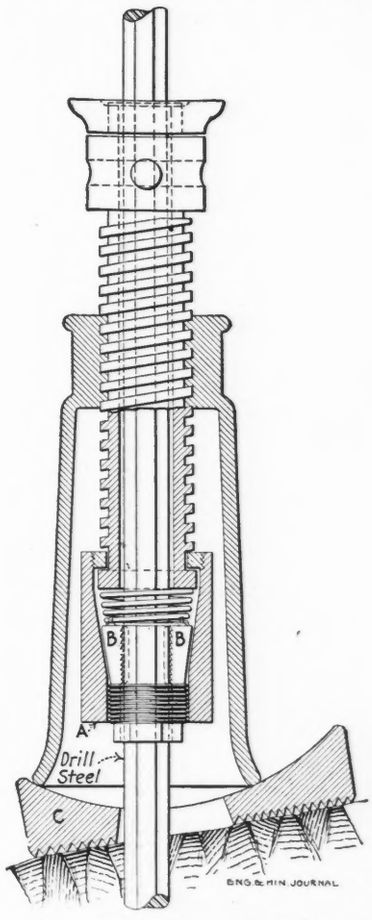

CORNER OF MANWAY COMPARTMENT

2x6-in. joists parallel to the end plates. Repair work on the pipes necessitates the lowering of material and tools, which ordinarily must be carried down by hand or slung from sollar to sollar. To enable such supplies to be lowered in the skip and taken into the manway, a door has been provided in the brattice at each sollar. The ladder opening in the sollar is 2 ft. square, situated in a corner next to the skipway. The door occupies the place of the second and third brattice boards and is hinged at the bottom so as to cover most of the ladder opening when it is swung down. It is 3 ft. 10 in. long and its top comes even with the center of the set above the sollar set. It is held closed against the divider of this set by a wedge made out of a 2x4-in. piece, slipping through a 1x4-in. slot in another 2x4-in. piece spiked horizontally to the brattice and divider. A 2x2-in. filler is nailed to the top of the 2x6-in. sollar-joist next to the skipway, in order to bring the bottom of the door flush with the sollar floor.

❖

## Device for Pulling Stuck Drill Steel

To avoid delay and possible loss of a drill hole a special apparatus was devised and used on the Catskill Aqueduct. It consists of a hollow jackscrew with a collar on its lower end, to which is attached a cylindrical gripping chuck *A*, containing a set of toothed gripping jaws *B* in its conical interior, according to *Engineering & Contracting*. This jackscrew stands on a saucer-shaped base *C*, which, as the drawing indicates, permits the jack to follow the line of the drill regardless of its inclination to the rock. In operation, jack and base are slipped over the drill. When the screw is turned upward its operation, pulling on the sleeve, compresses the spring, forcing the wedges tighter and tighter against the drill to which the force of the pull is transmitted. The standard jack, 3 in. in diameter with ¼-in. pitch, has a lift of 8 in. and if this does not loosen the drill sufficiently to permit of its removal by hand, a new grip is secured by simply turning the jackscrew backward, lifting again and repeating until the drill bar is free. Several sets of grip jaws are provided, so as to handle different sizes of drill rods.




PAUL MITCHELL DRILL-PULLING JACK

This device is made in sizes to suit the work required to be done. For drills less than 1¼ in. in diameter a 3-in. jackscrew weighing 80 lb. with 30 tons lifting capacity is used; for drills up to 2 in. diameter of shank and 50 ft. long on heavy quarry drilling, a 3-in. jackscrew of 100 lb. weight and 50 tons lifting capacity is made. Paul & Mitchell Co., Millbrook, N. Y., market the device.

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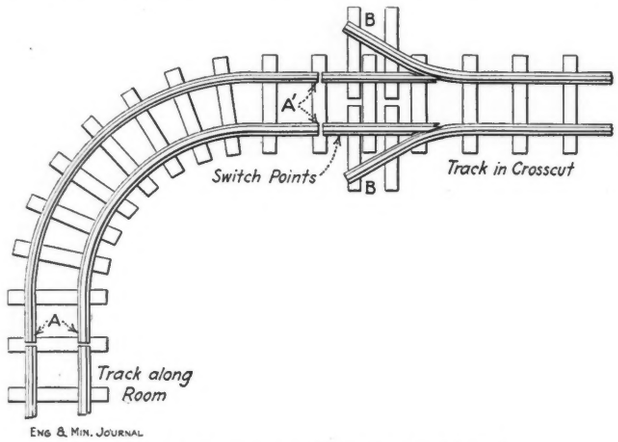
## Fitting Track Curves in Top-Slice Rooms

In the top-slicing method of ore extraction as practiced on the Mesabi, successive rooms are opened off the crosscut extending 10 ft. one way, and 40 ft. the other. The track from the crosscut is turned into the long side of the room only. For the first room mined from any




TRACK CURVES IN TOP-SLICE ROOMS

crosscut, a curve is fitted into the track such as represented by the portions of the rails *A-A'*. When the room is mined and caved, the track is taken out and it is desirable to use the same curved portion for laying track into the next room. It is only rarely that the break in the crosscut rails is such that the curve will fit. The difficulty is overcome by Captain James Rosewall of the Harold mine by using two switch points, as shown. The curve rails are laid, the portions *B* of the crosscut rails are spread out and the switch points fitted in to make a tight and smooth joint. The switch points used, of course, are such as would be used for a split or fixed switch and not for a stub switch.

The trick is one taken from openpit practice, where in changing tracks it is often difficult to get joints to match without recourse to this device.

❖

## A Safety First Calendar

The greatest difficulty in work along safety lines is to impress on the employees the importance of such work and to obtain their coöperation. Most of the enlightened companies in mining as well as industrial lines now do their share or more than their share, and the carelessness, ignorance and recklessness of the workmen is usually responsible for such accidents as occur. Education of his employees is the main problem confronting the operator. Classes, bulletins, competitions, rules and disciplinary methods are employed to solve the problem. The National Tube Co. has lately added a new device to the list of those in use. A safety calendar has been designed for distribution to each of the 30,000 employees of the company. The calendar is exceedingly attractive; it carries a picture illustrating a safety precaution, and on each month of the calendar is printed a safety motto. It is hoped that such a daily reminder of the safety-first principle will aid appreciably in forcing on the workman a sense of his obligations.

Some of the mottoes read as follows:

**It is better to be careful a thousand times than to be injured once. Get the safety habit. If you see a man acting carelessly, tell him about it, and do not be afraid of hurting his feelings by doing so.**

**Neglect of slight injuries often results in blood poisoning and serious trouble. The company has provided an emergency hospital, where employees injured in the mill can receive the best of attention. Do not neglect small injuries.**

**Many employees used to think it was brave to do work in a reckless way, and cowardly to be looking out for one's safety. Fortunately such people have become scarce. They are now regarded as fools, and they are discharged when the management finds them out.**

**Playing, wrestling, or fooling on the mill premises, as well as playing or fooling with machinery or tools, is dangerous. Such conduct should be strictly prohibited.**

**Every danger sign posted in the mill means that the danger pointed out is real. Men must ascertain what is on these signs around places where they work and give heed to the warnings. The red ball on a sign means danger.**

**The women and children of an employee's family can be of great help in the safety work by continually urging him to be careful and use safe practices. If he has a slight cut or injury, insist that it be dressed promptly at the mill emergency hospital.**

**Your eyes are valuable to you. Wear goggles when working where chips or sparks may fly. They may be awkward at first, but you will soon get used to them and then you would not work without them.**

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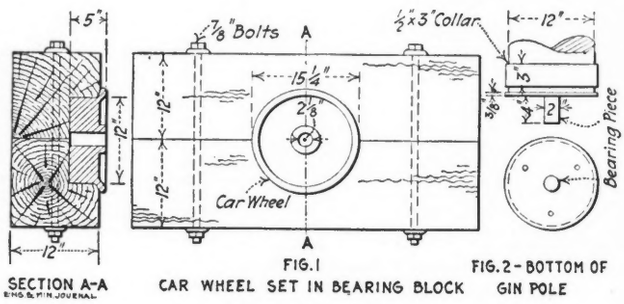
## Foot Block for Revolving Gin Pole

For many purposes in constructing with a gin pole, it is convenient to be able to revolve the pole. An ingeniously contrived bearing for this purpose used at the Gilbert mine on the Mesabi is herewith illustrated. An




GIN-POLE FOOT BLOCK

ordinary 12-in. car-wheel is clamped in recesses in two 12x12-in. by 4-ft. timbers by bolting together the latter with two ⅞-in. bolts, the wheel flange being permitted to extend above the timbers. The bore in the wheel is 2⅛x5 in. To the bottom of the 12-in. wooden gin pole itself is nailed an iron plate with a central pin 2x4 in., which fits in the bore of the wheel. The bottom of the pole is further provided with a collar of ½x3-in. iron, shrunk on.

❖

**Patents Covering Cobalt in High-Speed Tool Steel** are owned by the Becker steel works of Willich near Crefeld, Rhenish Prussia, which claims that its efficiency is thereby greatly increased.

# DETAILS OF METALLURGICAL PRACTICE

## A Boiler Feed-Water Filter

In most tropical regions, at low elevations, the seepage water that is temporarily retained in the soil and not the rapidly drained flood waters must be relied upon for boiler feed. This water remaining in long contact with the decomposed rock of which the soil consists, dissolves certain salts, and becomes surcharged with organic matter from decaying vegetation. It also holds in suspension minute particles of rock material. For these reasons boiler-scale troubles are apt to be experienced whether or not there be limestone in the vicinity.

A case in point at a mine in Nicaragua is described by C. Carleton Semple in *Power*. Upon taking charge of the mine he found that a 30-hp. locomotive-type boiler which was supposed to be capable of generating enough steam to operate all the machinery in the 100-ton mill, could not supply steam enough to keep more than half the machinery going at full speed.

This boiler was found to be badly scaled. The scale was made up of alternate bands of red and white material. The red material was granular, the white compact and both hard. A test with hot and cold strong hydrochlorie acid failed to show effervesence, indieating absence of carbonates. The glasses in which these tests were made were left standing over night, and the next morning the scale was found to have dissolved in the acid and to have formed a heavy gelatinous mass, from which it was surmised that the scale was made up chiefly of minerals held in suspension and not of salts in solution in the water. This simple test indicated that the preventive for the trouble consisted in removing the fine material from the feed-water supply.

Of course, attention was given immediately to the removal of the scale already formed. This scale was entirely too hard to be removed by any scraping or punching tools that could be operated through the handholes, and to have taken out the tubes would have delayed operation for six weeks, because no extra tubes were on hand and a new set would have had to be ordered from New Orleans.

Several commercial brands of boiler compounds had previously been tried with indifferent success. After ascertaining the source of the trouble the boiler was filled to within a few inches above the top row of tubes with water after about 1 gal. of kerozene had been poured in through one of the handholes. The boiler was then fired up and a pressure of only 30 lb. maintained, while no attempt was made to run the plant. The blowoff was opened for a short period every three hours and the water level reëstablished. After three days the fire was drawn and all the scale that had loosened was removed.

After a second treatment the boiler was placed in regular use and every morning one-half pint of kerosene was added to the feed water. For the first six weeks the fire was drawn every week and the loosened scale removed. A few weeks after this treatment had been started it was possible to run all of the machinery part of the time and half of it all the time at full speed. After two months all of the machinery could be kept running all the time at good speed. After seven months an 80-hp. return-tubular boiler was ready to be put in commission to operate an addition to the mill. The small boiler was then retubed, and it was found that practically all of the scale had been removed from between the tubes by the kerosene treatment, but little had been removed from the crown-sheet.

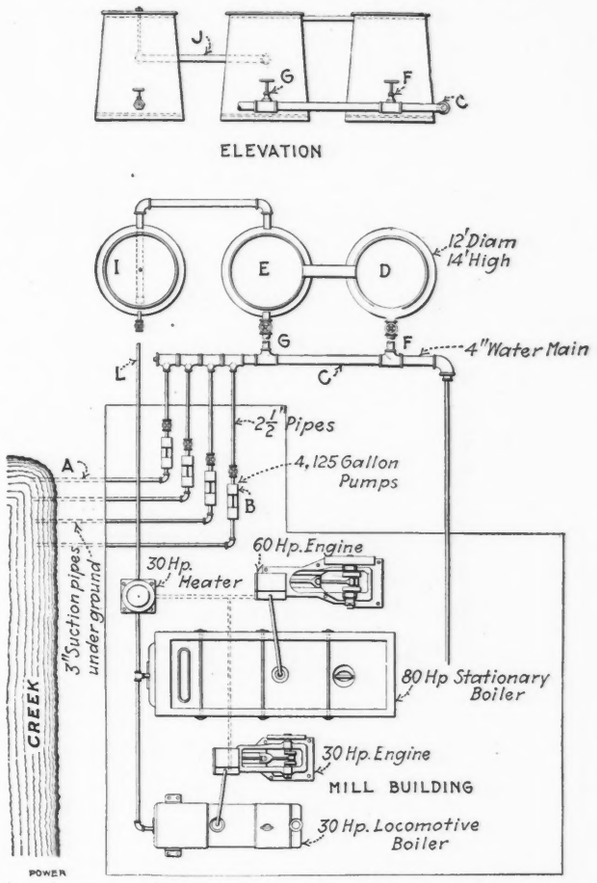



FIG. 1. PIPING OF THE FILTER TANKS

Before firing up the new boiler the outside surfaces of the tubes and the inner side of the boiler shell were rubbed over with flake graphite until a thin glossy coating covered the metal. This was done not so much with the idea of preventing corrosion, of which there was no evidence, as to prevent any scale from adhering.

Meanwhile a filtering plant was installed to remove the solids in suspension in the water taken from the creek for the boiler-feed supply. This plant was exceedingly simple and required only one 12x14-ft. wooden tank in addition to the two 14,000-gal. tanks that held the mill-water supply. These were arranged as shown in Fig. 1, in which *A* are 3-in. suction pipes from the creek to the

four pumps; *C* the 4-in. water main that supplied the mill with water and which was connected at one side and near the bottoms with the mill-water tanks *D* and *E*, the connecting pipes being controlled by the valves *G* and *F*. The tanks *E* and *D* were connected at the tops by a trough, about 6 in. deep. The filter tank *I* was connected with the tank *E* by the 4-in. pipe *J*, about midway between the top and bottom of the tanks, and which extended across the tank to the opposite side, the end of the pipe within the tank having been plugged and the pipe itself drilled with ½-in. holes. The valves on the mill-water main were normally wide open, so that the speed of the pumps had to be so adjusted that all three tanks remained full of water.

Normally the valve *G*, Fig. 1, was closed and the valve *F* left open, so that the water entered the tank *D* at the bottom, rose in it to near the top, thence passed over into the tank *E*, through the trough and rising in the tank *E* to the height of the pipe *J*, flowed into the tank

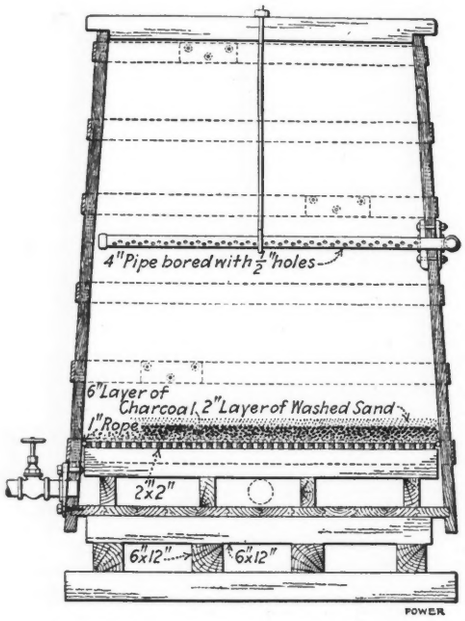



FIG. 2. DETAILS OF CONSTRUCTION

*I*. In rising through the tanks *D* and *E* the coarser solids had ample opportunity to settle.

The bottom of tank *I* was provided with a filter, which, as shown in section in Fig. 2, consisted of a grating 1½ in. less in diameter than the diameter of the tank. This grating was made up of 2x2-in. scantling laid upon two sets of timbers 12 in. deep, so that the bottom of the filtering bed was 24 in. above the bottom of the tank. Upon the grating a double layer of thin, white cloth, which in all tropical countries is sold under the name of *manta*, was tacked in place and the grating calked by a piece of hemp rope driven down between the edge of the grating and the sides of the tank. On the cloth was spread a layer of screened charcoal 6 in. deep, the pieces of which were not less than ½ in., nor greater than 2 in. in diameter. Upon the charcoal was spread a layer of washed river-sand containing no particles that would pass a screen with 20 meshes per linear inch. This sand sank into the spaces between the lumps of charcoal, but was, on the average, 2 in. deep over the charcoal. The layer of charcoal was used only to prevent too tight packing of the sand upon the filter cloths.

After the filter had been in use for a week or 10 days its upper surface became coated with a thin gelatinous coating which allowed water to percolate through it, but entangled the finest sediment and prevented it from passing through the filter bed.

The water below the filter tank *I*, from which all sediment had been removed and which was clear, was drawn off through the pipe *L* to a 30-hp. feed-water heater, from which all the plates had been removed. All of the exhaust steam from one 60-hp., one 30-hp. engine and four service and four boiler-feed pumps was led into it, heating the feed water to 210° F., before flowing to the pumps. The bottom of the heater was about 2 ft. above the four pumps, not shown in the sketches, so that the water flowed to them by gravity. The feed water was fed to the boiler constantly; one or the other of each pair of pumps, there being two feed pumps for each boiler, was always in motion, the speed being so regulated that the feed equaled the evaporation.

After this system had been installed no further trouble was experienced from scale. It was the custom to stop operations the first and 15th day of each month, which were the mill cleanup days. Then the boilers were blown out and about half an ordinary water bucket of granular material would be found in the bottom. This was probably the salts held in solution in the water and which could, therefore, have passed the filter bed. No scale formed on the plates or tubes, and no corrosion was evident at the end of two years.

At these cleanup times the drain valves on the tanks would be opened to drain off the settled sand and sludge. The sand on the filter beds was removed and a new layer substituted every six months. The cloth was renewed after being in use 18 months. The heater served as a sand trap, inasmuch as it would have caught and held sand that might have been washed through a hole in the filter cloth and thus have prevented its entering the boiler had such a hole formed.

All the lubricating oil in the exhaust from the engines and pumps entered the feed-water heater, from which the plates and box for removing such oil had been taken out. Consequently much oil must have returned to the boiler and the quantity accumulated steadily for two weeks. A cheap mineral cylinder oil was used, but no trouble was experienced from its presence. On the contrary, the oil was regarded as beneficial rather than detrimental, as, together with the organic matter in the water, it probably caused salts that had been in solution in the water to settle as a granular sand rather than in a compact mass. The filtering capacity of one 12x14-ft. filter tank was just sufficient for the two boilers. The water percolated very slowly.

## Tin Reclaiming by Matte Smelting

The reclamation of tin from tin waste, slag or even from ore, by matte smelting, is urged by Jan Rueb, The Hague, Netherlands (Brit. pat. 27,148 of 1912). According to his ideas, the stanniferous material is smelted with enough pyrite or other sulphur-bearing material to matte all the tin. The matte is then leached for tin with alkaline sulphides. If copper is present, it may be desirable to roast the matte, and leach out the copper first.

# THE ASSAYER AND CHEMIST

## Assay Method for Palladium and Platinum

By H. D. Greenwood*

Palladium is a silver-white metal, much used for plating surgical and scientific instruments and in the dental trade as a substitute for gold and platinum. The dental trade uses over one-half the palladium produced. It is unaltered on exposure to hydrogen sulphide and, therefore, lends itself well to plating fine silver ware.

Palladium is now being recovered in small quantities by the copper refiners, and sold to the trade in the form of bar, powder and the oxide; the latter two find the greatest favor in the trade, as in these forms it can be crushed to about 80 mesh and accurately sampled. Owing to the small quantities of palladium for sale, it has been the custom to accept the weights and assays of the refiner, the returns merely showing a lump sum paid for a certain lot.

In comparing the methods of assay, it has been found that no two refineries use the same method and in nearly every case it is a recovery method rather than an analytical one. The following method which was tried out by two chemists, gave closely agreeing results. I believe it to be short and accurate, although there is nothing new or original about it. Criticism is cordially invited so that a start can be made toward establishing a standard method.

### Palladium

Weigh out eight portions of 0.500 gram each into 250-c.c. Jena beakers, dissolve in 10 c.c. concentrated $HNO_3$, 5 c.c. concentrated HCl and 5 c.c. $H_2O$, placing the beaker on the water bath; when action ceases transfer to hot plate, boil, dilute with $H_2O$ to 100 c.c., and filter. Should there be an insoluble residue, it probably contains palladium oxide. The insoluble residue should be filtered off and boiled with 3 c.c. formic acid and 5 c.c. $H_2O$, which will reduce oxides of palladium to metal, which can then be dissolved as above.

Expel all HCl by evaporating the filtrate with repeated additions of $HNO_3$, bringing the volume to about 100 c.c. Add 25 c.c. of a 10% solution of mercuric cyanide, boil slightly and allow to stand over night. Filter through an ashless paper, washing the precipitate well with a warm 1% solution of mercuric cyanide. Burn in a porcelain or silica crucible. The oxides formed on burning are reduced by boiling the burned residue with 50 c.c. of a 20% solution of formic acid, filtering on a tared gooch and weighing as palladium.

The oxides can be reduced in hydrogen gas, care being taken to remove the stream of hydrogen before taking away the flame so as to prevent the palladium from absorbing hydrogen.

One-quarter- and one-gram portions may be taken, but after a little experience, it will be found that ½ gram makes the best working portion.

### Platinum

Weigh out eight portions of 1 gram each into 250-c.c. Jena beakers, add 15 c.c. concentrated HCl, 10 c.c. concentrated $HNO_3$ and 5 c.c. $H_2O$; place on the water bath, after action has ceased, transfer to hot plate and expel all $HNO_3$ by repeated additions of HCl, evaporate to 40 c.c., dilute to 100 c.c. with water and filter off residue, if any. (See treatment of residue under "Palladium.") Evaporate the filtrate to 40 c.c., add 25 c.c. ethyl alcohol and 25 c.c. of a saturated solution of ammonia-chloride, stir well, bring to a boil and allow to stand over night in a cool place.

Filter the ammonium-platinic chloride through a weighed gooch, washing the precipitate with a 20% $NH_4Cl$ solution, dry, ignite and weigh as Pt. When the Pd contents is high (Pd 900 to Pt 5) the reprecipitation of the $(NH_4)_2PtCl_6$ is sometimes necessary, and where the percentage of Pt is low the various portions may be combined to make a workable and weighable quantity. The results should agree within two parts per thousand (0.20%) and splitting limits on the material should not be greater than 3 to 5 parts. Should copper be present it is separated from palladium by precipitating the latter as ammonium-palladic chloride, then dissolving and heating the precipitate as above. No copper salts are present in the palladium powder sold to the trade.

Note—The jewelry trade is also beginning to absorb large quanities of palladium in the manufacture of white gold (80% gold and 20% palladium). This alloy has the same color as platinum, but is harder, cheaper and wears better. The demand for palladium exceeds the supply.

*Chief chemist, U. S. Metals Refining Co., Chrome, N. J.

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## Suggestions on the Platinum-Palladium Assay

By A. M. Smoot*

Many of the errors in the platinum-palladium assay arise from the fact that the chlorides of these metals in aqueous solution are present at least partially as the hydrochlorplatinic and hydrochlorpalladic and -ous acids, that the ions are not entirely $Pt''''$, $Pd''''$ and $Cl'$, but $H'$ and $PtCl_6''$ and $PdCl_6''$. For instance, if the attempt be made to throw down the chlorine of these compounds with $AgNO_3$, the precipitate will carry a certain amount of the platinum metal, which is almost certainly not entrained, but present as $Ag_2PtCl_6$. The remembrance of this peculiarity of the platinum-group metals will often help greatly in their analysis.

Palladium can be separated from platinum by taking advantage of the easy reduction of the palladic compound. When the two metals are in *aqua regia* solution, evaporating to dryness several times with HCl, thus expelling all traces of nitrogen oxides, is sufficient to re-

*Ledoux & Co., 99 John St., New York.

duce the palladic to the palladous form. The platinum can then be precipitated as ammonium platinic chloride, as $(NH_4)_2PdCl_4$ is soluble in excess of ammonium chloride. A little nitric acid then converts the Pd″ to Pd″″, and in this state it can be precipitated as $(NH_4)_2PdCl_6$.

When in the higher state of valence, it is obvious that both platinum and palladium can be separated from copper as the chlor-salts, and later separated from each other.

There are considerable precautions to be taken in igniting such compounds as $(NH_4)_2PtCl_6$. They decompose very rapidly when the decomposition temperature is reached, and the great volume of gas disengaged is likely to carry off the heavy metal mechanically. With platinum it is decidedly preferable to redissolve the $(NH_4)_2PtCl_6$ in water, add sulphuric acid, pass in $H_2S$, filter off, and ignite the sulphide, which is a slow-roasting process.

However, if the hydrochlor-salts are ignited, char the filter paper at the lowest possible temperature, and afterward raise the heat just as slowly as possible.

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## The Determination of Nickel with Dimethylglyoxime

The use of dimethylglyoxime as a means of separating nickel and cobalt was given in a paper written by O. Brunck in 1907, who gave credit to Tschugaeff for suggesting dimethylglyoxime as a means of detecting the presence of nickel. When this method was proposed it had one fault, the high cost of the dimethylglyoxime, but recent experiments have shown that the method is of great value, and with its application now almost universal, has come a reduction in the cost of the reagent that places the new method at the command of anyone who wishes to use it. The general outline of the dimethylglyoxime method appears in the JOURNAL of Apr. 26, 1913, p. 857. An article upon some of the ramifications of this subject appeared in the *Metal Industry*, August, 1913, by Percy F. Brown, from which this abstract is taken.

Brunck calls attention to the fact that the nickel can be determined in either a dilute or strongly concentrated solution, and suggests the use of a 1% alchoholic solution of the dimethylglyoxime. A slight excess secures complete precipitation, but theoretically four parts of the reagent are required to precipitate one part of nickel. The nickel solution, which usually contains free acid, should be heated in a beaker nearly to boiling and the reagent added. Then ammonia is added drop by drop until the solution smells faintly of the ammonia. Filter through a gooch crucible, using suction.

For the separation of nickel from cobalt, according to Brunck's method, 0.5 gram of the sample is dissolved in HCl, or if a salt, it is dissolved in water, and the solution evaporated nearly to dryness. After diluting to 400 c.c., with water, add 0.2 gram of dimethylglyoxime, 2 grams of sodium acetate. Filter after allowing to stand one-half hour. Nickel and manganese may be separated by using sodium acetate to neutralize the acid instead of ammonia. For separating nickel and zinc, either ammonia or acetic acid may be used, but the latter is preferable. For separating nickel and iron, to the solution containing iron, in the ferric state, tartaric acid is added before precipitation, to prevent the subsequent formation of ferric hydroxide on adding ammonia. The method for separating nickel and aluminum is similar to that used for nickel and iron.

Tartaric acid is added to prevent the precipitation of chromium by the ammonia, but it is also necessary to have a sufficient amount of ammonium chloride present when the separation of nickel and chromium is attempted.

The use of a-benzildioxime was suggested by Frederick W. Apack in *Chem. Trades Journ.*, June 14, 1913, reprinted in the JOURNAL, July 12, 1913. The reagent is said to be quite as delicate as the dimethylglyoxime, and has the additional advantage that coloration is produced, even with small traces of nickel, much more quickly than with the dimethylglyoxime. This reagent is said to give a much more insoluble precipitate than with the dimethylglyoxime.

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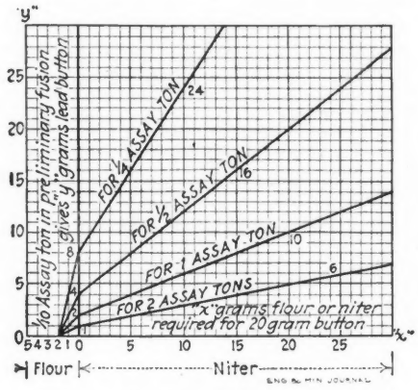
## Quick Calculation of Assay Charges

BY R. E. CHASE, JR.*

After weighing the lead button from a preliminary fusion, an assayer will generally perform a mental calculation to arrive at the quantity of reducing or oxidizing agent required in the regular fusion. The busy assayer working on miscellaneous sulphide ores, making a number of preliminary fusions at a time, will find the accompanying diagram of considerable convenience. It should be posted in the balance case or on the wall nearby. He can then read off his flour or niter charges directly and check himself back and forth half a dozen times in less time than it would ordinarily take him to make one mental computation.




HANDY DIAGRAM FOR ASSAYERS

The Y axis gives grams of lead button obtained when $^1/_{10}$ assay ton of ore was used in the preliminary fusion. Grams of flour and niter required to produce a 20-gram button in the regular fusion are read off on the left and right of the zero point on the X axis.

Curves are drawn for regular fusions, using ¼, ½, 1 and 2 assay tons of ore respectively. It is assumed that the flour has a reducing power of 10, and the niter an oxidizing power of four. For example, suppose that $^1/_{10}$ a.t. of ore in the preliminary fusion reduces four grams of lead. Reading along on the fourth horizontal line from the bottom, we find that for a regular fusion of ¼ a.t., one gram of flour will be required to reduce a 20-gram button. A ½-a.t. charge, however, would run "straight" (no flour or niter). Charges of 1 to 2 a.t. would require respectively 5 and 15 grams of niter.

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# Contract Systems in Michigan Copper Mines

HOUGHTON CORRESPONDENCE

*SYNOPSIS—Contract systems strictly are not binding, but they afford an incentive for increasing output per man by paying bonus for all work done over a stipulated amount, yet no man falling behind his contract fails to receive a living wage. Difficulties of making fair contracts to company and miner or tram-men are discussed. Scientific management applied as a measure of contract work.*

Although the strike of the Michigan copper miners was undoubtedly agitated and called as part of the regular propaganda of organized labor, still the claim has been made that the reason for the apparent ease with which the Western Federation converted an entire and seemingly satisfied community to its ranks must be laid at the door of the cry for efficiency which for the last three years has been so loudly heard in the Copper Country. There is, of course, some justice in this claim; for leaving aside the undoubted benefits derived by the miners in the way of larger pay checks as the result of scientific innovations, the fact remains that the introduction of new contract, bonus and piece-work systems are always regarded with suspicion; that at first they benefit only the few; and that while these few probably see the advantages of such systems, still the rank and file is apt to be disgruntled; and this large number of somewhat disgruntled men, regarding their companies with suspicion, perhaps made fertile soil for the agitator from the union camps to cultivate. That the managers saw what effect such innovations would have on the men, there is every reason to believe, but they either misjudged the activity of the agitators, or discovered it too late, or else they decided that the changes must be made at all costs, come what may.

There are several distinct reasons why a definite, binding contract system cannot be applied to underground operations in the Copper Country. They are, first, one party in the contract, the laborer, is unable financially to enter into any arrangement as to pay, which would be binding, if he fell behind on the contract. In the Michigan copper country the large majority of laborers and miners have little money saved, a fact which the union agitators have emphasized strongly. To fall behind, therefore, on their contract, would mean hardship. That this state of affairs is recognized by the companies is evident from the fact that today nowhere in the Copper Country does a so called contract miner go home pay-day with less than a living wage, no matter if according to his contract, he has earned but half the amount.

Second, the nature of the underground operations is such as to render it impossible to fix a rigid contract price. In mining, the character of the ground is almost always variable. A given price per foot or fathom may be satisfactory for a few months, but the time comes when the miner is drilling in hard ground or coppery ground. Nobody knows how long this hard stretch of ground will last, and the miner must be assured of a living wage in the meantime. The company also must protect itself when the miner runs into soft ground. So there is need of some factor in the contract that can be juggled when the character of the ground varies. Contract tramming is still in the experimental stage in the Michigan copper mines. Although it has been tried on certain levels of a few of the mines, no one mine is as yet doing even half of its tramming on contract. The method of mining is such that the trammer does not always have a "good chance." Two Water-Leyner drills in a 9x6-ft. drift will break on an average about 11 tons per shift. This is about half a shift's work for a party of two trammers. But the miners are in the habit of blasting, say nine cut-in holes, breaking perhaps six or seven tons, leaving a couple of the squaring holes for the next shift to fire when they have squared. The squaring holes break 15 or 16 tons. So the amount of ore in the drift usually varies, and one day the trammers have less than half a shift's work and the next perhaps more than half, but less than a full shift's work. When they are not tramming from the drift they will probably be sent to run ore from a chute. At this latter operation they should make from 15 to 35 tons per man per shift of 10 hours. So the "chance" which these trammers have varies from day to day, and is entirely beyond their control. Depending directly upon the number of holes drilled each shift by the miners, and on the "chance" to "run" a mill. The trammers who tram from chutes alone can make a consistent showing only when plenty of dirt is on hand to be taken from the chute every day. When such is the case a fair contract can be fixed. To equalize the "chance" and enable the captains to make a fixed tramming rate, certain Calumet & Hecla mines are making the experiment of shifting the trammers about from time to time, sending them first to one level and then another.

Third, the method of mining is often such that an incentive for the man to work fast and perhaps carelessly at some particular operation is detrimental to the effectiveness of the method as a whole. In a mine where stopes are worked on shrinkage, it is of importance that the broken copper rock be kept close up to the back to afford the miners a good chance to rig their machine and also, as in the case in some of the mines south of Portage Lake, to assure support for a bad hanging wall. A party of trammers on contract tramming from a chute under a stope in which miners are expected to work must not therefore "run" the chute, even if they have a good chance to make something on their contract by so doing. Similarly, a mine in which careful selecting of stoping ground and close picking of the broken rock are being done cannot very well put the stope miners or the pickers on contract. If this were done miners would want to bundle ahead with a big breast and would not try to avoid poor bars of ground. And the pickers would send up poor rock which should be discarded and left in the mine for fill.

## CONTRACTORS NEVER RECEIVE LESS THAN A LIVING WAGE

To overcome these various objections, every contract for sinking, drifting, stoping or tramming in the Copper Country mines has some factor in it which can be juggled. And the pay the contractor gets represents not what he has actually made according to the terms of his contract, but rather it represents a living wage plus

an arbitrary bonus for the extra effort the contractor has put forth. But he never receives less than a living wage.

The tendency of late in some of the Calumet & Hecla mines has been to try to get down to a hard and fast contract system. In the early days supplies all had fictitious values; a box of powder for instance might cost as much as $30. Maps and records were not kept as accurately then as now, the mining captain and not the superintendent handled the contracts, and the variable factor in the contract was the elasticity of the captain's tape on measuring-up day. The late Captain Pollard of the Wolverine mine, where a so called contract system for stoping has been in vogue for many years, and successfully, invariably used his right forearm for all stope and drift measurements when he was afraid the miners had fallen behind on their contract or had made too much on it. In shaft sinking when the miners fell behind their contract for some reason beyond their control, they were usually given a bonus or extra for cutting plat or for helping the timbermen. Today, however, the tendency is to get away from these subterfuges and try to put things on a more definite basis.

### Scientific Management Tests

Several innovations in contract drifting were tried at the Superior mine some two years ago when it was necessary to do many thousand feet of development. This was at the time when the one-man machine was being introduced in the mines of Michigan. Accurate time records after the type described by F. W. Taylor in his books on scientific management were made on the drift miners. They were given a contract price with the understanding that it would not be cut. The form of contract was simple; it consisted merely in a given price per foot of small drift. The miners were not charged for any supplies. They were given all spare parts necessary, shovels, monkey-wrenches, oil, etc., the only limitation put upon them at all was in the matter of powder. Records of drifting when the miners had to pay an exorbitant price for a box of powder showed that good drifting could be done at that mine using only 8 lb. of 40% powder per foot of drift. So a penalty of 10c. per lb. was made which would be deducted from the contract price for every pound of powder over 10 that the miners used per foot of drift. That is, if the price according to contract was $1.80 per ft., if the miners used 11 lb. of powder per ft. in driving the drift, the contract price would be cut to $1.70 per ft. On the other hand no allowance was made to the miners for any great saving of powder. If they only used 6 lb. per ft. of drift the contract price remained the same. This proved a satisfactory system; but contract prices did finally have to be cut or boosted as the ground varied, and it was found necessary to raise the contract price and charge the miners cost for powder and for other supplies such as fuse, caps, wrenches and oil. Such a contract is what one finds generally in the Copper Country today. It is not, of course, any more binding than any of the contract schemes that have gone before it. At best it is merely a method of letting the miner understand that he will be paid for extra effort, and all the innovations made are schemes to measure that extra effort.

A contract system was worked out at one of the Calumet & Hecla subsidiary mines for stoping, which seems to have been successful. The miners work 24 shifts per month, or 48 shifts for the party, day and night. For the 48 shifts the company account rate is $3.25 per shift or the monthly wage is $78. For this pay they are supposed to break, using one Water-Leyner machine, 900 tons of rock per month. This is "company account" work. It amounts to 18¾ tons of rock broken per shift at a cost of 17⅓c. per ton. For every ton above 900 the miners get 10c. For instance, if the tramming record shows that the party has broken 1000 tons, or 100 tons more than company account standard, the miners get $10 extra pay or $5 per man. Thus these extra tons of rock cost the company 10c. each as against the company-account rate of 17⅓c. per ton. This is entirely fair, for the miners have the understanding that they will always receive at least $78. Supplies are not charged to the miners unless they exceed 7 or 8c. per ton. If the miner has used up 9c. worth of supplies per ton of rock broken he must pay the extra cent. If he has used up 10c. worth of supplies the captain has the right to pay him company account, $78, or possibly contract pay less 1c. per ton. Here again no allowance is made to the miner if his supply cost runs below 7c. per ton.

At the mines controlled by the Copper Range Consolidated Co., no attempt is made to set a definite contract price for the drifting. The vein varies greatly in width and as the miners must drift as wide as the copper goes there would be difficulty setting a rate either per foot or per ton. There is close supervision of all the operations in these mines whether the work is done on a company account or so called contract and from years of experience the drifters and other contract miners learned that extra effort on their part will mean extra pay, and, as in most of the mines in this district, the miner need never worry about going home with less than a living wage.

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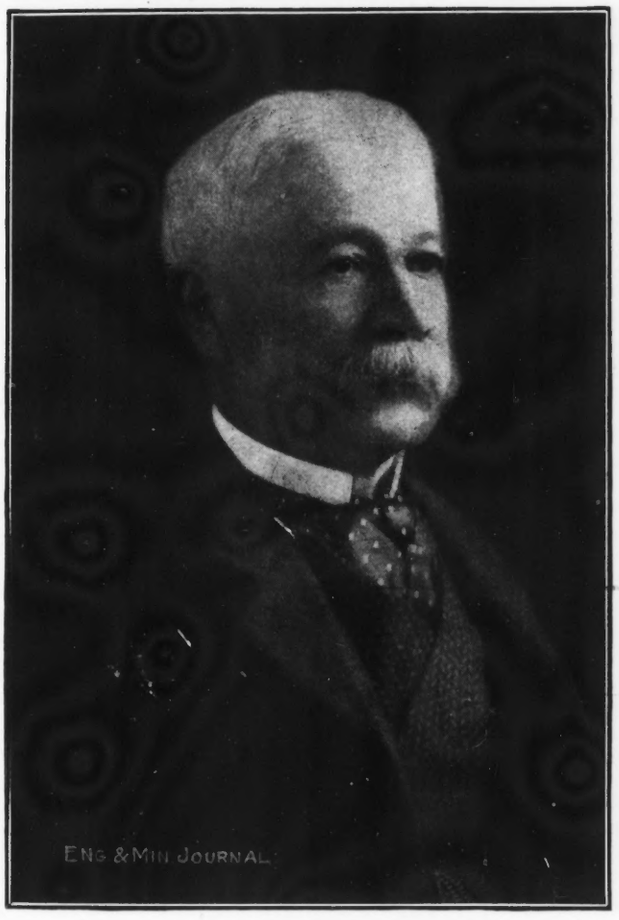
## Major R. G. Leckie

By H. Mortimer Lamb*

As briefly announced in a recent issue of the Engineering and Mining Journal, Major Robert Gilmour Leckie, who may almost be described as the father of mining engineering in Canada, died at Sudbury, Ont., Nov. 5 last, in the 81st year of his age. Major Leckie was born in Renfrewshire, Scotland, Aug. 23, 1833. He came of fine old stock, being the representative of the ancient Stirlingshire family of Leckie of that Ilk. He was educated at the Glasgow High School and Glasgow Technical College. He went to Montreal at the age of 23, and for a time was associated there with a ship-building enterprise. Very shortly thereafter, however, he became interested in mining, first in the eastern townships of Quebec, and later in Nova Scotia. In the eastern townships he was associated with early copper-mining efforts, and also held an interest in nickel properties in the township of Orford, which were acquired subsequently by Boston capitalists, headed by W. E. C. Eustis, who organized a company first known as the Orford Nickel Co., then as the Orford Nickel & Copper Co., and finally as the Orford Copper Co., which again, after a lapse of time, was merged in the International Nickel Co. Major Leckie was for some time managing director of the Orford Nickel Co. In Nova Scotia he was associated

*Secretary Canadian Mining Institute.

with numerous coal and gold-mining enterprises, and about the year 1880, was responsible, in association with the late William Hedley, of Halifax, and Senator Senecal, of Montreal, for the consolidation of the coal companies operating in the neighborhood of Springhill, in Cumberland County, with the Springhill & Parrsborough Ry. Co., thus forming the Cumberland Ry. & Coal Co., of which he became managing director. Under his direction, this undertaking from modest beginnings presently grew to great importance, attaining an output of 500,000 tons of coal per annum. Again, during Major Leckie's régime at Springhill, the Provincial Workmen's Association—or coal miners' union—was organized in Nova Scotia, but, it is interesting to note, that although after




MAJOR J. G. LECKIE

his retirement there were at Springhill something like 23 strikes within a period of 21 years, no strike took place during his term of management, which was characterized by moderation combined with firmness. In 1890, Major Leckie became general manager of the Londonderry Iron Co., a post he held for three years. At this time he was also successful in consolidating the numerous smaller coal undertakings in Cumberland County, including the Joggins Mining Co. and the Milner, while the Joggins Ry. was also taken in, under the title of the Canada Coal & Ry. Co., now operating as the Maritime Coal, Power & Ry. Co. Before his departure from Nova Scotia in 1898, Major Leckie acquired the Torbrook iron mines, which he worked until they were purchased by the Messrs. Drummond, of Montreal. After leaving Torbrook, he acted in the capacity of examining engineer for Col. Robt. M. Thompson, of New York, and in this connection reported on nickel and other mines in New Caledonia, Norway, Sweden and Australia. He was also for many years consulting engineer at Sudbury for the Canadian Copper Co. Since his retirement from consulting practice his activities have been employed in acquiring and partially developing promising prospects in northern Ontario. Of these, at least one, a gold property at Long Lake, near Sudbury, has been placed on a productive basis, and having been acquired, is now being worked by the Canadian Exploration Co. with success.

This, then, is a brief outline of a long and honorable professional career. It merely suggests the energy and enterprise of him who is the subject of this sketch. But Major Leckie's activities and interests were not bounded by the limitations of his profession. He was public spirited to an eminent degree. He, in coöperation with Charles Fergie and John E. Hardman, was chiefly responsible for the organization of the Mining Society of Nova Scotia. He was the first president of the Federated Canadian Mining Institute, and a charter member of the Canadian Mining Institute, which was, as is well known, a reorganization of the former society. He joined the American Institute of Mining Engineers in 1879, and was a vice-president of that society in 1893-94. He took a great interest in military affairs, and during the Fenian Raid held a commission as lieutenant in a rifle company raised in the eastern townships at that time. In 1882 he was gazetted major in the 53d Battalion, with which regiment he remained for several years. He was an ardent Imperialist, a stalwart Conservative in politics, and a member of the Church of England. Last, but far from least, he was a sportsman to the core. Sport of every description, racing, hunting, fishing, cricket, curling, all held for him the greatest attraction, and he believed always "in playing the game." Only once in 20 years has he failed to be present at the annual meetings of the Canadian Mining Institute. Of these meetings, and more especially of "after-meetings," he was the life and soul, and despite his years, ever the youngest man there. He will be sorely missed, for as one of his oldest friends has just written to me: "Leckie's passing over to the majority leaves the world a less happy place for all his friends; but we are sure he will be waiting for us on the other side with a smile and a hearty handclasp."

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## Refining Copper with Cuprous Electrolytes

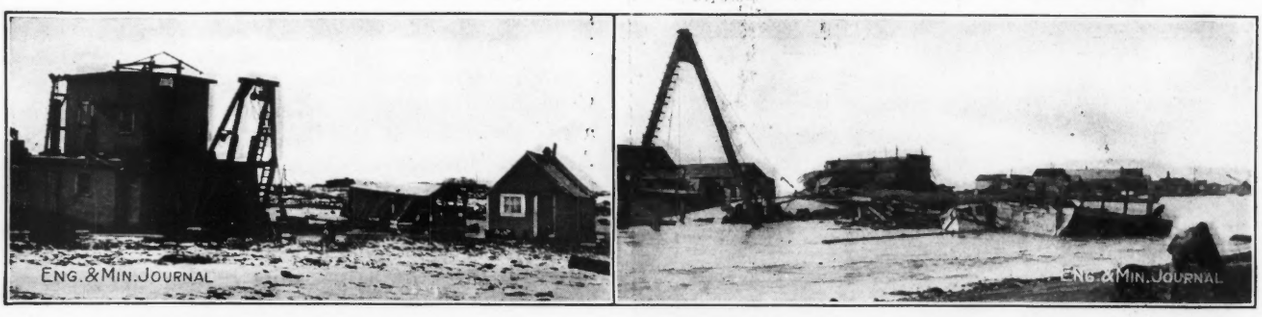
It has long been recognized that were it possible to use cuprous salts to make the baths in copper refineries, the power consumption would be reduced 50%. Such an electrolyte is claimed by George D. van Arsdale, of East Orange, N. J., to be composed of cuprous-ammonium sulphite (U. S. pat. 1,069,305).

This cuprous-ammonium sulphite is made by making a copper-sulphate solution strongly ammonical, and then impregnating with sulphur dioxide, or by reducing with such reagents as phosphorous acid. This would apparently get around the insolubility of most cuprous salts, and by keeping an excess of $SO_2$ present, the reversion to cupric form could be prevented.

# PHOTOGRAPHS FROM THE FIELD


A Storm Practically Destroyed Nome, Alaska, Oct. 6, Wrecking 500 Buildings

The damage has been estimated at $1,500,000. The town of Soloman was destroyed by the same storm




The Waterfront after the Storm, the Severest Ever Recorded at Nome

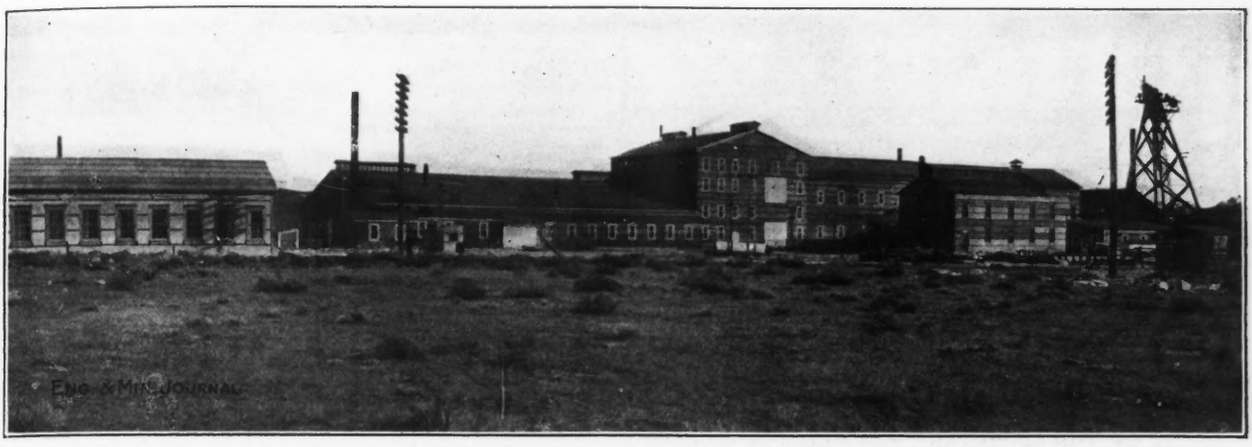
After a dry summer the storm was a climax to a discouraging season, production having been about half of normal.


The Main Streets of Nome after the Storm Had Passed

The Nome miners have petitioned Congress for a suspension of 1913 assessment work; many lost their homes and their mining outfits.


One of the Wrecked Buildings and Pontoon Bridge across Snake River at Nome

Four were killed in the storm. The steamers "Corwin" and "Victoria" managed to reach open sea and escaped damage.

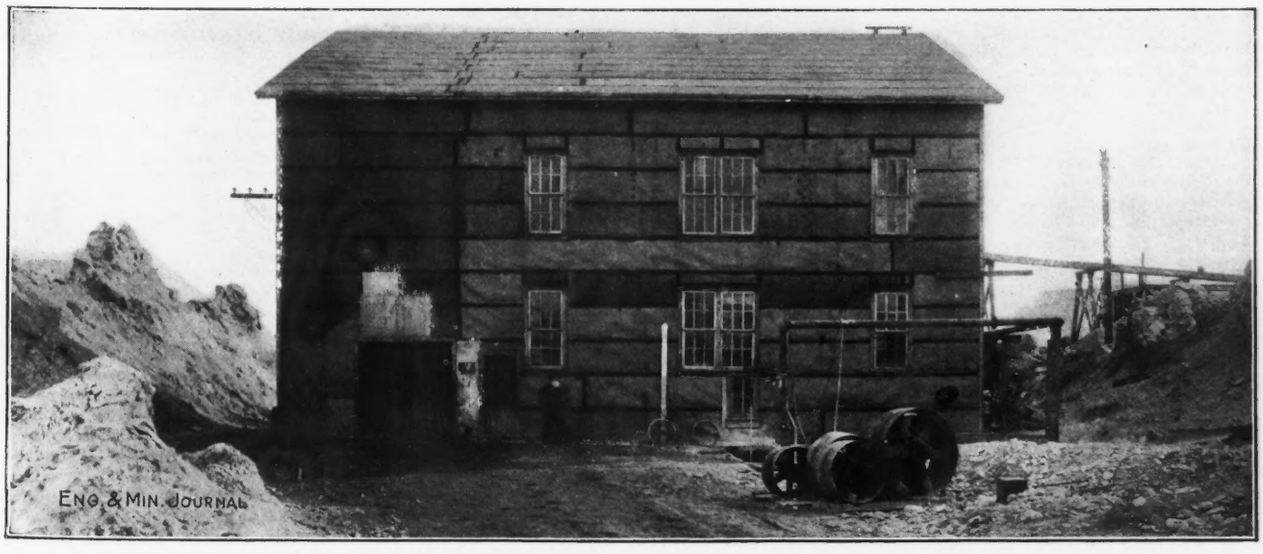



PLANT AT ANACONDA, WHERE CHARLES S. BRADLEY EXPERIMENTED IN LEACHING COPPER ORES

A leaching process for copper ores is being sought by metallurgists in most of the principal copper-producing regions.


THE ANACONDA COMPANY'S EXPERIMENTAL LEACHING PLANT FOR COPPER ORES

This plant is reckoned as being of 80 tons daily capacity.




PECK EXPERIMENTAL CENTRIFUGAL CONCENTRATOR FOR COPPER SLIMES, AT ANACONDA

Another Anaconda plant where a process for the recovery of fine copper minerals is being developed.

# NEW PUBLICATIONS

HANDBUCH DER MINERALCHEMIE. Edited by C. Doelter. Vol. II, Part 4. 7x10, pp. 159, paper; 6.50 marks. Theodor Steinkopff, Dresden, Germany.

ANNOTATED BIBLIOGRAPHY OF IOWA GEOLOGY AND MINING. By Charles Keyes. 8x10½, pp. 908. Vol. XXII, Iowa Geological Survey, Des Moines.

THE SAN FRANCISCAN VOLCANIC FIELD, ARIZONA. By Henry Hollister Robinson. Pp. 215, illus. Professional Paper 76, U. S. Geological Survey, Washington, D. C.

LA IRRIGACION DEL VALLE DE ICA. By C. W. Sutton. Boletin del Cuerpo de Ingenieros de Minas del Peru, No. 79. 7x9¾, pp. 198, illus., paper. Ministerio de Fomento, Lima, Peru.

MINING AND TREATMENT OF FELDSPAR AND KAOLIN IN THE SOUTHERN APPALACHIAN REGION. By A. S. Watts. Pp. 170, illus. Bull. 53, U. S. Bureau of Mines, Washington, D. C.

REPORT OF THE SECRETARY FOR MINES OF TASMANIA FOR YEAR ENDING DECEMBER 31, 1912. 5½x8¾, pp. 155, illus., paper. W. H. Wallace, Secretary for Mines, Hobart, Tasmania.

PORTIONS OF ATLIN DISTRICT, BRITISH COLUMBIA: With Special Reference to Lode Mining. By D. D. Cairnes. Pp. 130, illus. Memoir 37, Canada Dept. of Mines, Geological Survey Branch, Ottawa.

SUMMARY REPORT OF THE MINES BRANCH OF THE DEPARTMENT OF MINES FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1912. Pp. 175, illus. Louis Coderre, Minister of Mines, Ottawa.

THE MINING AND QUARRY INDUSTRY OF NEW YORK STATE. Report of Operations and Production during 1912. By D. H. Newland, 5¾x9, pp. 114, paper. Bull. 166, N. Y. State Museum, Albany.

CYANIDATION IN THE MERCUR DISTRICT OF UTAH. By L. O. Howard. With introductory chapter by Don Maguire. 7x10¼, pp. 64, illus., paper; 50c. Reprinted from "Salt Lake Mining Review," October, 1913.

OFFICIAL YEAR BOOK OF THE COMMONWEALTH OF AUSTRALIA FOR 1901-1912. No. 6, 1913. By G. H. Knibbs, Commonwealth Statistician, 6¼x9¾, pp. 1226, illus., board. Commonwealth Bureau of Census and Statistics, Melbourne, Australia.

THE GEOLOGY OF THE HUDSON RIVER AND ITS RELATION TO BRIDGES AND TUNNELS. By George F. Kunz, Reprinted from Appendix B of the Eighteenth Annual Report of the American Scenic and Historic Preservation Society, 1913. 5¾x9, pp. 454. J. B. Lyon Co., Albany, N. Y.

REPORT ON CONDITIONS OF EMPLOYMENT IN THE IRON AND STEEL INDUSTRY IN THE UNITED STATES. Vol. III: Working Conditions and the Relations of Employers and Employees: Vol. IV: Accidents and Accident Prevention. Pp. 594 plus 350, illus. Prepared under the direction of Charles P. Neill, Commissioner of Labor, Washington, D. C.

ANALYSES OF COALS IN THE UNITED STATES. With Descriptions of Mine and Field Samples Collected Between July 1, 1904, and June 30, 1910. By N. W. Lord, with chapters by J. A. Holmes, F. M. Stanton, A. C. Fieldner and Samuel Sanford. Part I—Analyses; Part II—Descriptions of Samples. Pp. 1199. Bull. 22, U. S. Bureau of Mines, Washington, D. C.

CYANIDE PRACTICE, 1910 TO 1913. Edited by M. W. von Bernewitz. 6x9, pp. 732, illus.; $3. Mining and Scientific Press, San Francisco, Calif.

A collection of articles on cyanide practice in general and in detail, which have been published in the "Mining and Scientific Press", between 1910 and 1913. It is the third book of its kind to be published.

CONVERSION TABLES OF FOREIGN WEIGHTS, MEASURES AND MONEYS. By John J. Macfarlane. 6x9, pp. 62, paper; 50c. Foreign Trade Bureau, Philadelphia Commercial Museum, Philadelphia.

This set of table is the best we have seen in its particular field. It gives the American equivalents of foreign weights, measures and moneys and vice versa.

AMERICAN RAILROAD ECONOMICS. By A. M. Sakolski. Pp. 295; $1.25. The Macmillan Co., New York.

A sound and concise presentation of a complicated subject, which ought to be studied by legislators who contemplate engaging in railway legislation. Also a useful and interesting book for people in general.

THE GYPSUM AND SALT OF OKLAHOMA. By L. C. Snider. 6x9¼, pp. 214, illus. Bull. 11, Oklahoma Geological Survey, Norman.

Contents: General consideration of gypsum; the manufacture of gypsum products; gypsum products and their uses; geology of the gypsum-bearing area of Oklahoma; nature, occurrence and development of the gypsum of Oklahoma; and the salt resources of Oklahoma.

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES. 7¼x10, pp. 1666, cloth; $10. S. E. Hendricks Co., New York.

The twenty-second annual edition of this directory has been revised and enlarged and now contains about 437 pages of new matter. Its aim is to furnish complete classified lists of manufacturers in the various industries and trades, including mining, for the benefit of both buyers and sellers. A complete and simplified index adds to the value of the work as a reference book.

THE IRON ORES OF MISSOURI. By G. W. Crane, 6½x10, cloth; pp. 434, illus. H. A. Buehler, State Geologist, Rolla, Mo.

Contents: History, development and production of Missouri iron ores; the ores of iron, factors controlling their value; physiography of the iron-bearing region; geology; brown ores; the hematites of the filled sinks; specular hematite in porphyry; iron ores of the Carboniferous and Silurian; descriptions of known deposits of iron ore; table of analyses, indexes.

GOLD DREDGING. By T. C. Earl. 5½x9, pp. 208, illus.; 20s. E. & F. N. Spon, Ltd., London, Eng.

This is an interesting little book by a man who has evidently had some experience in the subject whereof he writes. It is not exhaustive and does not go deeply into the engineering features, but it is not in any way an undigested compilation of articles from the magazines and newspapers. Its illustrations comprise a very interesting collection of photographs from many out of the way places, and there are a lot of good statistical tables. It is a book that is worth the while of those who are interested in its subject.

OUTLINES OF MINERALOGY. By Grenville A. J. Cole. 5x7½, pp. 339, illus.; $1.60. Longmans, Green & Co., London, Eng.

This is the latest addition to the already long list of mineralogies. The author is professor of geology in the Royal College of Science for Ireland. His idea in this book was to treat minerals as constituents of the earth, and it is thus intended primarily for geologists. It is strong in its presentation of the physical properties of minerals and is sketchy on the purely descriptive side. We note with interest and approval that the author has relinquished the name "calamine" to the metallurgists to whom it belonged originally, and calls the carbonate of zinc "smithsonite" and the hydrous silicate "hemimorphite" as proposed by Ingalls 15 years ago. If all mineralogists had been so rational some costly litigation might have been avoided.

GEOLOGISCHE DIFFUSIONEN. By Raphael Ed. Liesegang. 6¼x9¼, pp. 180, illus., paper, 5 marks; cloth, 6 marks. Theodor Steinkopf, Dresden and Leipzig.

The special study of colloids has now developed to such a degree that the author finds not a few points in which its results are of importance in geology. Artificial colloids such as gelatin and albumen have furnished the materials for interesting and important experiments. Pigments, for example, such as silver salts when precipitated under the proper conditions afford a so called "rhythmic" pattern of concentric colored bands not unlike Newtons rings. They remind one strongly of agates, whose possible deviation from gelatinous silica will at once come to mind; of concentric patterns produced in weathering and to a small degree of bonded veins. The author attacks all these and a number of other geologic matters, and endeavors by his experiments with colloids to throw light upon them. The experiments are significant and well merit the attention of geologists who are interested in these and related phenomena.

GOLD, PRICES AND WAGES. By J. A. Hobson. Pp. 181, illus. $1.25. Methuen & Co., Ltd., London; George H. Doran Co., New York.

This book is largely an examination of the quantity theory of money, and we may say at once is a rejection of it, at least in the form commonly held and expounded, but of course not, as the author says, of the "sense in which the so called quantity theory is a simple, self-evident proposition," which admits no question, requires no exposition, and neither raises nor solves any problem. Mr. Hobson in a preface of six pages concisely summarizes his arguments, with the unique idea that "busy readers may make up their minds, before starting, whether it is worth while to follow his line of reasoning."

We can assure every one interested in the subject that it is worth while, Mr. Hobson's reasoning and arguments being clear and scholarly, and of a character that the exponents of the quantity theory will find it hard to controvert. In other words, Mr. Hobson does not attribute increasing prices for commodities to the increase in gold production, but assigns other reasons, which is the side of the question that we have taken since many years. The British and French economists lean this way more than do the American. Mr. Hobson illuminates not only this but also some of the other great economic problems of the day that are closely associated with it. In many respects his ideas are ingenious and novel.

# CORRESPONDENCE AND DISCUSSION

## The Parral Agitator

In the JOURNAL of Nov. 29, 1913, there appeared under the heading "Argo Mill, Idaho Springs, Colo.," an article by J. V. N. Dorr in which the flow-sheet of the mill is described. The following reference made in this article to the Parral tank I consider misleading:

> The underflow from Dorr A goes to the first agitator, which is a 20x12-ft. Dorr machine and not a Card table No. 1, as shown. The other agitator is a Parral which is causing a lot of trouble on account of the continual building up of the solids. The overflow from the Parral passes to Dorr No. 1 (thickener).

That the readers of the JOURNAL may be informed about the above statement I will submit what the manager of the mill writes concerning the operation of the Parral tank in this mill. And, by way of preface, I wish to give certain facts that will explain the conditions.

The apparatus of the Parral tank in question was sold the Argo Reduction & Ore Purchasing Co. for its mill by the Denver Engineering Works. The apparatus was of the general design made for the agitation of the slime pulp of ordinary quartzose ores after concentration. I was, at that time, in a district in Mexico between which and the United States mail communication had been severed since last March, and in consequence I had been out of touch with the installation of the tank or its operation until my return to the United States early in the fall. On Sept. 28 last, I opened communication with Arthur A. Roller, manager of the mill, inquiring about the service of the tank. To my letter Mr. Roller very frankly replied under date of Oct. 21, as follows:

> Your favor of Sept. 28th at hand. One 12x20 Parral tank has been in operation now for about six months. It is working on a continuous-agitation basis, 20-lb. air pressure, tube-mill product showing a screen analysis as follows:

| | Per Cent. |
|---|---|
| On 100 mesh | 3.97 |
| On 150 mesh | 9.10 |
| On 200 mesh | 11.43 |
| Through 200 mesh | 75.14 |
| Total | 99.64 |

> We had no trouble in keeping the tank going and after shut downs of 8 to 12 hr. with the air off have started within a couple of hours. But the tank has been gradually filling up with packed slime at points between the four 8-in. air lifts. * * * * I forgot to state that we are treating a heavily mineralized ore, one which concentrates five tons into one, and although we concentrate out considerable of the mineral ahead of the agitators, the slime pulp still contains lots of mineral.

Though the tank had been treating heavily mineralized slime for six months and after various shutdowns from 8 to 12 hr. was "gradually filling up at points between the four 8-in. air pipes" is not so bad. Here is an extract of a letter which I happen to have at hand from James I. Long, manager of the Pamilla Mill, at Parral.

> We have had, as you know, a great deal of trouble with agitation in those tanks that used the rubber sleeves originally provided with them. The sleeves soon became slack and allowed the compressed-air pipe to fill with the fine sand which caused no end of trouble, and, as we had no trouble with your valves under trial we ordered a complete outfit of them to replace the rubber sleeves, and since that time all troubles with the agitation in the Parral tanks have been eliminated.

But had the tank and the Parral apparatus installed in it at the Argo mill been designed for the heavily mineralized pulp which the mill, as a custom plant, is called upon to treat, there would have been no filling up.

BERNARD MACDONALD.

South Pasadena, Calif., Dec. 5, 1913.

⁂

## Economical Fine Grinding in Pans

In an article on this subject by M. G. F. Söhnlein, the author describes some recent experiments in fine grinding with pans as a substitute for tube mills. He states that while his 5-ft. pan working under the conditions required when used as an amalgamating device, had a grinding capacity of only 2½ tons per 24 hr. ground to +150 mesh, by providing it with a forced central-feeding arrangement he was enabled to increase the grinding capacity of the pan to 30 tons per 24 hr. ground to −200 mesh at a cost of about 30c. per ton. He proves, I infer, that so far as installation and operating costs are concerned, the grinding pan is much cheaper and better as

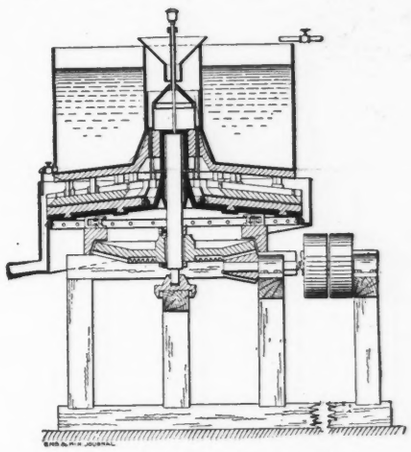
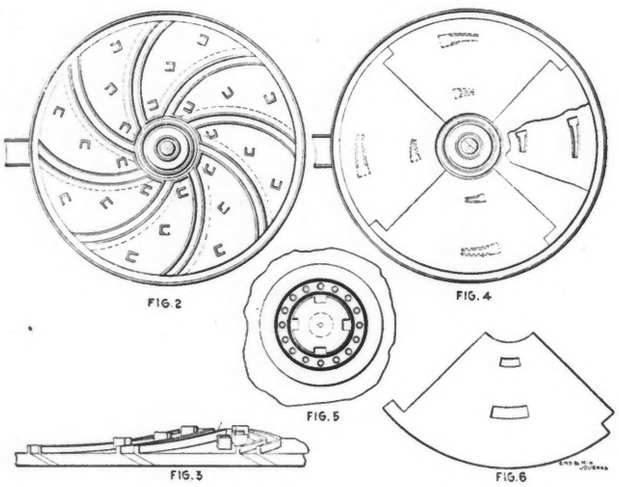


FIG. 1. FINE-GRINDING PAN

a fine-comminuting machine than the tube mill, provided the iron wear of shoes and dies of pan does not interfere with subsequent treatment.

Being, perhaps, as vitally interested in the subject of pan or muller-grinding devices as any one, I feel it incumbent on me, since reading Mr. Söhnlein's description and seeing the drawing of his forced central-feeding device to state that in the spring of 1880, while superintendent of the pan-amalgamating mill of the Silver Cliff Mining Co., at Silver Cliff, Colo., I experimented with a central-feed arrangement, almost identical with the one shown and described by Mr. Söhnlein, and succeeded in increasing the grinding capacity of a 4½-ft. cone-bottomed pan, grinding from 30-mesh screen, pulp to pass 100 mesh, from an estimated hourly capacity of ½ ton to approximately 10 tons per hr., or a capacity equal to that of the whole 20 pans in the mill under the old feed conditions.

The only respect in which my feed arrangement differed from that of Mr. Söhnlein was that I closed the outer ends of the channels between the shoes so that no particles of pulp could be thrown out by centrifugal force before being ground by shoe and die. My method of operating both feed and discharge was altogether different from that used by Mr. Söhnlein. I completely closed every space in the muller spider and shoe-ring so that all the pulp had to pass between the shoe and die to the periphery of the grinding surface, and discharge thence downward to the mercury channels in bottom of pan and out through the plug-hole into an idle settler. From this point it was shoveled, after being partially dewatered, into another pan for amalgamation. The sides of the pan were not used at all in the grinding operation, for the objects were not only a positive, direct feed but an equally positive, unobstructed discharge of ground material, the latter an impossibility where the overflow-discharge idea is used. Furthermore, instead of grinding a pulp consisting of 48% solids, my pulp probably contained less than 15% solids, as I used all the water that would pass through between the shoe and die while grinding, in order to flush out all the ground pulp as rapidly as possible. I also loaded the muller with 1500 lb. weight of old shoes and dies because the ordinary pan muller is




DETAILS OF PAN CONSTRUCTION

altogether too light to be successfully used as a pulverizing device, no matter how the pulp feed and discharge may be arranged. The muller speed was reduced from 70 to 40 r.p.m. on this particular pan.

The results of my experiment were favorable in one respect and disappointing in another, for while the increase in the pulverizing capacity exceeded my expectations many fold, we were no better off so far as our extraction was concerned, for we then discovered that 20% of the silver was held in a complex mineral, and the ore was too low in grade to bear the expense of a chloridizing roast to render the silver amalgamable.

To this day I have no very definite knowledge of the power expended in driving the muller with its extra weight during the experiment, having then had no further concern in that regard than to wonder if, after reducing the speed and more than doubling the weight of the muller, an 8-in. belt traveling about 600 ft. per min. and driving a gear train having a ratio of 1:4, would turn the muller when grinding the sands, but as the belt did the work without a slip, I am quite certain that it could not transmit more than 10 hp. under the conditions.

At that time the pulverization of ores to a greater degree of fineness than 40 mesh was confined to a few silver-amalgamating mills in this and foreign countries and half a dozen gold mills in Gilpin and Clear Creek Counties, Colo., consequently my muller grinding device was of no value to me except as a distant future possibility.

When fine grinding in mill practice had gained such headway, I applied for a U. S. patent completely covering the central pulp-feed and direct-discharge ideas as applied to muller grinding, and on Dec. 7, 1909, U. S. patent No. 942,424 was granted me. The accompanying illustrations will show that, while I have taken the pan muller as my basic idea for grinding, I have evolved from it a grinding mill which, except as to arrangement of driving gear, has not a feature in common with a pan of any description whatsoever, being both in design and in action as distinct a departure from any kind or style of grinding pan as is possible to conceive. The annular tank shown on top of the shoe-driving disk in Fig. 1 is removable and intended solely to receive dripping water to compensate for loss of shoe weight by wear—to keep the weight constant while the shoe is being worn away. The only thing that has prevented my placing this mill on the market even before receipt of patent is the excessive iron wear in a mill of its grinding capacity, justly deemed by cyanide authorities a serious objection to muller-grinding mills.

I am again inspired with the hope, however, of doing something with my regrinding mill, for in the JOURNAL of Apr. 12, 1913, a magnetic device for the separation of fine iron from mill pulps was shown and described, which, if the claims of the inventor are verified, will render mills of the pan-type competitors to be reckoned with by tube-mill manufacturers.

In conclusion, I desire to suggest to Mr. Söhnlein, through the JOURNAL, that he might use some of my ideas to his advantage in his mill. He is perfectly welcome to them for such use so far as I am concerned, for any benefit he may derive from them should help me indirectly.

E. E. WANN.

Los Angeles, Calif., Oct. 7, 1913.

## Grinding Ores for Cyanidation—II

In the cost data on grinding, published in Table VII, page 921, the cost of breaking given for the Independence mill includes also sorting. Breaking alone amounted to 12c. per ton. The figure given for grinding, 52.17c., includes concentration in addition to roll and chilean-mill reduction. It is a department cost, taking in tube milling the middlings from concentration tables and pumping sands and slimes to the cyanide department. Corresponding data for the year ended June 30, 1913, is: Breaking and sorting, 17.35c., and crushing and concentrating, 42.46c. per ton. Sorting cost about $0.064, leaving the amount chargeable to breaking about $0.109 per ton milled. This shows a low cost for both sorting and breaking.

A. A. NASON.

New York, Dec. 9, 1913.

# EDITORIALS

## The Position in Silver

The price of silver, which was fairly steady during the early half of the year, and which in October ranged between 61 and 62c. in New York, began to fall after that time, and has since experienced a serious decline. The first recessions were apparently due to reports of insufficient rains and the consequent prospect of short crops in India, but a more potent cause was a certain uneasiness felt as to the general financial condition in that country.

That this uneasiness was well founded has been shown by the failure late in November of the Indian Specie Bank of Bombay, a large institution, mainly under the management of Indian capitalists. This bank had been the main stay of the great speculation which has dominated the silver market for over two years, and which for the most part of that time, appeared to be successful. The burden of carrying the large stocks of silver necessary to the success of that speculative movement proved too heavy in the end, however, and the whole affair broke down. The consequence was a break in prices, and on Dec. 1, the metal reached its lowest point at 56⅛c., in New York, although there was a subsequent rally of about 1½c. and the price now stands between 57 and 58c., with an apparent probability that it will continue around that level.

The failure of the Indian Specie Bank was followed almost immediately by the sudden death of its managing director, and in the proceedings following the closing of its doors, it was brought out that in addition to stocks in Bombay, the bank was carrying silver to the amount of over £3,000,000 in London, and a demand for more margin on this was one of the moving causes of the suspension.

The speculation seems to have failed, partly because the stocks became too heavy to be carried, but mainly because of the finesse of the financial agents of the Indian government, who succeeded last summer—as we noted at the time—in securing from other sources, and at a moderate price, the supplies of silver which were needed for coinage. It was this demand and the possibility of being able to exact high prices from the government, which had made the speculators so persistent. The situation was a serious one, and there was a prospect of a general break which might have carried the metal down to 55c. or even below. The news comes from London, however, that the silver stocks referred to, together with some of the contracts of the Indian speculators, have been taken over by a syndicate which is strong enough to carry them for the present and until a more settled condition of the market is reached.

Another point which affected the position has been the long delay in the settlement of affairs in China. It was expected that the new government of that country would be able to secure a substantial loan and to undertake the reorganization of the currency which has been proposed and planned for some time. This reorganization would have required the purchase of a large amount of silver, but it has been long delayed. Moreover, the position in China is such that it is quite uncertain when the work can be undertaken. Purchases of the metal from that country have been rather light, and in fact Chinese bankers have been selling more or less silver to India to meet the current demand, which, of course, has acted unfavorably on the London market. At the present time, it is a difficult matter to say when the Chinese demand will revive.

Upon the whole, it is probable that the silver market will be quiet and rather depressed for some time to come. Gold shipments to India for several months past have been lighter than they were a year ago, and this is to some extent an encouragement for sellers of silver, but the position, apparently, will not show much improvement for several months.

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## The Coming Gold Camp

Unless a long list of our most experienced engineers have committed an error of judgment, the Gastineau district of Alaska, including the mines of Treadwell Island on one side of the Gastineau channel, and those adjacent to the town of Juneau; on the opposite side of the channel is destined to become, during the next five years, the most important gold-mining district of America. The mines of Treadwell Island have been for many years producing about $3,500,000 in gold per annum, and without doubt will continue to do so for many years to come. Around Juneau there is now being developed a deposit of gold ore which, in point of tonnage, probably exceeds anything else that is known in the world, except perhaps the Rand. Several mines are now being developed, these including the Perseverance, Juneau and Ebner. For the Perseverance and Juneau stamp mills are already in course of erection. It is contemplated that the Alaska-Gastineau Mining Co. (Perseverance mine) will eventually mine and mill 20,000 tons of ore per day, the Alaska-Juneau about 12,000, the Ebner about 8000, a total of 40,000 tons per day, or say 12,000,000 tons per annum. It is expected that this ore will yield about $1.50 per ton. If this estimate be borne out, we shall have a new production of $18,000,000 per annum, or nearly 20% of the total gold production of the United States at the present time.

❋

## "Standard" Copper

A correspondent inquires of us, "What is 'standard' copper, which is quoted regularly in the newspapers, and appears to have something to do with the New York Metal Exchange?" He adds that he knows what standard copper is in the London market.

Standard copper, in American parlance, means about the same thing as in London, or is so intended to mean, but there is the difference that in London there is a big

speculative trade in standard warrants, i.e., certificates, while in the New York Metal Exchange there is scarcely any worth mentioning.

It is a great many years since any important business, except in tin, has been done on the New York Metal Exchange. The organization owns a valuable piece of property which causes many of the metal houses to maintain their membership, but in late years it has been scarcely more than a statistical bureau. A few years ago an effort was made to revive the affairs of the Exchange by the inauguration of speculative trading in "standard" copper, after the fashion of the London market, but no attempt ever fell flatter. This was a disappointment to the brokers and dealers, who hoped to see some business developed in the exchange, but the important interests refused to be represented there, and such speculative business in "standard" copper as there is continues to be executed through the London market.

Some few small brokers and dealers frequent the New York Metal Exchange and go through the form of offering and bidding for some trifling quantities of something or other, which, in the case of "standard" copper, is apt to result in a quotation of something like 15½c. offered, 14½c. bid, no sales, and 15c. named as settling price, which is apparently what is telegraphed to the newspapers. In the American market, "standard" copper does not mean anything of consequence; nor do quotations of it.

❖

## Notes on Mine Valuation

This subject, so frequently discussed, is no doubt one of the most important branches of the mining engineer's profession and particularly so to those who specialize along its lines. Obviously the value of a mine depends primarily upon the ore contained in it. The first step to arrive at a conclusion is, consequently, a careful sampling of all the ore exposed in the mine. Inasmuch as the value of the mine depends so largely upon this sampling and the interpretation of the results obtained, it surely ought to be done by a capable and reliable man. Of course, it is not necessary for him to perform the actual manual labor, which is largely mechanical and can be done by anyone strong enough to wield a pick or a hammer and maul. The general plan of sampling and the specific way of taking each separate sample, the notations of the appearance of the vein or deposit where each sample is taken and all observations, geological and otherwise, necessary to arrive at an intelligent conclusion, should be done, however, by a man of experience. The final interpretation of results thus obtained may then be successfully made by an engineer who has never seen the property but is familiar with the characteristics of the district.

It is quite often the case, that a property sampled in one way is shown to be of no value whatever, whereas, if sampled differently, a good margin of profit is exhibited. There are several reasons for this, which two examples will illustrate. In one case the cross-sections of the vein taken were too wide and in consequence, the average assays were too low to admit of mining and treating at a profit. The chief value was found to be in a small streak in the large vein and when this streak was mined and milled separately a good profit was obtained.

In another case, the ore was in a wide brecciated zone and the fines carried the "mineral," while the coarse material was barren. A general sampling of the whole indicated a grade of ore too low for successful treatment. Later on, by mining all of the material, screening ont the coarse (which was returned for filling) and milling the fines, a dividend-paying mine was developed.

Now suppose that in either or both of these cases, the sampling had been done by a man of but little experience and the results given to an experienced engineer to pass upon, with no further data at hand, probably the properties would be turned down. However, in the present condition of the mining industry such instances are becoming rare. As a general rule examinations of mines are now made by engineers of experience. They may differ in their general conclusions, but 99 times out of 100, it will be for some other reason than a variation in sampling.

Undoubtedly, it is easier to determine the value of a developed mine than correctly to "size up" a partially developed mine or a "prospect," which is necessarily a matter of judgment and experience in the main. The old saying, that "one man cannot see any farther into the ground than another," in a practical sense is not true. The man who has spent a life time in working, developing and examining mines and prospects all over the world, can certainly surmise better what is under the surface, than can a carpenter, a lawyer or an aviator. Most of the big mines of the world had the "ear-marks" before they were prospected and it surely requires judgment and experience to recognize and correlate the "ear-marks." The engineer who can do that has a very valuable asset.

A knowledge of the district and the character of its mines and ores is essential and for this reason it is often advisable to obtain a local engineer of good reputation to make a report on a mine in his district, the conditions of which he knows. At the present time, however, this is not of so much importance. But few new districts have been opened in the recent years and the older districts have been so carefully examined and described, that they are familiar to most of the engineers of experience. Certain general characteristics are common to the several mines of the same district and do not apply to the mines of another district, so that results deduced from the assay and geological maps must be influenced more or less by these facts. A failure to recognize this condition often results in the turning down of properties that do not look favorable from an inspection of the maps and even after a complete examination. A number of valuable mines both in Tonopah and Goldfield were rejected by supposedly competent engineers, simply for the reason that they were not familiar with the characteristics of the orebodies in the Tertiary eruptives of the mineral zone east of the Sierras. There has never been a time in the history of the Goldfield Consolidated when a correct estimation of ore and ore reserves could be made from assay plans. An assay across a breast might run $2 today and $2000 tomorrow. The ore-shoots were irregular, both in size and assay, and were encountered where least expected and were not found where expected. An examination at any time by an engineer who did not take into account these characteristics would show a great underestimation of its value. It is experience that counts in mine valuation, and more especially in prospect valuation, rather than mechanical sampling of exposed ore faces.

## BY THE WAY

Brainerd, Minnesota, is undecided in its mind as to whether it most desires to be known as the metropolis of the Cuyuna iron range or as the home of "Bullet Joe" Bush and "Chief" Bender, erstwhile Giantkillers.

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This story is told of a "hill billy," in one of the southeastern Missouri lead-mining towns. A street orator was lecturing on the white-slave question. One night as the shift was coming off, they were talking about the lecture. The hill billy listened and finally asked, "What is all that air doin' at the corner?" Someone replied that the man was lecturing on "white slaves." The hill billy became very enthusiastic and said, "Well, it's about time somebody started somethin' to git more wages fer us fellers."

❖

A few months ago we heard in certain quarters much talk about the probable imports of pig iron from China in the event of a reduction of the tariff. American blast furnaces were to be swamped by the flood of iron made by Chinese cheap labor. The trade is now bracing itself to resist this flood, which in the eight months ended Aug. 31 reached the enormous total of 50 tons, or no less than 0.000002% of our domestic production. Nor does the flood seem likely to increase, for a recent consular report gives the price of Hanyang foundry iron at furnace at 33.50 Hankow taels, equal to $22.50 per ton—more than double the price Alabama furnaces are quoting.

❖

This may be a new one to some of our readers: Enter to the only drink dispensary in the dusty Southwestern town, an engineer on an examination trip. A small crowd surrounds a happy-looking prospector who is setting them up. One man informs our engineer, "Jim just struck the thin edge of an orebody on his Red Mountain prospect today, and he's feeling mighty good." Then follows an introduction to Jim, who declares with emphasis, "Yes, sir, I am within just three feet of a million dollars." A year later, happening into camp again, our engineer encounters Jim, sitting dejectedly on a bench in front of the same dispensary. After a drink, in reply to an inquiry about the great orebody, Jim states with sad emphasis, "Partner, I'm a million feet from three dollars."

❖

There are various methods of attacking the problem of decreasing underground accidents, and the attainment of relatively safe conditions depends largely upon the existence of a real desire and an earnest effort to that end. It would be hard, however, to find a more effective way than that adopted by E. P. Clonan, manager of the Port Henry Iron Ore Co., at Mineville, N. Y. Mr. Clonan follows the simple plan of being himself his own foreman. He makes it a practice to go underground with the men in the morning and stay under the entire shift. He personally inspects conditions of the working places and removes sources of possible danger. The inevitable result is that the mine has made a remarkable record for safety; it has been years since there was a death from accident underground, and this is in the face of the fact that conditions are inherently dangerous, the magnetite which forms the ore being mined out in great chambers with occasional pillars, leaving the backs far above the men and quite invisible. The technical and business details of mine management Mr. Clonan considers secondary to the welfare of his miners and delegates them to his subordinates. The only real obstacle we can see to the extensive application of this idea is that to make it effective, the manager must himself be a first-class and well trained miner.

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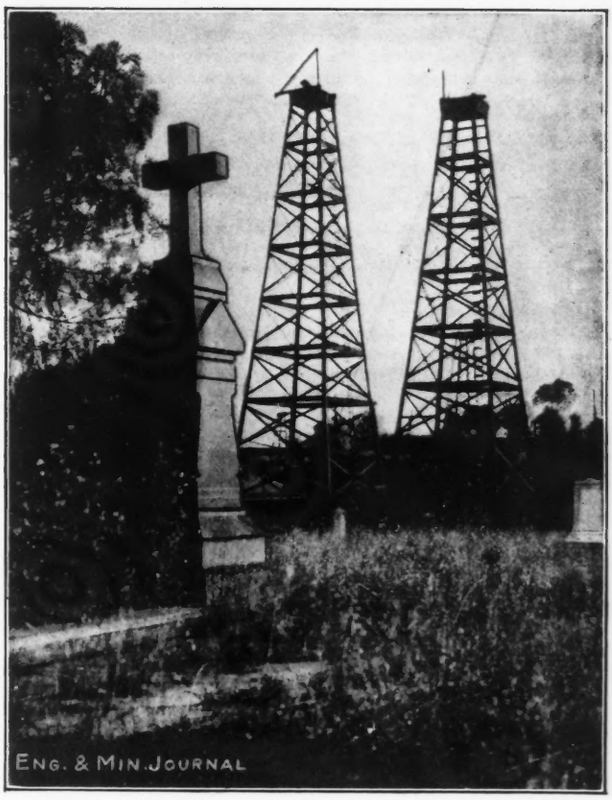
Oil wells and tombstones are found side by side in the city of Los Angeles, where a rich oil deposit underlies the city of the dead. The derricks are built as close




OIL WELLS BY THE CEMETERY, LOS ANGELES

to the tombs as possible, though, of course, they are not permitted to encroach upon the sacred precincts. The wells have been producing steadily for years and the foundations of great fortunes were laid in this Los Angeles oil field.

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The new Michigan compensation law for injured workmen provides that if an agreement cannot be reached between employer and employee as to the amount of compensation, the matter shall be settled by a board of arbitration, consisting of three members, one to be appointed by the state board of commissioners and one by each of the parties to the controversy. In a recent case at Iron River the Spring Valley Iron Co. appointed their attorney, the board of commissioners sent their chairman, and Charles Matson, the injured miner, who had lost an eye in the Zimmerman mine, selected a woman, Mrs. Lydia Kovala, to put up an argument in his favor.

## PERSONALS

Philip Argall, of Denver, Colo., has been visiting in New York.

Leo von Rosenberg, of New York, is in the Ray district in Arizona.

Edwin J. Collins has returned to Duluth, Minn., from a two weeks' trip to Montana and Utah.

Walter G. Perkins spent a few days in New York last week on his way from Chosen to London.

J. F. B. Erdletts, Jr., of 341 Salisbury House, London, is in Austria Hungary on professional business.

H. DeWitt Smith who has been examining placers in Santo Domingo has returned to New York.

Dr. William B. Phillips, head of the University Geological Survey of Texas, has been visiting New York.

Ott F. Heizer is now general manager of the Argo Reduction & Ore Purchasing Co., at Idaho Springs, Colorado.

Dwight E. Woodbridge, of Duluth, Minn., has been in the Monte Cristo district in Washington. He expects to spend part of the winter examining iron ore deposits in New York.

President E. P. Earle of the Nipissing mine, and David Fasken, a director, both of whom are also on the directorate of the Caribou-Cobalt, have returned from a visit of inspection to the Cobalt camp.

Francis G. Fabian and Harry E. Hall have formed a partnership under the firm name of Fabian & Hall, to engage in general mining and consulting engineering, with offices at 220 West 42nd Street, New York.

Mining Commissioner T. E. Godson, of Ontario, will go to Cobalt on Dec. 18 to make a personal inspection of Cobalt Lake before deciding to grant the application of the Cobalt Lake Mining Co. for permission to drain the lake.

Miss Eva Endurance Hurdler, a member of the Missouri Geological Survey and a graduated mining engineer is to wed Frank C. Greene, of New Albany, Ind., geologist for the Missouri Survey, on Dec. 18, and then quit her profession.

M. Stephan, operating manager of the Cie. des Forges & Acieries Electriques, Ugine, Savoie, France, who has been in this country for several weeks on business pertaining to the Girod electric furnace, sailed for Europe Nov. 13 on the "Olympic."

The S. W. Clawson collection of Bisbee copper ores was opened for public inspection by the Chamber of Mines & Oil at Los Angeles, Calif., Dec. 11. The fine specimens were bought for the mining exhibit by Thomas Thorkildsen and J. O. Royer and the cabinet containing them was secured by the generosity of J. Ross Clark and Seeley W. Mudd.

Sir Lionel Phillips, one of the best known mine owners in South Africa, was attacked at Johannesburg, Dec. 11, by a Dutch storekeeper named Nissun, and received three bullet wounds. His condition is said to be good and he is on the way to recovery. Sir Lionel was closely associated with Cecil Rhodes and Alfred Beit in the early days of the Transvaal, and has been, for a number of years, the Johannesburg partner of the house of Wernher, Beit & Co. In the troubles of 1896, he was sentenced to death at Pretoria, together with Colonel Frank Rhodes, George P. Farrar and John Hays Hammond, the sentences being later commuted to fines and banishment.

## SOCIETIES

**New Mexico School of Mines**—The faculty and senior class were entertained by C. T. Brown recently with a smoker at which Dr. F. L. Nason, chief geologist for the New Jersey Zinc Co., gave a talk on the zinc deposits of Mine Hill and Sterling Hill in New Jersey.

**American Museum of Safety**—The first International Exposition of Safety and Sanitation began in New York, Dec. 11, at the Grand Central Palace, Lexington Avenue and 46th Street. A number of large companies have exhibits there, including the United States Steel Corporation.

**Sheffield University, England**—The head of the Applied Science Department, Professor Arnold, recently indicated the policy to be adopted at the new non-ferrous department which has been built in St. George's Square at a cost of £45,000. He said there would be two sections. One would be the basic metal section, where the melting work, analysis, and thermal testing of the various non-ferrous alloys would be done. The other section would be for plating. It was proposed to award science certificates which would carry a rank similar to that of the present associateship in ferrous metallurgy. A new departure was the formation of the University Metallurgical Club, which would be a metallurgical council of war for the Sheffield silver and steel trades.

**New York Academy of Sciences**—At the 96th annual meeting held in New York Dec. 15, the following officers were elected for the ensuing year: President, George F. Kunz; vice-presidents, Charles P. Berkey, Raymond C. Osburn, Charles Baskerville, and Clark Wissler; corresponding secretary, Henry E. Crampton; recording secretary, Edmund Otis Hovey; treasurer, Henry L. Doherty; librarian, Raiph W. Tower; editor, Edmund Otis Hovey; councilors (1914-1916), Wallace Goold Levison and Marshal A. Howe; members of finance committee, Emerson McMillin, Frederick S. Lee and John Tatlock. The meeting room of the Academy of Sciences is in the American Museum of Natural History, in the joint library of both institutions. To the honorary membership, limited to 100, two new members were elected: Dr. Charles Déperet, professor of geology at the University of Lyons, France, proposed by Prof. James F. Kemp of Columbia University and Sir David Prain, director of the Kew Botanical Gardens, England, proposed by Prof. Nathaniel Lord Britton, director of the New York Botanical Garden.

## OBITUARY

William F. Crane died at Montclair, N. J., Dec. 14, aged 57 years. He was controller of Phelps, Dodge & Co., and had been connected with that company for a number of years.

William Sydney Myton died in New York, Dec. 9, aged 70 years. He had been an operator in mining property for over 40 years, and owned interests in a number of mines in Colorado.

## NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ROASTING—Process of Roasting Fine Ores. Wilhelm Buddëus, Wiesbaden, Germany, assignor to John Dern, Salt Lake City, Utah. (U. S. No. 1,079,897; Nov. 25, 1913.)

SINTERING—Improvements in Apparatus for Sintering Ores. J. E. Greenawalt, Denver, Colo. (Brit. No. 10,249 of 1913.)

PHOSPHATE—Method of Manufacturing Double Superphosphate. Thomas Leopold Willson and Maximilian Mattheus Haff, Ottawa, Ont.; said Haff assignor to said Wilison. (U. S. No. 1,078,887; Nov. 18, 1913.)

COPPER—Improved Process and Apparatus for the Production of Copper by Electrolysis. M. Perreur-Lloyd, Boulogne-sur-Seine, France. (Brit. No. 6896 of 1913.)

HARDENING COPPER—Process of Hardening Copper. James A. McLarty, Toronto, Ontario, Canada. (U. S. No. 1,079,786; Nov. 25, 1913.)

CYANIDING—Improvements in Apparatus for Agitating or Thickening Ore Pulp. A. James, London, Eng. (Brit. No. 8801 of 1913.)

FILTRATION—Vacuum and Water Connections. Clarence G. Patterson, Berkeley, Calif., assignor to Butters Patent Vacuum Filter Co., Inc. (U. S. No. 1,078,552; Nov. 11, 1913.)

OPENHEARTH FURNACES—An Improvement Relating to Regenerative Openhearth Furnaces. T. B. Rogerson, Glasgow, Scotland. (Brit. No. 10,853 of 1913.)

ALUMINA—Purifying Alumina. Howard F. Chappell, New York, N. Y. (U. S. No. 1,079,889 and 1,079,900; Nov. 25, 1913.)

ZINC—A Process of and Apparatus for Use in Manufacturing Zinc. C. V. Thierry, Paris, France. (Brit. No. 7953 of 1913.)

DRILL—Pneumatic Rock Drill. Eduard Altenhoff, Oberhausen, Germany. (U. S. No. 1,079,735; Nov. 25, 1913.)

HOIST—Mine-Hoist Recorder. Orie W. Ingels, Carlyle, Ill. (U. S. No. 1,079,493; Nov. 25, 1913.)

MAGNETIC SEPARATORS—Improvements in Magnetic Separators. H. J. H. Nathorst, Malmberget, Sweden. (Brit. No. 8485 of 1913.)

ORE CONCENTRATION—Improvements in or Relating to Apparatus for Ore Concentration. W. Broadbridge, A. C. Howard and Minerals Separation, Ltd., London, Eng. (Brit. No. 25,490 of 1912.)

ELECTRIC FURNACES—Improvements in Electric Furnaces. Comp. pour le Traitement des Metaux et des Minerais par l'Electricite. Ampere a Puteaux (Seine), France. (Brit. No. 12,444 of 1913.)

# EDITORIAL CORRESPONDENCE

### SAN FRANCISCO—Dec. 11

**The State Mining Bureau** has now sufficient men in the field to gather the data necessary for a complete review and record of the mining industry in California. State Mineralogist Hamilton, and Secretary Thayer, recently made a trip to the oil fields in preparation for the field work to be done by field assistant, McLaughlin. Mr. Hamilton has made general visits to other mining districts and is adopting a course in vogue several years ago of familiarizing the Bureau in a general way with the mining industry. There is at present a fine opportunity to extend the usefulness of the mining bureau for the reason that for the first time in many years there is a sufficient appropriation to carry out a broad line of work.

**General Petroleum, Ltd.,** is a new British organization capitalized at $75,000,000. On an exchange of securities it will take over the General Petroleum holdings in California, excepting the pipe line and 12 tank fields under construction. The new organization will be in nature a holding company, which will be authorized to issue $50,000,000 of 7% cumulative preference stock and $25,000,000 of ordinary stock. The syndicate handling the organization of the new company has advanced $1,000,000 to General Petroleum and will advance $2,000,000 more after Jan. 1, 1914. This money is to be used to meet obligations and against it $3,000,000 loan debentures will be floated by the new company. The closing of the deal is contingent upon the agreement of the General Petroleum underwriters to deliver half of the outstanding General Petroleum bonds for exchange. It is believed that enough of the bonds are now on hand to meet the obligation.

**The Western Fuel Co. Case** went to trial Dec. 9 before United States District Judge Dooling. The defendants in court were the president, vice-president, treasurer, other directors, the superintendent and two weighers who are charged with conspiring to defraud the Government of customs dues by the short weight of coal importations, and cheating the Government with short-weight deliverance in the army transport service and keeping engineers of steamship companies on a secret pay roll in compensation for their accepting short-weight fuel supplies. The delay in the trial last spring was one of the causes for the resignation of United States District Attorney McNab. The Western Fuel Co. is the largest importer of coal in California. A large amount of coal comes from Australia. The company has formerly been in the position of a monopoly and usually dictated the price of coal to the consumer. Since the general adoption of oil for fuel the coal business has fallen off and has not been so profitable.

### DENVER—Dec. 13

**The Cost of the Coal Strike** is estimated at $10,000,000 to date, conservative estimates placing the cost at $80 for every person in the state. The estimate is made up as follows: Loss in wages to 11,000 miners on strike, $2,607,000; loss in wages to 7000 railroad and other employees out of work as result of strike, $2,212,000; loss in traffic to railroads, $1,185,000; strike benefits collected from union miners at work to maintain strike, $632,000; loss to public through advanced cost of coal, $790,000; loss to operators through inability to fill orders, $1,580,000; cost of mine guards, loss of property and incidental expenses, $474,000; cost of maintaining militia, 46 days at $5000 per day, $230,000; loss in wages by militiamen, average $5 per day per man, $230,000; total, $9,940,000. Minor disturbances in the strike zone continue, and the military is busy most of the time. There is apparently no hope for a truce or for settlement; the miners are quiet and seem to have settled down for a long contest of endurance. They are receiving $38,000 per week for benefits. The suffering and loss to the people of the state has now been increased by the blizzard which has blocked the railways to the mining camps, closed the mines, filled the streets of the cities and towns, and rendered the haulage and delivery of coal to a large extent impracticable. Denver has given up the attempt to clear the highways, and is menaced by a coal famine, as the coal companies have practically ceased attempting deliveries in the residence districts, and will not guarantee any until Dec. 22. Strikebreakers continue to arrive in large numbers. The Victor-American Fuel Co. received a shipment of Alabama negroes Dec. 11, who were placed to work in local mines, and four or five other large consignments of experienced miners are said to be on the way. According to a statement issued at the Colorado Fuel & Iron Co.'s employment agency, all of the places of striking miners will be filled within two weeks if the present influx of workmen continues. The situation is so bad in Denver that the authorities have practically told the citizens of the resident districts that they must dig out their own streets so that coal deliveries can be made or else freeze. All the Cripple Creek mines have been closed down by fuel shortage owing to the snow blockade of the railway, and this is probably the case with every mine in the state that did not have its winter's supply of coal laid in before the storm. Street-car service in all the mining towns is closed indefinitely. On Dec. 11 coal-mine operators, dealers, tramway and railroad officials met in conference and decided to establish branch coal sales depots in all outlying districts of the city, when purchasers will pay about $1.50 per ton more than regular prices in the city and must haul it themselves. The price of 35c. per 100 lb. has been fixed.

### CALUMET—Dec. 13

**Another Injunction Has Been Granted** by Judge O'Brien, this one on the complaint of President Moyer, of the Western Federation of Labor, restraining the members of the Citizen's Alliance from interfering with the officers of the Federation, intimidating, or compelling them to leave the district against their will. The Michigan supreme court has handed down its decision in the injunction case granted on complaint of the mining companies against the Federation and insists that all acts meant to intimidate mine employees are forbidden, and calls for absolute prohibition of morning parades, which have been the cause of most of the disturbances. It also stated that Circuit Judge O'Brien misconstrued his official duty in procedure in the injunction case. A grand jury has been granted in Houghton County and will be in session within a few days. Special Prosecutor Nicholls has been put in charge of the grand jury, and he has also been appointed deputy attorney-general for Keweenaw County, taking the place of Prosecuting-Attorney Hamilton, of Keweenaw County. Judge O'Brien, accompanied by Sheriff Cruse and Attorney Nicholls, attended meetings of the Federation at Calumet, Ahmeek and Painesdale. He addressed the men stating that they must obey the law and live up to the injunction. He asked them to give up their guns to the sheriff, but the sheriff left the hall without securing any firearms. The action taken by the Citizen's Alliance has come only after a period of lawlessness and crime, in which murders were committed, houses dynamited, and working men subjected daily to threats, insults and beatings. The machinery of the law was completely broken down, and the action taken at the meetings Wednesday have the approval of every law-abiding citizen.

### ISHPEMING—Dec. 13

**The Curtailment of Mining Operations** seems more extensive than usual at the close of lake navigation, yet the contrast between the work now going on and the work of the shipping season exists largely because of the unprecedented production attained during the year. There are employed, it is believed, approximately as many men as at this time in 1912. Working forces had been greatly increased in the spring and there was exceptional activity while shipments were in progress. There have been retrenchments this autumn on all the old ranges, yet a survey of the situation indicates that only on the Mesabi is the volume of work materially less than was the case a year ago at this date, and this recession is largely offset by the increased activity in the new Cuyuna district, just as are the suspensions and curtailments at various mines in the other fields practically equalized by the development work at newer properties. To produce at the rate of 50,000,000 tons per annum requires a vast volume of preparatory work. Whether the demands of the iron trade will necessitate the continuance of that rate the coming year cannot be foreseen at this time. Nevertheless the Lake Superior region will be ready next spring to duplicate the output recorded this season. In the Iron River district of the Menominee range, little or no work is in progress at the Spring Valley company's Zimmerman mine, Pickands, Mather & Co.'s Baltic, Bengal and Fogarty properties, the Erie Ore Co.'s Youngs mine and Oglebay, Norton &

Co.'s Berkshire. However, while not as much ore will be produced as during the winter season a year ago, there is still considerable activity. Corrigan, McKinney & Co. are employing a large force at the Tully property, a mine which is in course of development. The same company is operating the Baker, adjoining the Tully. The Steel Corporation is employing practically the usual force at the Dober mine, as is Pickands, Mather & Co. at the Caspian, the Rogers-Brown Ore Co. at the Hiawatha, Rogers and Chicagon, the Mineral Mining Co. at the James and its other shafts, Oglebay, Norton & Co., at the Chatham, the Davidson Ore Co. at the Davidson, and the Jones & Laughlin Steel Co. at the Forbes. The last property is in the stage of development, with a second shaft sinking. Of the Wickwire Steel Co.'s group, the forces at the Virgil, Cortland and Wickwire have been scaled down 50% of the summer force, but there has been no curtailment at the Homer. The men at work in the Crystal Falls district of the Menominee constitute fully as large a force in the aggregate as a year ago. The only recent suspensions have been at the McDonald mine, a small property controlled by the Erie Ore interests and now closed, and in the operations of Pickands, Mather & Co. in the Amasa field. The Tobin mine of Corrigan, McKinney & Co. was put on the inactive list early in the year. Offsetting these retrenchments, M. A. Hanna & Co. are employing good-sized forces in the development of the Carpenter and Ravenna properties, two of the largest on the range, and the operations of the Longyear interests and Pickands, Mather & Co. in the Mastodon field are steadily expanding. The Mastodon field is well named, for it possesses one of the greatest iron deposits yet discovered in Michigan. The Longyear interests have started drifting at the 200-ft. level of their Judson inclined shaft, in Section 13, 42-33, and it is expected that the orebody, 150 ft. distant, will be reached early in January. Sinking to the second level is in progress. The Chicago & Northwestern R.R. has extended its line directly to the shaft. The autumn weather has been such that excellent headway has been made with the construction of the various mine buildings. The Mansfield mine, which the Steel Corporation is abandoning despite the fact that the lease has not expired, is filling with water, the pumps and the piping having been removed.

### JOPLIN—Dec. 12

**Striking Developments Have Lately Been Made** notwithstanding the slump in ore prices and the shutting down of properties all over the district. These developments have been made by the large operator and by the small one, the importance of each being about balanced. Those of the large operator are concerned principally with drilling large leases and of the small one of sinking shallow shafts into deposits of old-time richness. Of the first-class are the leases in the Miami-Hattonville region, extending from the Hattonville group of mines northward beyond the Oklahoma-Kansas state line. Those concerned in taking leases and preparing to drill them are, Lennon & McConnell, Chapman, Longacre & Short, Barnes & Co., and the Underwriters Land Co. All of these companies have taken up large acreages of virgin ground and are preparing to test them out by drilling during the next six or ten months. Each company has from 500 to 1000 acres under lease and the amount of drilling done during the period should be sufficient to test a large portion of the ground north of the new Oklahoma camp. The Underwriters Land Co. has just closed up its contracts for 800 acres. The land lies north of the Oklahoma-Kansas state line in the immediate vicinity of the Blue Mounds. All of it is in virgin territory although it lies immediately in the line of previous development in the older camp. Three drills will be put to work on the land as soon as they can be shipped from Joplin. On the other tracts there are already a number of drills at work. The area of this bona fide "wild cat" drilling will be the greatest undertaken in the Joplin district for many years. The district has grown by the drilling of small tracts adjoining a camp or in some instances in drilling isolated land outside of the original Miami camp drilling a number of years ago. But this is the largest acreage that has been tested. The Miami camp success brought about by the wild-cat development of the Miami Royalty Co. is responsible for this present trend of development. Perhaps another potent reason lies in the exodus of operators from the sheet-ground camps of the Webb City area to richer ore deposits during the present low-price period. The other trend of development in small leases by small operators is resulting in some rather astonishing things. Last month saw the discovery of what has been pronounced the richest shallow find for years. A group of prospectors, rather discouraged in their operations at a shaft, wandered down to a neighboring shaft and while going across a small branch they noted the glint of freshly broken galena in some outcropping flint boulders. They got a pick and shovel and started to investigate and in two hours had broken through the flint boulder into soft mud ground which ran 25% zinc blende and about 5% lead. They concluded to sink a shaft right on down and sunk 16 ft. in this ore. Being in the bed of the stream they then filled up the shaft and concreted it over and secured a lease upon four lots and began sinking a shaft a short distance from the bank of the stream. They struck the ore at 10 ft. and sank the shaft to 32 ft., taking out ore all the way. A drift was started and by the end of the second week the ore taken out after having been cleaned in a custom mill and the concentrate sold paid all the expenses of opening up, milling and a profit of $1700 besides. The second two weeks will see $5000 worth of ore mined and marketed in addition to the profit already earned. This discovery was made by Hill & Co. upon the Cave Springs Lead & Zinc Co. land, at Cave Springs. Naturally such a discovery has set a score of other prospectors to work in the same vicinity until practically the entire acreage surrounding this strike is now under lease and shafts have been started. This camp, which years ago was noted for its large production from rich mines, is now showing a marked increase after an idleness covering many years. One custom mill is now turning out from three to five cars of concentrates weekly and all of it is coming from just such shallow deposits, except in a few instances where a group of gougers are robbing the pillars of an old mine.

### CASA GRANDE, ARIZ.—Dec. 10

**The Casa Grande Mining District** is about eight miles south of the town of Casa Grande, Ariz., and extends south to the Mexican border. Excepting the development being done by the Keystone Union Development Co., there has been but little activity in the district until recently, when the rumors of a proposed railroad to the Ajo mines, to be built by the Calumet & Arizona company revived work to a considerable extent. The Copperosity mine has been developing for the last four months and is capable of a production of 25 tons per day of 6% copper ore, for at least a year to come. The property is owned and operated by a Texas company. A Boston company has been developing a property known as The Reward. It is capable of a production of 100 tons per day, of 15% zinc ore. The same company has developed copper ores that are being shipped, the wagon haul being about 29 miles. The Lake Shore, a copper property 31 miles south of Casa Grande is owned and operated by the Keystone Union Development Co., of Pittsburgh, which is shipping a carload of 8% copper ore, weekly. The same company is developing the Orizaba, a silver-lead property, which experienced a period of prosperity, in the earlier history of the district, having a record of $60,000 to its credit. The ore was in quartzite and was found in irregular fissures. The company now operating sunk through the quartzite to an intrusive sheet of porphyry, where ore is found. Sinking to water-level has disclosed a continuous body of lead-silver ore carrying about 1% vanadium, 14% lead, 8 oz. silver and 0.14 oz. gold, per ton. Drifting along the line of contact, at a depth of 125 ft. has disclosed a continuous oreshoot, thus far. The Nugget property, 14 miles from Casa Grande, has been developed to a depth of 84 ft. and shows a shoot of ore having an average thickness of 7 ft., with the shoot extending the entire length of development, which is approximately 125 ft. The Turning Point mine is developed to a depth of 300 ft., disclosing lead-carbonate ore, carrying gold, silver and lead. A stamp mill with concentrating tables was installed, but losses were so large that its operation was temporarily discontinued, pending contemplated improvement. The Jack Rabbit property owned and operated by McKeesport, Penn., men, who have sunk a shaft to a depth of 400 ft., were obliged to discontinue operations, on account of a heavy flow of water encountered when the vein was cut, at that level. This property has made a production in silver ore, of approximately $80,000. In the last few months, some of the larger mining companies have had their field men visit the district.

### COBALT—Dec. 12

**Kirkland Lake Properties** including Tough-Oakes, Burnside, Wright and Robbins properties in the Kirkland Lake district, have been taken over by Englishmen. A company capitalized at £300,000 has been formed and 275,000 shares were issued at par, £1. This issue was over-subscribed and is now selling at a premium of 10s. per share on the English market. Final details regarding the purchase have not been made public, hut it is understood that the Burnside property will be purchased ouright, while the remaining three will be taken over for part cash and part shares. Of these four properties, the Tough-Oakes is generally considered the most promising. Good ore has also been found on the Burnside property. The Robbins and the Wright are mere prospects. Veins in this section are narrow, although high grade.

# THE MINING NEWS

## ALABAMA

### Jefferson County

LOUISVILLE & NASHVILLE AND SOUTHERN RAILROADS filed applications for a rehearing of Mobile pig-iron rate case and Selma coal-rate case. Commissioners some time ago ordered reduction of $1 per ton on pig iron from Birmingham to Mobile and of 20c. per ton on coal from Montgomery to Selma.

BESSEMER SOIL PIPE CO. (Birmingham)--Plant working on half time, affecting over 300 men. Repairs will be made and it is expected that plant will go into operation after Jan. 1.

GADSDEN PIPE CO. (Birmingham)—This plant and that of Campbell Manufacturing Co. are again in operation and it is said that Coosa Pipe & Foundry Co. will open after first of year.

ALABAMA & NEW ORLEANS TRANSPORTATION CO.—Barges are being operated on regular schedule between Tuscaloosa and Mobile. Barges carry 1000 tons and are self-propelling. This will furnish cheap transportation south for coal, iron and steel products from northern Alabama.

GULF STATES STEEL CORPORATION (Birmingham)—Deeds of Standard Steel Co. to Gulf States company were filed Dec. 5. Change does not alter operations but new company plans improvements and betterments. First cast iron was made week of Dec. 8; 25 extra men went to work.

## ALASKA

THREE SUITS AGAINST B. L. THANE have been filed, each to recover $31,250. F. L. Morris is plaintiff in one action, H. H. Patterson in another and Patterson and Morris join in third. It is claimed that Morris and Patterson owned individually and collectively a group of mines in Alaska and engaged Thane to dispose of them. Thane entered into an agreement with W. P. Hammon for purchase of group, understanding being that three plaintiffs in present action were each to receive one-fourth of profits. Mines were finally transferred to Alaska Gold Mines Co., Thane receiving 6250 shares of stock of corporation in payment. It is now alleged that instead of turning over to Patterson and Morris their share of proceeds, he has retained all of it for himself.

ALASKA UNITED (Douglas)—October milling, Ready Bullion mill, 20,132 tons yielding $42,329, or $2.12 per ton, $16,597 being profit; 700 mill, 18,774 tons yielding $32,160, or $1.73 per ton, $6438 being profit.

## ARIZONA

### Maricopa County

TUNGSTEN CLAIMS NEAR CAVE CREEK have been sold by Charles Philes to Eastern men. Ore carries copper in addition to tungsten. A contract will be let for driving a tunnel which will cut vein at a considerable depth.

A MATZATZAL CINNABAR PROPERTY will probably be equipped with a 50-ton Scott furnace. This property, near Phœnix, was recently purchased by Eastern men. There is at present considerable prospecting for cinnabar in that locality. Several groups of claims have recently been sold by locators.

### Mohave County

BI-METAL (Kingman)—Extensive examination was recently completed for Mines Co. of America. It is reported that results do not justify taking over property.

TOWNE (Chloride)—It is reported that this property, which has been a part of John Barry estate, has been sold to Cudahy company by Mrs. Barry, administratrix.

TOM REED (Oatman)—Bullion shipment for November was, with one exception, largest in history of property, amount being $110,000. Normal production for several months has been between $90,000 and $100,000.

### Pima County

VEKOL (Casa Grande)—A Texas company has purchased five-year lease held by W. J. Forbach and resumed work. An air compressor and gas engine are being installed. From 1880 to 1891 Vekol was one of the famous silver producers of Arizona, yielding several million dollars. Over 20 miles of shallow workings were opened at this time. Ore deposit is a replacement in limestone. At a depth of 300 ft. sulphides of lead and zinc were encountered with silver. No effort was ever made to develop and treat complex ores of lower levels. New owners will ship such ores as will pay freight and treatment costs and develop lower levels, carrying on experimental work looking toward design of a treatment plant.

### Pinal County

ARIZONA KING (Price)—Mine, seven miles above Price, in Box Cañon, has been sold by C. G. Werner to A. W. Scott, of New York. A new camp has been built and considerable equipment purchased. Two shafts will be sunk to a depth of 500 ft.

KELVIN-SULTANA (Kelvin)—No. 1 winze, which is being sunk from 300-ft. level, has at depth of 30 ft. opened up 5 ft. of 5% copper ore. A crosscut is being driven 50 ft. below main drift in No. 2 winze. New electric sinking hoist is installed in 300-ft. station.

CALUMET & ARIZONA (Superior)—Sinking of three-compartment shaft to 700-ft. level has been completed and work is already begun on station. It is probable that drifting will be done in two directions on this level. The crosscut on the fifth level, started some time ago, is well along and work on the extension of this drift will also be pushed. There are also five drifts from the tunnel under way. The C. & A. is now working 65 men in the mine and on assessment work.

### Yavapai County

HAYNES COPPER CO. (Jerome)—Shaft has been completed to 1200-ft. level. Extensive diamond drilling before beginning explorations is contemplated.

BAGDAD (Hillside)—A patent for 45 claims has been filed recently. During last year over $30,000 has been spent in drilling and other development work by General Development Co.

NELSON (Crown King)—Lower tunnel is being driven at rate of 100 ft. per month; 800 ft. having been driven, leaving 1000-ft. before shoot exposed in upper level will be cut. When under apex of vein face will be 900 ft. below surface.

Y. P. (Senator)—Equipment for remodeled plant is beginning to arrive. Two Huntington mills, a Monell slimer, six Monell tables, two Bunker Hill screens, a 20x24-ft. rag plant, engines and pumps have been received. When the remodeling of mill is completed it is expected that plant will treat about 80 tons daily. Several thousand tons of mill ore have been opened up in old Cash workings since they were unwatered.

HENRIETTA (Big Bug)—Electrical equipment is being installed. By time mill is ready to operate there will be upward of 1500 tons broken in stopes and ready for treatment. Copper-Gold Zone Mines Consolidated, an English company, which is developing the Henrietta is also planning to open up Nigger Brown mine in Black Cañon and is repairing wagon road from Turkey Creek to mine preparatory to hauling in supplies and necessary equipment.

### Yuma County

OLD PLACER DEPOSITS EAST OF EHRENBERG, on Colorado River, are to be operated by E. L. Burchamp, of San Juan field, Colorado. Cemented gravel is to be excavated by steam shovel and treated in specially designed apparatus

## CALIFORNIA

### Amador County

SOUTH EUREKA (Sutter Creek)—The 3c. dividend in November has been paid and another is expected in December. Starting of additional stamps in Oneida mill is contemplated.

ARGONAUT (Jackson)—It has been necessary to close down mill temporarily until repairs to hoisting gear are completed. New cable, purchased some time ago, will be installed. It is 4800 ft. long and weighs five tons.

ZEILA (Jackson)—Negotiations for sale of mine and mill to Nevada men are still pending. Large orebody disclosed in north end of ground, if developed, will make a new mine and require sinking of a new shaft. Old mine cannot be profitably worked below present lowest, or 1500-ft. level without additional expense which present owners seem disinclined to incur. If mine is not sold by end of year it will probably be closed down.

### Calaveras County

REINER MINING CO. (Stockton)—Company has been reorganized by election of E. H. Ehrler, of St. Louis, as president. Reorganization resulted from investigation of affairs of company under management of John C. Benson. Mine is at Altaville in Angels Camp district, and was being reopened after fire which destroyed surface improvements; but was closed down in July pending investigation. Mine will be reopened.

### Eldorado County

AJAX GOLD MINING CO. (Georgetown)—Mining properties of Everett F. Porter, between Georgetown and Georgia Slide, have been taken over by this company. Porter will be retained as superintendent. J. C. Tippett, of San Francisco, is president.

### Humboldt County

HORSE MOUNTAIN COPPER (Eureka)—Returns from first shipment of copper ore and concentrates to Tacoma smelter are reported to show that both are rich. This is said to be first shipment of copper ore for smelting ever made from Humboldt County.

### Inyo County

TECOPA CONSOLIDATED MINING CO. (Tecopa)—Shipment of 41 cars containing approximately 1700 tons of ore were shipped in November to Salt Lake smelters. Similar but smaller shipments were made during year. Mines are connected by standard-gage railroad with Tonopah & Tidewater R.R. at Tecopa in southeastern part of county.

### Nevada County

BRUNSWICK (Grass Valley)—Announcement of a dividend of 6c. per share is reported. Disbursement will amount to about $30,000. This is first dividend to be paid out of proceeds of production. Several years ago a dividend of 3c. per share was paid out of accumulated funds.

### Kern County

YELLOW ASTER (Randsburg)—Dividend of $5000 was declared Nov. 25, making total of $55,000 in 1913, and $1,176,789 since incorporation. Power lines which will supply pump-

ing power are ready for electric motors. Lines to mills are completed, also concrete foundations for motors being built by Westinghouse company. Southern Sierras Power Co. has recently completed a concrete switch house at substation east of Randsburg and installed a large transformer.

**Shasta County**

MIDAS (Harrison Gulch)—New cyanide plant is treating old tailing dumps.

MAD OX (Stella)—Mine, equipped with a 10-stamp mill, has been taken over by H. W. McEwen. McEwen has also taken bonds on Desmond Bros. Red Cross group south of Mad Ox. These mines have been producers.

GLADSTONE (French Guich)—The twelfth consecutive dividend has been declared, payable Jan. 5, 1914. This makes $108,000 dividends in 1913, and a total of $1,008,000. It is deepest gold mine in Shasta County. A new electric hoist is being installed

## COLORADO

**Clear Creek County**

JOSEPHINE—Mine on Kelso Mountain near Silver Plume has been developed during last six months. A substantial reserve of silver-lead ore has been opened. Lower adit has opened 30-in. vein of galena for 200 ft. Upper adit is driven at elevation 300 ft. above lower adit and has cut main oreshoot 200 ft. from portal. Experiments have recently been made on ore from old dumps. Trial shipments have been made to Scotia mill at Silver Plume with satisfactory results.

**Lake County**

UNWATERING THE DOWNTOWN SECTION will probably soon be started as Jesse F. McDonald, Colorado's former Governor, has secured capital necessary and is securing leases on Penrose Sixth St. shaft, Alice and Coronado mines, and on Nile, Augusta, Grey Eagle, Pocahontas, Bon Air, and Welson properties. Pumping will be done through Penrose and Coronado shafts. It will take three months to complete unwatering.

YAK TUNNEL (Leadville)—Sutton, Steele & Steele dry-process concentrators may be installed next spring.

LITTLE JONNY (Leadville)—Two men were killed Dec. 6 by cave-in while working on lease in fourth level of No. 2 shaft.

**San Juan Region**

TIGER (Silverton)—A snow slide occurred at this mine in Silver Lake Basin afternoon of Dec. 5, the snow caving in boarding house. All the crew of Iowa mine which is working under lease were housed there, the men crossing Silver Lake to and from mine on a jig-back tramway, no one however was hurt. Silver Lake mine boarding house will be occupied for rest of winter by Iowa and Tiger mine crews.

MAYFLOWER (Silverton)—An extensive deposit of sulphide ore was opened this autumn and to date 8 cars have been shipped netting from $300 to $1000 per car. A short Bleichert tramway has been constructed joining upper tunnel where ore was opened, with boarding house below. Lessees and owners of this group of claims, mainly members of Malchus family, pioneers in this district, are contemplating building a mill in early part of next season.

SUNNYSIDE (Silverton)—Fire which occurred morning of Dec. 2, destroyed tramway terminal in which it started, blacksmith shop, transformer house and large snow shed connecting them. As a result mine, employing 125 men is closed. Plans for rebuilding have already been made and it is estimated that it will require at least 60 days to repair damage. Lesehen tramway was dropped for a distance of 4000 ft., four towers being thrown down. Two towers, it is understood, will be erected to replace these until spring. Big span over Eureka Creek was left intact.

**Summit County**

WELLINGTON (Breckenridge)—A timberman was killed Dec. 6 by a cave.

**Teller County**

DIVIDENDS PAID IN NOVEMBER were: Golden Cycle, $45,000, and Elkton Consolidated, $50,000.

COLORADO SPRINGS & CRIPPLE CREEK DISTRICT R.R.—On Nov. 20 an extensive rock-slide occurred, near mile-post 19, which tied up this railway for 10 days. As this road hauls all shipments from district, most of mines were more or less hampered in November production.

EL PASO (Cripple Creek)—A station has been cut on level of Roosevelt drainage tunnel.

VINDICATOR (Goldfield)—Plans are being prepared for erection of a concentrating plant to be located near mine.

GOLDEN CYCLE (Goldfield)—A serious cave occurred on afternoon of Dec. 1, extending from third to tenth levels, and about 200 ft. along La Bella vein. Five men were caught, two of whom were rescued uninjured within a few hours. Others have not been found yet, and no hope is held out for them. They are Frank M. Woods, Jr., son of F. M. Woods, of Woods Investment Co., former owner of Gold Coin, Townsite of Victor, and other properties of early days, and two miners, Sam Sorensen and Pat Keveney. Except for rescue work, mine is shut down.

## IDAHO

**Bonner County**

IDAHO-CONTINENTAL (Porthill)—Property will be shipping concentrates soon after Jan. 1, unless unforeseen delays occur in completing concentrator. Mill of 200 tons daily capacity is nearing completion. Hydro-electric power plant on Boundary Creek, 14 miles from Porthill, is completed and ready for service, and transmission line to mine was finished a few days ago. Crushing rolls in concentrator are now preparing concrete material for compressor plant, equipment for which is ready for installation, and as soon as drill power is ready operations in mine will begin. Road from mine to Porthill, nearest railway point, is in excellent condition. Sleighs will be used to haul ore during winter and either auto trucks or caterpillar engines during summer.

**Clearwater County**

ORO GRANDE GOLD MINING CO. (Orogrande)—This company, capitalized at $1,500,000, was organized to take over Hogan mining property in central Idaho gold belt. Basis of operations is a dike that traverses property for two miles known to be 300 ft. wide from hanging-wall side, footwall never having been reached. Through glory-hole 100,000 tons of $3 to $4 ore have been taken out. Mining will begin this winter. Surface equipment, consisting of 20-stamp mill and cyanide plant of 500 tons daily capacity will be ready to go into commission early in spring. Mine and mill are electric lighted throughout by plant on property. A sawmill and a power plant are included in equipment. A few changes in mill are expected to reduce cost of mining and milling to $1 per ton in treating a large tonnage.

**Cœur d'Alene District**

MOSCOW (Murray)—Good milling ore has been encountered in face of 300-ft. drift. Work will be continued as long as weather permits.

## MICHIGAN

**(Iron)**

THE VALUATION OF STOCKPILES occupied the greater part of discussions when representatives of most of the iron-mining companies operating in Michigan met at Lansing, Dec. 16, to talk over mine taxation with members of state tax commission. Tax commission realizes that it has not been fair in way stockpiles have been assessed. Mine operators claim that taxing stockpiles is double taxation as ore is taxed in ground and again when it reaches surface. Commission uses Lake Erie ore prices to determine valuations, while operators maintain this method is unjust, claiming that ore that has been in stock for years and cannot be sold is not worth near value placed on it by commission. There is ore in stock in Marquette County, high in silica, which has been at mines for 10 years and cannot be disposed of. This ore has little or no value at present but is taxed every year and more has been paid in taxes than will ever be received in return if ore could be sold. Commission desired to get all information it could and so sent out notices for conference at state capitol. State geologist realizes that method of assessing stockpiles is wrong and it is now certain that a change will be brought about.

## MINNESOTA

**Mesabi Range**

BUCKEYE—Work is being rushed at this new operation.

ANISTEO—But three shovels are in operation, working day and night.

PRAIRIE—Three or four drills have been placed in operation and preparations are being made for a railroad spur to property.

EUCLID (Chisholm)—This mine, within city limits of Chisholm, has in late years caused city much annoyance through caving. Mine was gutted by a serious fire several years ago, and is now flooded with water from Longyear Lake, due to a break in dam between mine and lake. A small stockpile was washed away. This is mine over which State of Minnesota started action several years ago to determine State's right to mine ore underlying state waters, suit being in name of White Iron Lake Co. As but a small amount of ore remains in mine, it probably will never be unwatered.

## MISSOURI-KANSAS-OKLAHOMA

**Joplin District**

PRINCIPAL CALAMINE PRODUCER of Joplin district now is Granby, Mo., with 10,000 tons produced. Most all properties are small, but making profits. Many new mines opened recently.

REO (Sarcoxie, Mo.)—Good productions of zinc ore are being made weekly.

CAYWOOD & CO. (Joplin, Mo.)—Ore running 20% is being taken out at 90-ft. level on Grundy land.

COAHUILA (Duenweg, Mo.)—Monthly production of 50,000 pounds lead concentrates and heavy tonnage of blende reported.

J. P. HURST & CO. (Joplin, Mo.)—These Chicago operators have opened orebody on Gray land. High-grade ore found from 100 to 126 feet.

HARTLEY LAND (Cave Springs, Mo.)—Moon & Co. have encountered heavy run of lead ore at 27-ft. level. Five acres are under lease.

EDNA GROUP (Galena, Kan.)—Scott & Merrell are developing good ore run at 47 ft.; Wyandotte tract, adjoining, also scene of new strikes.

RED LION (Joplin, Mo.)—Gerster & Raines, of Galena Kan., have made mine prolific producer of zinc ore, good weekly turn-ins being reported.

W. B. STONE MINING & MFG. CO. (Galena, Kan.)—This company's Cooper Hollow tract has been reopened by Gillman & Co., with several lots subleased and prospecting begun. Several years ago it was one of the most productive of district.

UNITED-LEHIGH (Carl Junction, Mo.)—Concentrator may be moved to Peacock camp, short distance west, for reopening old Peacock property, which was closed down few years ago, when plant burned. Operators believe good orebodies are yet available.

**Washington County**

SOUTHEAST MISSOURI LEAD CO. (Potosi)—In sinking second drill hole on tract four miles south of Potosi, 3 ft. of disseminated lead ore has just been struck at depth of 807 ft. and another occurrence fine ore at depth of 930 ft. First hole found a little ore above sand at depth of 96 ft.

## MONTANA

### Madison County

BLOWOUT (Rochester)—Retimbering of shaft at this Corbin Copper Co. property has been finished and preparations are being made to resume crosscutting to vein on 500-ft. level.

### Silverbow County

A NOTICE TO EMPLOYERS OF LABOR IN BUTTE was lately published in the Butte daily papers as follows: "You are hereby notified by Butte Workingmen's Union that, in accordance with resolutions adopted by this Union Nov. 21, and approved by Silver-Bow Trades & Labor Council, Nov. 23, 1913, that on and after Jan. 1, 1914, wages for all men under and subject to jurisdiction of this union shall be not less than $4 per day." High wages paid in Butte for all kinds of labor, attract more men in search of work than can possibly be employed. It is estimated that there are at present over 4000 idle men in Butte who flocked into city, from all parts of country, attracted by glowing reports of activity and high wages.

NORTH BUTTE (Butte)—Plans are under consideration by this company to expand its activity, involving issue of new stock to raise required funds. It is said that amount of new stock will not exceed 20,000 shares and that stockholders will approve plans of directors, in view of many advantages incident to increased activity. North Butte has produced 27,000,000 lb. of copper during year at an average cost of 9½c. This is equivalent to a net earning of $1,600,000 or about $4 per share. Dividends to the amount of $2 per share have been paid, leaving $800,000 in treasury out of year's earning.

ANACONDA COPPER MINING COMPANY (Butte)—A. E. Wheeler, for last 10 years superintendent of Boston & Montana reduction works at Great Falls, has resigned to become consulting engineer for Union Miniére du Haut Katanga, operating in the Belgian Congo, Africa. James O'Grady has been appointed local manager of the works, J. H. Klepinger superintendent and Mr. Krejci assistant superintendent, change to take effect Jan. 1. Butte payroll of company for November aggregated $1,126,000. It is said to be largest payroll in history of Butte district. Roll is made up on a basis of $3.75 for miners.

BUTTE & DULUTH (Butte)—With installation of an electric hoist a dispute has arisen among union men as to whether hoist should be operated by a member of electricians' or of engineers' union. A meeting has been called by Butte Miners' Union to decide this point which seems to be a vital one. This is due to fact that at a number of mines in Butte, electric hoists are being installed to take place of those driven by steam. An innovation in surface mining was introduced lately under personal direction of Captain Wolvin. Two 50-ft. holes were drilled, 30 ft. apart and 30 ft. back of face of opencut. Each hole was loaded with 20 sticks of dynamite, followed by a charge of seven kegs of powder. Explosion of two holes dislodged 500 tons of rock. Method will be followed in future and it is planned to introduce steam shovels for loading blasted ore into cars which take it to leaching plant.

## NEVADA

### Comstock Lode

TAILINGS IN CARSON RIVER are being treated. One small pump dredge is in operation.

CALEDONIA (Gold Hill)—Several days shutdown was necessitated by breaking of pinion on electric hoist at New York shaft.

COMSTOCK PUMPING ASSOCIATION (Virginia City)—Recently installed Starrett sinking pump in Consolidated Virginia winze on 2500-ft. level of C. & C. shaft has received initial test and been found to be satisfactory.

### Clark County

AZALEA (Goodsprings)—Company was recently incorporated in Los Angeles to develop this property.

BULLION (Goodsprings)—It is reported that a concentrating plant similar to that now at the Singer will be built.

QUARTETTE (Searchlight)—Property has been sold and company is in process of liquidation. Previous to sale there had been paid in dividends and refunding rights a total of about $420,000.

SOUTH NEVADA (Las Vegas)—It is expected that first test run of new cyanide plant under erection at this property will be under way within next 30 days. Mill is to have a capacity of 300 tons daily.

### Elko County

NEVADA-ANACONDA (Elko)—Lease and bond has been taken for $60,000, it is stated. A shaft is being sunk and surface equipment installed. Bunk houses have been built.

### Humboldt County

IMLAY MINING CO. (Imlay)—Development work will commence at once. An assessment of 1c. per share has been levied.

STALL BROS. (National)—Tunnel is being driven to crosscut contact which is believed to be source of rich float, large quantities of which have been shipped.

ROCHESTER MINES CO. (Rochester)—A mill will be built early in 1914, it is stated, in either Rochester or Weaver cañon. Initial capacity 100 tons per day. Process, amalgamation, concentration and cyanidation.

### Lander County

GOODWIN & PLUMAS (Copper Cañon)—An option has been secured and a company organized. A mill will be built, it is stated.

### Lyon County

NEVADA-DOUGLAS (Ludwig)—Estimated production for November, 1913, 4650 tons averaging 5% to 6% copper. All ore not assaying over 3½% has been reserved for treatment in the contemplated leaching plant.

### White Pine County

STEPTOE VALLEY WORKS (McGill)—Mr. Hoffman, representative of Kelley Filter Press Co., has been on ground lately negotiating for installation of a plant for treatment of 2000 tons of slimes daily. These slimes which are now settled in first of a series of ponds are said to carry 1½% copper and 80c. in gold per ton. Present method of handling consists in excavating with an orange-peel bucket and air drying, and is not satisfactory for several reasons. Proposed plant costing $200,000 will deliver a product holding only 3% of moisture.

CONSOLIDATED COPPERMINES CO. (Ely)—Mines and property have been inspected lately by W. B. Thompson and Thomas F. Cole, their inspection also included water rights and possible smelter site at Warm Springs. Local papers were unable to secure an interview, and nothing is known here of future plans. Giroux mines have been doing nothing except on Ora claim for two months. At original Coppermine shaft, just north of Star Pointer, the upraise for new shaft starting at 215-ft. level has been holed through to level of Minnesota tunnel at a height of 180 ft., which is about one-half distance to surface. Raise is being made on stulls to surface and should break through before Feb. 1, after which shaft will be timbered from top to bottom. Development work has been carried on east of shaft with satisfactory results. Crosscuts in a northerly direction have been started at 100-ft. intervals, results indicating a continuous orebody lying north of main drift, and extending several hundred feet easterly and westerly.

NEVADA CONSOLIDATED—Company is crowding steam-shovel work in both Eureka and Liberty pits. There are about 750 men working with nine steam shovels and same number of churn drills. Three shovels are on ore in Eureka pit and two in Liberty pit, including 100-ton shovel belonging to Coppermines company but operated by Nevada Consolidated. This shovel has been excavating new 5% ore into Liberty pit through Ora lode claim, and is mining 1000 tons per day, which is sent to Steptoe works and credited to Giroux company. Three of the four shovels working on overburden are near summit of Eureka Hill, where company has an immense task in removing barrier between two pits. Another three months should see top slice removed, after which work will be slower still on account of rapidly increasing area of horizontal section. Seven of the nine churn drills are spudding in holes ahead of shovels and two are engaged in prospecting Josie claim at mouth of Liberty pit. Results of drill work on Josie indicates to a certainty that Eureka-Liberty orebody extends westward into Coppermines formerly Giroux property. One hole after penetrating more than 200 ft. of lime struck commercial ore, and continued in ore for 560 ft. From Josie claim westward for nearly 5000 ft. to Brooks incline shaft of Giroux company, surface indications are favorable, and while it is not anticipated that ore is continuous, the possibility is now admitted. Property west of Josie claim is entirely within holdings of Coppermines company.

## NEW JERSEY

### Morris County

WHARTON STEEL CO. (Hibernia)—Company closed down operation Dec. 3, when it discharged 60 men. Pumps in mines were stopped and removed from shafts later. No ore has been mined in several months. All mines at Upper and Lower Hibernia, owned formerly by the Glendon, Andover, Hibernia, and Bethlehem Steel companies, are owned by the Wharton Steel Co. Until a few years ago from 800 to 1200 men were employed at Hibernia mines, and that place was then a thriving village of more than 2000 persons. After death of Joseph Wharton a few years ago, business began to dwindle. Until two years ago output of mines was 10,000 tons of ore a month. Company owns mines at Teabo and Allen, near Rockaway township. These mines are idle, and so are furnaces at Wharton.

## NEW MEXICO

### Grant County

PHELPS DODGE & CO.—Work trains are now running into camp of Tyrone over newly constructed railroad from Whitewater, and it is expected that by first of year a regular passenger and freight schedule will go into effect. Work in Tyrone is progressing slowly.

### Socorro County

JUANITA LEASE—Regular shipments are being made and regular force of men is employed.

N. I. T.—Unwatering will be commenced in this mine and active work started by first of year.

KELLY—This mine is to be operated again when repair work and general cleaning up is completed.

## NEW YORK

### St. Lawrence County

COMPANIES NOW PRODUCING TALC for use in paper trade, etc., are International Pulp Co., including Union Talc Co. (3 mills in operation), Ontario Talc Co. (1 mill), Uniform Fibrous Talc Co. (1 mill). All mills are operated by water power from Oswegatchie River, and production varies with supply of water due to season of year.

PILLING & CRANE (Benson)—Magnetite mines and concentrating plant were recently reopened by this Philadelphia company. About 100 men are employed. Ore is blasted in an opencut where large blasts are used. Material breaks in such large masses that considerable blockholing is necessary. Ore is crushed in giant rolls reducing to size of walnuts, is then conveyed on belt to mill proper where it is again crushed. Another belt conveys to steam driers from which it passes to storage bins ready for concentration. Ore runs about 30% iron and is concentrated by magnetic process similar to that used at Mineville, N. Y. Electricity is supplied from company's power plant on Oswegatchie River at Browns Falls, four miles from mill. Nodulizing plant is not now being operated. Shipment of concentrates is mostly to Pennsylvania furnaces.

## OREGON

### Coos County

SALMON MOUNTAIN (Myrtle Point)—This is only producing quartz property in county, although there are a number of placer mines. Equipment is a Little Giant mill, one Wilfley table and one crusher.

### Jackson County

NELLY WRIGHT (Gold Hill)—Operations with 10-stamp mill have just been started; capacity, 25 tons of ore per day. This mine was purchased a short time ago for $50,000, and promises to be a good producer.

## SOUTH DAKOTA

### Lawrence County

MOGUL (Terry)—Work of installing machinery in new mill is proceeding at a good rate, and it is hoped to have it all in place by end of month.

WASP NO. 2 (Flatiron)—Milling operations, which were recently suspended on account of a shortage of water, will soon be resumed, as a supply has been secured, and everything is in readiness for work.

TROJAN (Trojan)—The 250-ton cyanide mill is operating steadily, and everything has been gotten in shape for the winter's campaign. Snow sheds and other outside work has been completed, and construction practically suspended.

HEIDELBERG (Two Bit)—Shoot of vertical ore recently uncovered is showing up well with development. Sinking is now in progress, and a crosscut will be driven to ore. It is planned to begin shipments as soon as there is good sleighing.

### Pennington County

BLACK HILLS TUNGSTEN (Hill City)—Company will sink an additional 100 ft., and contracts for work have been invited, to be received up to Dec. 9. Property was this summer equipped with a small concentrator, in which a test run was made early in autumn.

KEYSTONE (Keystone)—Boland & Wamsley are shipping an average of one carload of scrap mica weekly. Several products are made from it, including ground mica, concrete and cement facing mica, flake mica, lubricant, decorating mica and tire powder. Hall & Everly are furnishing a large part of output.

## UTAH

### Juab County

TINTIC SHIPMENTS FOR NOVEMBER amounted to 751 cars; those for the week ended Dec. 5 to 154 cars.

GRUTLI (Eureka)—Ore running well in zinc has been opened on 180-ft. level. Vein material is from 4 to 6 ft. wide, with best streak ranging from 6 in. to 1 ft. in width.

TINTIC STANDARD (Eureka)—Silver-lead ore taken out in development work from 1000-ft. level, is being hauled from this property in eastern end of district. This is company's first shipment.

GOLD CHAIN (Mammoth)—Western part of this mine is now being developed from 1500- and 1800-ft. levels of Lower Mammoth. Two fissures carrying bunches of ore have been opened. Work from Lower Mammoth gives much greater depth than can be attained through company's own workings.

VICTORIA (Eureka)—There have been important developments on 1100, and a large part of present output of mine is coming from this level. November shipments were heaviest of any this year, and December is expected to show a larger output. Connections will soon be completed between 1050- and 900-ft. levels.

IRON BLOSSOM (Silver City)—At annual meeting held in Provo, Dec. 6, old officers were reëlected. Report shows a cash surplus of $438,551, an increase of $105,744 over balance on hand at first of year. Ore shipments amounted to 38,452 dry tons, of which 22,543 tons came from No. 1 workings and 15,909 from No. 3 workings. Developments on 600 level on East vein are reported promising, and ground on 1900, which is being developed is considered good.

YANKEE CONSOLIDATED (Eureka)—Prospecting is being done on 200 level to locate northern extension of Beck Tunnel-Colorado ore zone. Work done here thus far has been several hundred feet from surface, and new work will prospect territory higher up into which ore channel should naturally make from properties on south. Prospecting is being done on 2000 also. Output consisting of lead and zinc ore amounts to about 50 tons per week. Last car of zinc ore sent out ran 37 per cent.

### Salt Lake County

UTAH COPPER (Bingham)—A quarterly dividend of 75c. per share has been declared.

### Summit County

PARK CITY SHIPMENTS FOR WEEK ENDED NOV. 23 were 4,034,960 lb. In addition to regular shippers, Silver King Consolidated, American Flag and Thompson-Quincy contributed.

DALY-JUDGE (Park City)—A dividend of 15c. per share has been declared payable Dec. 20.

AMERICAN FLAG (Park City)—Air connections between the 1100- and 1000-ft. levels have been completed.

SILVER KING CONSOLIDATED (Park City)—A dividend of 25c. per share has been declared, payable Dec. 22.

SILVER KING COALITION (Park City)—A dividend of 15c. per share has been declared payable Dec. 24. Preparations are being made to develop ore-bearing ground below Alliance tunnel, and heavy equipment has been installed to sink a shaft 1000 ft. below the tunnel level.

MINES OPERATING CO. (Park City)—Operations were delayed a few days on account of breaking down of a dryer. This has been repaired, and average daily tonnage of approximately 150 tons is being handled. This tonnage will be maintained, and probably increased.

## CANADA

### British Columbia

HEDLEY GOLD MINING CO. (Hedley)—A crew of 40 men has been employed on dam under construction on Similkameen River. Dam is to be built diagonally across river and is to be 400 ft. long, with lower end about 200 ft. below mouth of Twenty Mile Creek. Excavation which has already been made has proved beneficial effect of slimes, which have been discharging into river from mouth of Twenty Mile Creek since stamp mill started to run nearly ten years ago, for it has rendered gravels and sands of river bottom impervious to water, thereby adding a most important element of strength to dam. Below this argillaceous covering formed by slime accumulations, it was found to be quite dry, although lower than bottom of channel in which water of river was flowing a few feet distant. After dam is completed slimes will be allowed to run into mill pond freely for a few months to supply an impervious mantle to gravel that has been disturbed by excavating in constructing dam.

GRANBY CONSOLIDATED (Grand Forks)—Results of operations at Grand Forks and Phoenix for four months ended Oct. 31, show a profit amounting to $253,808. Company has lately acquired properties of Snowshoe Gold & Copper Mines, Ltd., which will be operated through workings of Gold Drop mine, which they adjoin at Phoenix, and will be furnishing ore before Jan. 1. At Anyox, several additional properties tributary to smelter have been taken over, including a limestone property and one copper property carrying an excess of lime, insuring an ample supply of that material for flux. These properties have been held under option for periods sufficient to admit of prospecting and careful examination and some of them are expected to prove of considerable importance, materially increasing tonnage available for Anyox smelting plant. No single investment was large, but aggregate, including Snowshoe properties, amounts to $275,000, payments running over various periods. Work of completing new smelter has gone steadily forward without unforeseen difficulties. Matter of transportation, which is of great importance, has been receiving considerable attention and

### Ontario

CREIGHTON MINE (Creighton)—A serious cave-in occurred the night of Dec. 9. Two pillars above third level gave way at first and later one more went due to extra load, which it was obliged to assume. About 250,000 tons of material fell altogether, in two main falls. First fall took place at 6:40 p.m., and ground fell from between third level and surface of openpit down to fifth level, a distance of 300 ft. Material fell on muck over drywalls causing them to cave in. There were about 60 men working in and near that section and all but one got out safely.

## MEXICO

### Jalisco

AMPARO (Etzatlan)—Several carloads of concentrates have been shipped from camp in Etzatlan district to San Francisco, leaving country through Pacific port of Manzanillo. Present condition of smelting industry in Mexico made shipment to States necessary.

SAN RAFAEL Y ANEXAS (San Pedro Analco)—This Pachuca company now in control of San Pedro Analco properties in Hostotipaquillo district, is at work on a wagon road to Southern Pacific station of La Quemada. A cable line will be used in transporting supplies, and product across Santiago River.

CINCO MINAS (Hostotipaquillo)—A full force is again at work on 250-ton reduction plant, and end of year is expected to see it completed and ready for operation. Since anti-foreign outbreak at camp in October, when two Americans, Thomas Barrett and William Kendall, were killed, mining force has been reorganized, and active development has been resumed.

EL FAVOR (Etzatlan)—Rebel activity in Hostotipaquillo district has not interfered with mine or mill operations, but shipments of high-grade ore have been curtailed, due to fact that some freighters have withdrawn their animals to places of comparative safety, fearing confiscation by rebels. El Favor bullion output is being increased. Company has paid its fourth quarterly dividend, making the total disbursement for year $140,000, United States currency.

### Sonora

EXPORTS FROM AGUA PRIETA, for November were as follows: Nacozari, 13,491 tons; El Tigre, 214; Swamp Angel, 8; La Sonora, 101; La Alemana, 48; San Carlos, 10; San Pablo, 18; Monte Cristo, 10; La Union, 25; Good Enough, 19; Crestoncito, 4; Santa Rosa, 41; Ventana, 42; El Vaquero, 27; total, 14,058 tons. El Tigre shipped 63 bars of gold and silver bullion weighing 9748 lb. Estimates of ore and bullion values are: Copper, $2,119,400; silver, $806,700; gold, $259,600; total, $3,185,700.

HOHMAN (Nacozari)—An examination of this mine is being made. It was formerly known as Camp Colorado.

ORMUS (Cumpas)—Large boiler has been purchased and shaft will be unwatered.

ORMUS (Cumpas)—Work has been temporarily suspended and Manager McGimsey has gone to California to attend a meeting of company in regard to future development.

ROY (Esqueda)—Property is held under mortgage by First National Bank of Douglas. A bond and lease has been given to C. E. Jones who is now at mine making examination and cleaning up preparatory to starting work.

CINCO DE MAYO (Esqueda)—Property operated by "Constitutionalists" under management of Capt. E. Villareal is making a profit of 15,000 pesos per month. Mill treats about 20 tons per day making a concentrate assaying about 400 oz. silver per ton. Concentrates and high-grade ores are smelted in adobe furnaces and bullion is sent to refineries in United States. When mining first started ore was shipped to smelters but owing to state in which title is held smelting companies have refused to take ore necessitating smelting it at mine. About 200 men are employed in mine, mill and smelter.

# THE MARKET REPORT

## METAL MARKETS

**NEW YORK—Dec. 17**

The metal markets continue quiet with a declining tendency, which is balanced by a stronger tone in some quarters.

### Copper, Tin, Lead and Zinc

**Copper**—The improvement that we reported at the end of last week went but little further, after which things flattened out. There is gossip about some large sales having been made to dealers. Some of the large producers raised their nominal asking price to 14½c., delivered at buyers' works, but were not able to realize it. The market has been very dull. Domestic manufacturers have been indifferent. No sales to them have been reported to us, although copper has been offered freely at 14⅜c., delivered. A few millions of pounds have been sold for export at 14.25@14.35c., delivered in Europe.

The situation in Lake copper remains about as previously reported, the prices of the principal producers being nominally 14⅞@15c., while an occasional carload is sold by some outside producer at 14¾c. The position of casting copper remains unchanged.

At the close we quote electrolytic copper in cakes, ingots and wirebars at 14.10@14.15c. Casting copper is quoted nominally at 13¼@14c. as an average for the week.

The London standard market has fluctuated within narrow limits, holding around £65 for both spot and three months. The close is cabled at £65 2s. 6d. for spot and £65 for three months.

Base prices of copper sheets is now 20¼c. per lb. for hot rolled and 21¼c. for cold rolled. Full extras are charged and higher prices for small quantities. Copper wire is 15¾@16c. per lb. carload lots at mill.

Exports of copper from New York for the week are reported at 8032 long tons. Our special correspondent gives the exports from Baltimore for the week at 2155 tons.

At a recent meeting of the Union Miniere du Haut Katanga in Brussels, the president reported the production of copper for 11 months of 1913 at 6420 metric tons, from 48,500 tons of ore treated. This was an increase of 4016 tons metal over the previous year.

**Visible Stocks of Copper in Europe** on Dec. 15 are reported as follows: Great Britain, 11,910; France, 2650; Rotterdam, 2500; Hamburg, 2260; Bremen, 880; other European ports, 1000; total, 21,200 long tons, or 47,488,000 lb.; an increase of 400 tons over Nov. 30. In addition to the stocks above 1720 tons are reported afloat from Chile and 4300 tons from Australia, making a total of 27,220 tons.

**The Price of Casting Copper** was given in our last issue at 12¾@14c. for the week. This was a misprint, 13¾@14c. being the correct figure.

**Tin**—The London market, while very dull during the latter part of last week, showed an improving tendency beginning with this week. There was a fair activity and the confidence of speculators in the future of the market was expressed in their liberal purchases of future tin, which has been selling at a premium of over £1 10s. over spot tin. This confidence, however, was not imparted to sellers on this side, who seem to be anxious for business and, in order to obtain the same, ready to undersell London quotations. There was a fair amount of buying on the part of tinplate manufacturers, who report a better demand and, in consequence, an improvement in the consumption of pig tin in this industry.

The market closes steady at £172 for spot and £173 10s. for three months, and about 37¾c. for January tin here.

Messrs. Robertson & Bense report the arrival of tin ore and concentrates at Hamburg, Germany, in October, at 1368 tons, of which 1366.5 tons were from Bolivia and 1.5 tons from South Africa.

H. A. Watson & Co. report the arrivals of Bolivian tin at Liverpool in October at 30 tons bars and 1298 tons concentrates; the whole equivalent to 809 tons fine tin.

Tin production of Federal Malay States 11 months ended Nov. 30 was, 44,028 long tons in 1912, and 44,738 in 1913; an increase of 710 tons this year.

**Lead**—The low level of prices interested consumers, and a fair tonnage was taken by them during the week. The recent buying is believed to have gone a good way toward cleaning up stocks, although a little perhaps yet remains to be absorbed.

The foreign market is also somewhat firmer, Spanish lead being quoted at £17 17s. 6d. and English 7s. 6d. higher.

**Spelter**—Sales have been made right through the week at 4.97½@5c., St. Louis, covering December and December-January shipments. There is inquiry for future deliveries, but producers are averse to committing themselves. A feeling prevails that if the demand improves materially, the price for spelter may advance sharply.

The London market is somewhat firmer, good ordinaries being quoted at £21 10s. and specials £22 5s. per ton.

The base price of sheet zinc in carload lots is now $7.25 per 100 lb. basis, less 8% discount, f.o.b. cars, Peru, Ill.

It is estimated roughly that about one-third of the zinc smelting capacity of the United States is now idle.

### DAILY PRICES OF METALS

NEW YORK

| Dec. | Sterling Exchange | Silver | Copper | | Tin | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Lake, Cts. per lb. | Electrolytic, Cts. per lb. | Cts. per lb. | New York, Cts. per lb | St. Louis, Cts. per lb. | New York, Cts. per lb. | St. Louis, Cts. per lb. |
| 11 | 4.8510 | 57⅞ | *14¾ @15 | 14.05 @14.15 | 37⅜ | 3.97½ @4.00 | 3.80 @3.90 | 5.12½ @5.15 | 4.97½ @5.00 |
| 12 | 4.8520 | 58 | *14¾ @15 | 14.10 @14.20 | 37½ | 4.00 | 3.85 @3.90 | 5.12½ @5.15 | 4.97½ @5.00 |
| 13 | 4.8535 | 58 | *14¾ @15 | 14.10 @14.20 | 37½ | 4.00 | 3.85 @3.90 | 5.12½ @5.15 | 4.97½ @5.00 |
| 15 | 4.8535 | 57⅞ | *14¾ @15 | 14.05 @14.15 | 37¾ | 4.00 | 3.85 @3.90 | 5.12½ @5.15 | 4.97½ @5.00 |
| 16 | 4.8520 | 57⅞ | *14¾ @15 | 14.05 @14.15 | 38 | 4.00 | 3.85 @3.90 | 5.12½ @5.15 | 4.97½ @5.00 |
| 17 | 4.8510 | 57⅞ | *14¾ @15 | 14.10 @14.15 | 37¾ | 4.00 | 3.85 @3.90 | 5.12½ @5.15 | 4.97½ @5.00 |

*Nominal.

The quotations herein given are our appraisal of the market for copper, lead, spelter and tin based on wholesale contracts with consumers without distinction as to deliveries; and represent, to the best of our judgement, the bulk of the transactions, reduced to basis of New York, cash, except where St. Louis is specified as the basing point. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. below that of electrolytic. The quotations for lead represent wholesale transactions in open market for good ordinary brands, both desilverized and non-desilverized; the specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium. Silver quotations are in cents per troy ounce of fine silver.

LONDON

| Dec. | Silver | Copper | | | | Tin | | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Spot | | 3 Mos. | Best Sel'td | Spot | 3 Mos. | £ per Ton | Cts. per Lb. | £ per Ton | Cts. per Lb. |
| | | £ per Ton | Cts. per Lb. | | | | | | | | |
| 11 | 26⅜ | 65⅞ | 14.31 | 65 | 70 | 171½ | 172¾ | 18 | 3.91 | 21¼ | 4.62 |
| 12 | 26 13/16 | 65⅜ | 14.20 | 65 | 70 | 171⅜ | 172⅝ | 17⅞ | 3.88 | 21¼ | 4.62 |
| 13 | 26 13/16 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 15 | 26⅜ | 65⅜ | 14.20 | 65⅛ | 69¾ | 172 | 173½ | 17⅞ | 3.88 | 21¼ | 4.62 |
| 16 | 26⅜ | 65 | 14.12 | 64⅞ | 69¾ | 173 | 174¼ | 18 | 3.91 | 21⅜ | 4.64 |
| 17 | 26 11/16 | 65⅛ | 14.15 | 65 | 69¾ | 172 | 173½ | 17⅞ | 3.88 | 21½ | 4.67 |

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latte being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26c = £25 = 5.44c.; £70 = 15.22c. Variations, £1 = 0.21¾c.

## Other Metals

**Aluminum**—The market remains dull, with small sales, and no improvement is expected before the end of the year. Prices are not changed, but are rather nominal at 18¾@19¼c. per lb. for No. 1 ingots, New York. The foreign market is quiet but steady.

**Antimony**—Trade remains quiet; buyers seem to be taking only for pressing requirements. Prices show no material change. Cookson's is quoted at 7.40@7.60c. per lb.; Hallett's at 7⅛@7⅜c. For Chinese, Hungarian and other outside brands 6@6¼c. per lb. is asked.

**Quicksilver**—A fair business is reported and the market is steady, with no change in prices. The New York quotation is $39@40 per flask of 75 lb. for large lots. The jobbing price for small orders is 54@56c. per lb. San Francisco, $39 per flask, with special terms for export. London price is £7 10s. per flask, with £7 5s. quoted from second hands.

**Bismuth**—Quotations at New York are $1.72 per lb. for metal produced from domestic ores; $1.80 for imported metal. London quotation is 7s. 6d. per lb. The price is controlled by the European syndicate.

**Cadmium**—German quotation is 750 marks per 100 kg.—equal to about 81c. per lb.—f.o.b. works in Silesia.

**Nickel**—Quotations for ordinary forms, shot-blocks, or plaquettes—are 40@45c. per lb., according to size or order and quality. Electrolytic nickel is 5c. per lb. higher.

**Selenium**—For large lots, 100 lb. or over, $3@3.25 per lb. is quoted; while $5 per lb. is paid for retail orders.

## Gold, Silver and Platinum

**Gold**—There was no change in prices on the open market in London, 77s. 9d. per oz. being quoted. With the exception of some taken for India, the supplies arriving went to the Bank of England.

Imports of gold for the week at New York were $250,183, the larger part from Mexico. Exports were $98,438, chiefly to the West Indies.

**Iridium**—Dealers still ask $81@82 per oz., New York, for pure metal.

**Platinum**—The market is quiet and rather easy, but prices are unchanged. Dealers ask $43@44 per oz. for refined platinum and $47@50 per oz. for hard metal. The sales to jewelers this year have been rather light. The market abroad seems to be firmer than it is here, though the prices do not advance.

**Silver**—The market continues steady at the decline. Now that the large speculative interests that have been manipulating the price of silver so long have come to grief the probabilities are that the fluctuations in silver are likely to move within narrow limits; at any rate for the present.

Shipments of silver from London to the East, Jan. 1 to Dec. 4, as reported by Messrs. Pixley & Abell:

| | 1912 | 1913 | Changes |
|---|---|---|---|
| India | £10,229,000 | £9,606,000 | D. £623,000 |
| China | 1,674,500 | 755,000 | D. 919,500 |
| Total | £11,903,500 | £10,361,000 | D. £1,542,500 |

Imports of silver at New York for the week were valued at $578,017, largely from Mexico and South America. Exports were $789,984, nearly all to London and Paris.

## Zinc and Lead Ore Markets

**PLATTEVILLE, WIS.—Dec. 13**

The base price paid this week for 60% zinc ore was $38@39 per ton. The base price paid for 80% lead ore was $48 per ton.

SHIPMENTS WEEK ENDED DEC. 13

| | Zinc ore, lb. | Lead ore, lb. | Sulphur ore, lb. |
|---|---|---|---|
| Week | 3,794,440 | 172,100 | 1,024,360 |
| Year | 143,057,850 | 5,477,180 | 54,753,770 |

Shipments during week to separating plants, 2,609,740 lb. zinc ore.

**JOPLIN, MO.—Dec. 13**

One company filled orders for high-grade blende on a base of $38.50 per ton of 60% zinc, but all other companies paid a base of $40, with the demand stronger than last week. Blende carrying over 4% of iron sold on a metal base of $37@38 per ton. Calamine remains steady at $20@22 per ton of 40% zinc. The average price of all grades of zinc ore is $37.06. Lead sold as high as $54 per ton, though it is claimed by buyers that buying is on a base of $49 per ton of ore assaying 80% metal contents. It is evident a high base is being paid or some ore was contracted for several weeks ahead before the decline of last week. The average price of all lead is $49.86 per ton.

SHIPMENTS WEEK ENDED DEC. 13

| | Blende | Calamine | Lead | Value |
|---|---|---|---|---|
| Totals this week. | 8,781,540 | 1,067,890 | 1,955,160 | $231,280 |
| 50 weeks..... | 534,242,130 | 42,315,130 | 92,079,910 | $14,786,049 |

Blende value, the week, $170,200; 50 weeks, $12,709,115.
Calamine value, the week, $12,335; 50 weeks, $541,344.
Lead value, the week, $48,745; 50 weeks, $2,425,599.

# IRON TRADE REVIEW

**NEW YORK—Dec. 17**

The iron and steel markets are generally quiet, with little change from recent weeks, but perhaps a better tone beginning to be apparent.

Statistics of iron and steel imports in October, the first month of the new tariff, show no material increase over those of the two preceding months, while they are much smaller than the average of the first six months, of the year. The general trade showing is extremely favorable, since the merchandise trade balance for the month was $139,000,000, easily a new record. The record showing was accomplished by heavy exports and relatively light imports, the former influence being predominant.

Steel mill operations appear to have reached their minimum about the first of the month, as there has been no general decrease since then, production and shipments being at about 50% of capacity. With some extensive closings over the holidays the month's average will be less, and there is a prospect that January operations will show an increase. Predictions of an early increase in buying, perhaps by the middle of January, are becoming more common.

The pig-iron market this week makes a more cheerful showing than for some time. Several large orders have been placed, and there is more inquiry for iron. The business comes nearly all from large consumers, who seem to have made up their minds that bottom prices have been reached. Smaller buyers are still inclined to hold back.

**The United States Steel Corporation** reports unfilled orders on its books, Nov. 30, at 4,396,347 tons. This is a decrease of 117,420 tons from Oct. 31, and of 3,535,817 tons from Dec. 31, 1912. This is the lightest report made by the company since November, 1911; but the decrease during the past month was lighter than had been expected.

**PITTSBURGH—Dec. 16**

The attitude of steel buyers is not believed to be unfavorable, except that naturally they are indisposed to buy on a falling market. Steel prices, however, have been much steadier in the past fortnight than formerly, declines being almost insignificant, while mills are decidedly opposed to selling for far forward delivery at the current level, and this attitude may tend to encourage buyers.

Bars, plates and shapes can be bought at 1.20c. on very attractive orders, for early shipment, but on ordinary lots a quotation of 1.25c. is common, particularly on shapes. Sheets are quotable at about 1.90c. and 2.90c. for black and galvanized respectively, these prices being frequently shaded for prompt shipments, while on contracts for first quarter advances of $1 a ton are asked.

**Pig Iron**—The American Steel Foundries is believed to have bought about 10,000 tons of basic for first-quarter delivery to Alliance and Sharon, but details are unobtainable. Foundry iron is very quiet. We quote: Bessemer, $15; basic, $12.75; malleable, $13.50; No. 2 foundry, $13.50; forge, $13.15, at Valley furnaces, 90c. higher delivered Pittsburgh.

**Ferromanganese**—The market is quite steady at the new price of $47, Baltimore, freight to Pittsburgh being $2.16. English and German are on the same basis, and the German can be had with a guarantee of phosphorus as low as the English.

**Steel**—The mills seem to have established a dead line at $20 for billets and $21 for sheet bars, maker's mill, Pittsburgh or Youngstown. They will not sell beyond first quarter at this level. Transactions are extremely light.

**Connellsville Coke**—The Producers' Coke Co. is holding its coke strictly at $2 for first quarter or first half, and it is reported that some coke has been sold at this level. There are a few sellers at $1.90 or $1.85. Contracting is very slow, as prompt remains easily available at $1.75. Foundry coke is $2.50@2.75 for either prompt or contract.

**Foreign Trade of the United States** in iron and steel and machinery, 10 months ended Oct. 31, is valued as below by the Bureau of Statistics of the Department of Commerce:

| | 1912 | 1913 | Changes |
|---|---|---|---|
| Exports | $238,971,131 | $251,672,076 | I. $12,700,945 |
| Imports | 23,885,776 | 28,291,355 | I. 4,405,579 |
| Excess, exports | $215,085,355 | $223,380,721 | I. $ 8,295,366 |

The increase in exports this year was 5.3%; the gain in imports was 18.4%. For the last two months imports have shown a decrease as compared with last year.

**Foreign Iron and Steel Trade of Germany,** 10 months ended Oct. 31, metric tons:

| | Exports | Imports | Excess |
|---|---|---|---|
| Iron and steel | 5,396,512 | 520,663 | Exp. 4,875,849 |
| Machinery | 466,514 | 77,643 | Exp. 388,871 |
| Total | 5,863,026 | 598,306 | Exp. 5,264,720 |
| Total, 1912 | 5,354,361 | 625,989 | Exp. 4,728,372 |

### IRON ORE

Iron ore in the East is very quiet. This is reflected in the fact that a number of the iron mines in Cuba have closed down, or have suspended work for a time. The reason is that a number of furnaces are holding back from buying ore at present, and contract buyers have been hestitating about the prospects for next year's business.

**Imports and Exports of Iron Ore** in the United States, 10 months ended Oct. 31, long tons:

| | 1912 | 1913 | Changes |
|---|---|---|---|
| Imports | 1,741,577 | 2,191,136 | I. 449,559 |
| Exports | 1,088,901 | 907,275 | D. 181,626 |

Imports are chiefly from Cuba, Newfoundland and Sweden; exports to Canada. Imports of manganese ore for the 10 months were 227,890 tons in 1912, and 288,588 in 1913 ; an increase of 60,698 tons.

### COKE

Coke production in the Connellsville region for the week declined a little, being close to 322,000 tons. Shipments were only a few tons less. Makers are holding out for $2 per ton for furnace coke on contracts for 1914, but furnaces are very slow to close at that figure.

Virginia coke is now quoted at $1.75@2 per ton at oven for furnace coke.

**Exports and imports of coal in the United States** 10 months ended Oct. 31, in long tons:

| | Exports | | Imports | |
|---|---|---|---|---|
| | 1912 | 1913 | 1912 | 1913 |
| Anthracite | 3,032,691 | 3,598,343 | 1,657 | 864 |
| Bituminous | 12,395,776 | 15,543,656 | 1,337,891 | 1,136,737 |
| Coke | 679,772 | 731,868 | 86,425 | 67,297 |
| Bunker coal | 6,151,280 | 6,483,020 | ..... | ..... |
| Total | 22,259,519 | 26,356,887 | 1,425,973 | 1,204,898 |

The bunker coal, or coal sent abroad for the use of steamships in foreign trade, is practically all bituminous. The trade is chiefly with Canada.

## CHEMICALS

### NEW YORK—Dec. 17

The general trade has been still further quieted down by the approach of the holidays and the close of the year.

**Imports and Exports of Chemicals** and raw materials in the United States, nine months ended Sept. 30, were as follows:

| | Imports | | Exports | |
|---|---|---|---|---|
| | 1912 | 1913 | 1912 | 1913 |
| Arsenic, lb. | 4,190,361 | 5,615,876 | ..... | 66,000 |
| Copper sulphate, lb. | ..... | ..... | 5,712,696 | 3,765,323 |
| Bleach, lb. | 55,074,235 | 47,429,010 | 400 | 13,260 |
| Potash salts, lb. | 469,342,269 | 432,102,304 | 2,650,210 | 2,915,117 |
| Soda salts, lb. | 9,053,189 | 8,762,607 | 368,270 | 433,730 |
| Acetate of lime, lb. | ..... | ..... | 58,661,375 | 57,279,340 |
| Nitrate of soda, tons. | 347,694 | 524,831 | 6,560 | 4,276 |
| Sulph. ammonia, tons. | 28,230 | 33,492 | 160 | ..... |
| Phosphates, tons. | ..... | ..... | 927,822 | 1,096,102 |
| Sulphur, tons. | 22,056 | 10,868 | 42,127 | 71,680 |
| Pyrites, tons. | 690,338 | 716,085 | ..... | ..... |
| Magnesite, tons. | 71,486 | 123,661 | 861 | 1,648 |
| Chrome ore, tons. | 36,646 | 50,779 | ..... | ..... |

Exports include reëxports of foreign material. Some phosphate is imported, but it is not given separately in the returns.

**Arsenic**—Business continues dull with sales light. The nominal quotation is $2.95@3 per 100 lb., but it is claimed that on a large order business could be done at lower prices.

**Copper Sulphate**—Business has been slow and prices nominally unchanged, the principal seller asking $5 per 100 lb. for carload lots and $5.25 per 100 lb. for smaller parcels.

**Nitrate of Soda**—Recent heavy dealing seems to have filled up buyers, and there is very little doing. Quotations are unchanged at 2.17½c. per lb. for spot, and 2.20c. for futures.

### NEW CALEDONIA ORES

Exports of ores from New Caledonia nine months ended Sept. 30, as reported by the "Bulletin du Commerce" of Noumea, were 69,458 metric tons of nickel ore and 33,060 tons chrome ore. Exports of metals were 5761 tons of nickel matte.

### COPPER SMELTER'S REPORTS

This table is compiled from reports received from the respective companies except in the few cases noted (by asterisk) as estimated, together with the reports of the U. S. Dept of Commerce as to imported material, and in the main represents the crude copper content of blister copper, in pounds. In those cases where the copper contents of ore and matte are reported, the copper yield then is reckoned at 97%. In computing the total American supply duplications are excluded.

| | July | August | September | October | November |
|---|---|---|---|---|---|
| Alaska shipments | 2,705,136 | 1,847,785 | 2,261,216 | 1,951,883 | 3,391,300 |
| Anaconda | 22,100,000 | 22,500,000 | 22,600,000 | 18,400,000 | 25,250,000 |
| Arizona, Ltd. | 2,600,000 | 1,800,000 | 1,800,000 | 3,550,000 | 2,800,000 |
| Copper Queen | 8,369,607 | 8,252,404 | 8,434,803 | 8,292,929 | 7,115,991 |
| Calumet & Ariz. | 3,800,000 | 4,500,000 | 4,000,000 | 4,500,000 | ..... |
| Chino | 4,746,525 | 5,788,572 | 4,196,296 | 4,767,466 | ..... |
| Detroit | 1,549,224 | 2,187,223 | 2,102,818 | 1,861,878 | 1,922,352 |
| East Butte | 1,060,257 | 1,162,007 | 1,233,018 | 1,040,997 | ..... |
| Giroux | 584,546 | 524,953 | 198,178 | 156,084 | ..... |
| Mason Valley | 908,892 | 867,060 | 918,000 | 1,052,000 | 1,174,000 |
| Mammoth | 1,800,000 | 1,750,000 | 1,750,000 | 1,700,000 | 1,700,000 |
| Nevada Con. | 5,403,919 | 5,989,973 | 4,441,671 | 5,898,046 | ..... |
| Ohio | 601,700 | 689,000 | 685,900 | 698,691 | ..... |
| Old Dominion | 2,526,000 | 2,524,000 | 2,679,000 | 2,037,000 | ..... |
| Ray | 4,097,000 | 4,269,519 | 4,336,434 | 4,725,419 | ..... |
| Shannon | 880,000 | 1,248,000 | 1,232,000 | 1,216,000 | 1,110,000 |
| South Utah | 140,000 | 223,498 | 241,843 | 232,269 | ..... |
| Tennessee | 1,247,804 | 1,101,019 | 1,309,985 | 1,392,162 | 1,688,000 |
| United Verde* | 3,000,000 | 3,000,000 | 3,000,000 | 3,000,000 | ..... |
| Utah Copper Co. | 9,849,043 | 10,302,251 | 11,463,905 | 9,929,478 | ..... |
| Lake Superior* | 17,500,000 | 9,700,000 | 6,950,008 | 5,500,000 | 6,600,000 |
| Non-rep. mines* | 6,200,000 | 6,200,000 | 6,000,000 | 6,200,000 | ..... |
| Total prod. | 101,669,653 | 96,427,264 | 91,835,075 | 88,102,302 | ..... |
| Imp., bars, etc. | 29,029,990 | 22,474,471 | 35,703,660 | 21,935,023 | ..... |
| Total blister | 130,699,643 | 118,901,735 | 127,538,735 | 110,037,325 | ..... |
| Imp. ore & matte | 8,527,046 | 9,171,351 | 10,800,162 | 5,062,015 | ..... |
| Total Amer. | 139,226,689 | 128,073,086 | 138,338,897 | 115,099,340 | ..... |
| Miami† | 2,890,000 | 3,097,500 | 2,688,000 | 2,862,050 | 3,230,000 |
| Shattuck-Arizona | 1,019,388 | 1,001,634 | 1,163,237 | 993,224 | ..... |
| Brit. Col. Cos.: | | | | | |
| British Col. Cop. | 618,379 | 647,905 | 621,120 | 688,581 | ..... |
| Granby | 1,664,102 | 1,847,344 | 1,824,659 | 1,718,258 | 1,944,145 |
| Mexican Cos.: | | | | | |
| Boleo† | 2,240,720 | 2,264,640 | 2,369,920 | 2,424,800 | 2,315,040 |
| Cananea | 3,328,000 | 3,186,000 | 3,148,000 | 3,682,000 | 3,800,000 |
| Moctezuma | 2,693,006 | 3,542,047 | 3,024,121 | 3,178,136 | 3,517,800 |
| Other Foreign: | | | | | |
| Braden, Chile | 1,046,000 | 1,572,000 | 1,332,000 | 2,006,000 | 1,592,000 |
| Cape Cop., S. Af. | ..... | ..... | 607,040 | 712,320 | 649,600 |
| Kyshtim, Russia. | 2,500,000 | 1,585,000 | 1,187,000 | ..... | ..... |
| Spassky, Russia. | 660,800 | 1,048,320 | 1,025,920 | 983,360 | ..... |
| Exports from | | | | | |
| Chile | 9,856,000 | 8,736,000 | 5,600,000 | 6,160,000 | 7,616,000 |
| Australia | 10,304,000 | 7,720,000 | 6,944,000 | 7,728,000 | 11,200,000 |
| Arrivals-Europe‡ | 11,728,640 | 14,624,960 | 9,661,120 | 18,040,960 | 9,107,840 |

† Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.

‡ Does not include the arrivals from the United States, Australia or Chile.

### STATISTICS OF COPPER

| Month | United States | | | Visible Stocks. | | |
|---|---|---|---|---|---|---|
| | U.S.Refin'y Production | Deliveries, Domestic | Deliveries, for Export | United States | Europe | Total |
| XI, '12 | 134,695,400 | 69,369,795 | 55,906,550 | 76,744,964 | 103,801,600 | 180,546,564 |
| XII. | 143,354,042 | 58,491,723 | 65,713,796 | 86,164,059 | 96,947,200 | 183,111,259 |
| Year, 1912 | 1,581,920,287 | 819,665,948 | 746,396,452 | ..... | ..... | ..... |
| I, 1913. | 143,479,625 | 65,210,030 | 60,383,845 | 105,312,582 | 78,491,840 | 183,904,422 |
| II. | 130,948,881 | 59,676,492 | 72,168,523 | 123,198,332 | 77,504,000 | 200,702,332 |
| III. | 136,251,849 | 76,585,471 | 77,699,306 | 122,302,890 | 81,244,800 | 203,547,690 |
| IV. | 135,353,402 | 78,158,837 | 85,894,727 | 104,269,270 | 87,180,800 | 191,450,070 |
| V. | 141,319,416 | 81,108,321 | 68,285,978 | 75,549,108 | 85,948,800 | 161,497,908 |
| VI. | 121,860,853 | 68,362,571 | 68,067,901 | 67,474,225 | 77,235,200 | 144,709,425 |
| VII. | 138,074,602 | 58,904,192 | 78,480,071 | 52,814,606 | 71,904,000 | 124,808,606 |
| VIII. | 131,632,362 | 73,649,801 | 73,263,469 | 53,594,945 | 66,420,480 | 120,015,385 |
| IX. | 131,401,229 | 66,836,897 | 73,085,275 | 38,314,037 | 63,716,800 | 102,030,837 |
| X. | 139,070,481 | 68,173,720 | 68,123,473 | 29,793,094 | 53,625,600 | 83,418,692 |
| XI. | 134,087,708 | 48,656,858 | 70,067,803 | 32,566,382 | 48,787,200 | 81,353,582 |
| XII. | ..... | ..... | ..... | 47,929,429 | 46,592,000 | 94,521,429 |

Note—From Jan. 1, 1913, visible supplies in Europe do not include copper afloat.

### Assessments

| Company | Delinq. | Sale | Amt. |
|---|---|---|---|
| Arctic, Ida. | Dec. 1 | Dec. 31 | .00025 |
| Benton, Ida. | Nov. 25 | Dec. 23 | 0.005 |
| Big Cottonwood, Utah | Dec. 10 | Dec. 29 | 0.01 |
| Bullion, Nev. | Dec. 12 | Dec. 30 | 0.02 |
| Carbonate Center, Ida. | Nov. 5 | Dec. 22 | 0.001 |
| Clear Grit, Ida., postp'd. | Nov. 18 | Jan. 2 | 0.0025 |
| Comet Placer, Nev. | Dec. 6 | Dec. 22 | 0.03 |
| Ely Consolidated, Nev. | ..... | Dec. 31 | 0.03 |
| Empire, Ida., postp'd. | Oct. 30 | Jan. 2 | 0.005 |
| Gold Mountain Champion, Ida. | Dec. 9 | Dec. 30 | 0.0025 |
| Great Copper King, Ida. | Nov. 29 | Dec. 29 | 0.001 |
| Hypotheek, Ida. | Dec. 5 | Jan. 5 | 0.006 |
| Independence, Utah | Dec. 12 | Jan. 2 | 0.006 |
| Leroy, Ida. | Dec. 3 | Jan. 3 | 0.002 |
| Little North Fork, Ida. | Dec. 1 | Jan. 2 | 0.001 |
| Nabob, Ida., postp'd. | Nov. 17 | Dec. 21 | 0.005 |
| New Yerington, Nev. | Dec. 10 | Dec. 30 | 0.01 |
| North Franklin, Ida., postp'd | Oct. 16 | Jan. 29 | 0.005 |
| Overman, Nev. | Dec. 10 | Dec. 30 | 0.05 |
| Plaza, Utah | Dec. 13 | Dec. 29 | 0.0025 |
| Rescue Eula, Nev. | Nov. 25 | Dec. 29 | 0.01 |
| Robbers Roost, Calif. | Dec. 5 | Dec. 29 | 0.01 |
| Sag. Belcher, Nev. | Dec. 5 | Dec. 30 | 0.02 |
| Silver Star, Ida., postp'd. | Nov. 22 | Jan. 10 | 0.002 |
| Tintic, Utah | Dec. 10 | Dec. 31 | 0.002 |
| Utah of Fish Springs | Dec. 15 | Jan. 5 | 0.05 |
| Wasatch, Utah | Dec. 22 | Jan. 8 | 0.05 |

### Monthly Average Prices of Metals

SILVER

| Month | New York | | | London | | |
|---|---|---|---|---|---|---|
| | 1911 | 1912 | 1913 | 1911 | 1912 | 1913 |
| January | 53.795 | 56.260 | 62.938 | 24.865 | 25.887 | 28.983 |
| February | 52.222 | 59.043 | 61.642 | 24.081 | 27.190 | 28.357 |
| March | 52.745 | 58.375 | 57.870 | 24.324 | 26.875 | 26.669 |
| April | 53.325 | 59.207 | 59.490 | 24.595 | 27.284 | 27.416 |
| May | 53.308 | 60.880 | 60.361 | 24.583 | 28.038 | 27.825 |
| June | 53.043 | 61.290 | 58.990 | 24.486 | 28.215 | 27.199 |
| July | 52.630 | 60.654 | 58.721 | 24.286 | 27.919 | 27.074 |
| August | 52.171 | 61.606 | 59.293 | 24.082 | 28.375 | 27.335 |
| September | 52.440 | 63.078 | 60.640 | 24.209 | 29.088 | 27.986 |
| October | 53.340 | 63.471 | 60.793 | 24.594 | 29.299 | 28.083 |
| November | 55.719 | 62.792 | 58.995 | 25.649 | 29.012 | 27.263 |
| December | 54.905 | 63.365 | ..... | 25.349 | 29.320 | ..... |
| Year | 53.304 | 60.835 | ..... | 24.592 | 28.042 | ..... |

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

| Month | New York | | | | London Standard | |
|---|---|---|---|---|---|---|
| | Electrolytic | | Lake | | | |
| | 1912 | 1913 | 1912 | 1913 | 1912 | 1913 |
| January | 14.094 | 16.488 | 14.337 | 16.767 | 62.760 | 71.741 |
| February | 14.084 | 14.971 | 14.329 | 15.253 | 62.893 | 65.519 |
| March | 14.698 | 14.713 | 14.868 | 14.930 | 65.884 | 65.329 |
| April | 15.741 | 15.291 | 15.930 | 15.565 | 70.294 | 68.111 |
| May | 16.031 | 15.436 | 16.245 | 15.738 | 72.352 | 68.807 |
| June | 17.234 | 14.672 | 17.443 | 14.871 | 78.259 | 67.140 |
| July | 17.190 | 14.190 | 17.353 | 14.563 | 76.636 | 64.166 |
| August | 17.498 | 15.400 | 17.644 | 15.904 | 78.670 | 69.200 |
| September | 17.508 | 16.328 | 17.698 | 16.799 | 78.762 | 73.125 |
| October | 17.314 | 16.337 | 17.661 | 16.913 | 76.389 | 73.383 |
| November | 17.326 | 15.182 | 17.617 | 16.022 | 76.890 | 68.275 |
| December | 17.376 | ..... | 17.600 | ..... | 75.516 | ..... |
| Year | 16.341 | ..... | 16.560 | ..... | 72.942 | ..... |

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN

| Month | New York | | London | |
|---|---|---|---|---|
| | 1912 | 1913 | 1912 | 1913 |
| January | 42.529 | 50.298 | 191.519 | 238.273 |
| February | 42.962 | 48.766 | 195.036 | 220.140 |
| March | 42.577 | 46.832 | 192.619 | 213.615 |
| April | 43.923 | 49.115 | 200.513 | 224.159 |
| May | 46.063 | 49.038 | 208.830 | 224.143 |
| June | 45.815 | 44.820 | 205.863 | 207.208 |
| July | 44.519 | 40.260 | 202.446 | 183.511 |
| August | 45.857 | 41.582 | 208.351 | 188.731 |
| September | 49.135 | 42.410 | 223.762 | 193.074 |
| October | 50.077 | 40.462 | 228.353 | 184.837 |
| November | 49.891 | 39.810 | 227.619 | 180.869 |
| December | 49.815 | ..... | 226.875 | ..... |
| Av. year | 46.096 | ..... | 209.322 | ..... |

New York in cents per pound; London in pounds sterling per long ton.

LEAD

| Month | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1912 | 1913 | 1912 | 1913 | 1912 | 1913 |
| January | 4.435 | 4.321 | 4.327 | 4.171 | 15.597 | 17.114 |
| February | 4.026 | 4.325 | 3.946 | 4.175 | 15.738 | 16.550 |
| March | 4.073 | 4.327 | 4.046 | 4.177 | 15.997 | 15.977 |
| April | 4.200 | 4.381 | 4.118 | 4.242 | 16.331 | 17.597 |
| May | 4.194 | 4.342 | 4.072 | 4.226 | 16.509 | 18.923 |
| June | 4.392 | 4.325 | 4.321 | 4.190 | 17.588 | 20.226 |
| July | 4.720 | 4.353 | 4.603 | 4.223 | 18.544 | 20.038 |
| August | 4.569 | 4.624 | 4.452 | 4.550 | 19.655 | 20.406 |
| September | 5.048 | 4.698 | 4.924 | 4.579 | 22.292 | 20.648 |
| October | 5.071 | 4.402 | 4.894 | 4.253 | 20.630 | 20.302 |
| November | 4.615 | 4.293 | 4.463 | 4.146 | 18.193 | 19.334 |
| December | 4.303 | ..... | 4.152 | ..... | 18.069 | ..... |
| Year | 4.471 | ..... | 4.360 | ..... | 17.929 | ..... |

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

SPELTER

| Month | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1912 | 1913 | 1912 | 1913 | 1912 | 1913 |
| January | 6.442 | 6.931 | 6.292 | 6.854 | 26.642 | 26.114 |
| February | 6.499 | 6.239 | 6.349 | 6.089 | 26.661 | 25.338 |
| March | 6.626 | 6.078 | 6.476 | 5.926 | 26.048 | 24.605 |
| April | 6.633 | 5.641 | 6.483 | 5.491 | 25.644 | 25.313 |
| May | 6.679 | 5.406 | 6.529 | 5.256 | 25.790 | 24.583 |
| June | 6.877 | 5.124 | 6.727 | 4.974 | 25.763 | 22.143 |
| July | 7.116 | 5.278 | 6.966 | 5.128 | 26.174 | 20.592 |
| August | 7.028 | 5.658 | 6.878 | 5.508 | 26.443 | 20.706 |
| September | 7.454 | 5.694 | 7.313 | 5.544 | 27.048 | 21.148 |
| October | 7.426 | 5.340 | 7.276 | 5.188 | 27.543 | 20.614 |
| November | 7.371 | 5.229 | 7.221 | 5.083 | 26.804 | 20.581 |
| December | 7.162 | ..... | 7.081 | ..... | 26.494 | ..... |
| Year | 6.943 | ..... | 6.799 | ..... | 26.421 | ..... |

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

PIG IRON IN PITTSBURGH

| Month | Bessemer | | Basic | | No. 2 Foundry | |
|---|---|---|---|---|---|---|
| | 1912 | 1913 | 1912 | 1913 | 1912 | 1913 |
| January | $15.12 | $18.15 | $13.32 | $17.35 | $14.00 | $18.59 |
| February | 15.03 | 18.15 | 13.28 | 17.22 | 14.01 | 18.13 |
| March | 14.95 | 18.15 | 13.66 | 16.96 | 14.10 | 17.53 |
| April | 15.13 | 17.90 | 13.90 | 16.71 | 14.15 | 16.40 |
| May | 15.14 | 17.68 | 13.90 | 15.80 | 14.12 | 15.40 |
| June | 15.15 | 17.14 | 14.11 | 15.40 | 14.22 | 15.10 |
| July | 15.15 | 16.31 | 14.38 | 15.13 | 14.38 | 14.74 |
| August | 15.43 | 16.63 | 14.90 | 15.00 | 14.85 | 14.88 |
| September | 16.86 | 16.65 | 16.03 | 15.04 | 15.63 | 14.93 |
| October | 17.90 | 16.60 | 17.18 | 14.61 | 17.22 | 14.80 |
| November | 18.07 | 16.03 | 17.09 | 13.91 | 18.00 | 14.40 |
| December | 18.15 | ..... | 17.45 | ..... | 18.73 | ..... |
| Year | $16.01 | ..... | $14.93 | ..... | $15.28 | ..... |

## STOCK QUOTATIONS

COLO. SPRINGS Dec. 16

| Name of Comp. | Bid. |
|---|---|
| Acacia | ‡.03 |
| Cripple Cr'k Con. | ‡.01 |
| C. K. & N. | ‡.07 |
| Doctor Jack Pot. | .06 |
| Elkton Con. | .51 |
| El Paso | 2.50 |
| Findlay | .01½ |
| Gold Dollar | .06 |
| Gold Sovereign | ‡.02½ |
| Golden Cycle | ‡1.00 |
| Isabella | .09 |
| Jack Pot | .05 |
| Jennie Sample | ‡.04½ |
| Jerry Johnson | ‡.03½ |
| Lexington | ‡.003 |
| Old Gold | .01 |
| Mary McKinney | .57 |
| Pharmacist | ‡.01 |
| Portland | 1.00 |
| Vindicator | .82 |

SALT LAKE Dec. 16

| Name of Comp. | Bid. |
|---|---|
| Beck Tunnel | .04½ |
| Black Jack | .06½ |
| Cedar Talisman | .00½ |
| Colorado Mining | .10 |
| Crown Point | .00½ |
| Daly-Judge | 5.20 |
| Gold Chain | .17½ |
| Grand Central | .56 |
| Iron Blossom | 1.15 |
| Little Bell | .10 |
| Lower Mammoth | .01½ |
| Mason Valley | 3.00 |
| May Day | .05 |
| Nevada Hills | ‡.48 |
| New York | .00½ |
| Prince Con. | .21½ |
| Silver King Coal'n | 3.00 |
| Sioux Con. | .01 |
| Uncle Sam | .03¾ |
| Yankee | .03 |

TORONTO Dec. 16

| Name of Comp. | Bid. | Name of Comp. | Bid. |
|---|---|---|---|
| Bailey | .05 | Foley O'Brien | .16 |
| Coniagas | 7.12½ | Hollinger | 7.00 |
| T. & Hudson Bay | 70.00 | Imperial | ‡.02 |
| Timiskaming | .13½ | Jupiter | .07 |
| Wettlaufer-Lor. | .07 | Pearl Lake | .08½ |
| Apex | ‡.01 | Porcu. Gold | .11 |
| Big Dome | 14.75 | Preston E. D. | .01½ |
| Crown Chartered | .00½ | Rea | .12½ |
| Dohle | ‡.10 | Swastika | .02 |
| Dome Exten | .06½ | West Dome | .08 |

SAN FRANCISCO Dec. 16

| Name of Comp. | Bid | Name of Comp. | Bid |
|---|---|---|---|
| Comstock Stocks | | Misc. Nev. & Cal. | |
| Alta | .06 | Belmont | 7.15 |
| Belcher | .48 | Jim Butler | .64 |
| Best & Belcher | .05 | MacNamara | .07 |
| Caledonia | 1.65 | Midway | .33 |
| Challenge Con. | .13 | Mont.-Tonopah | .91 |
| Chollar | .02 | North Star | .37 |
| Confidence | ‡.38 | West End Con. | 1.22½ |
| Con. Virginia | .12 | Atlanta | .09 |
| Crown Point | .34 | Booth | .02 |
| Gould & Curry | .03 | C.O.D. Con. | .02 |
| Hale & Norcross | .07 | Comb. Frac. | .06 |
| Mexican | 1.15 | Jumbo Extension | .08 |
| Occidental | .70 | Pitts.-Silver Peak | .35 |
| Ophir | .18 | Round Mountain | .33 |
| Overman | .35 | Sandstorm Kendall | .04 |
| Potosi | .03 | Silver Pick | .03 |
| Savage | .10 | Argonaut | 2.50 |
| Sierra Nevada | .07 | Bunker Hill | 1.50 |
| Union Con. | .10 | Central Eureka | .28 |
| Yellow Jacket | .31 | So. Eureka | 2.00 |

N. Y. EXCH. Dec. 16

| Name of Comp. | Clg. |
|---|---|
| Amalgamated | 70½ |
| Am. Agri. Chem. | 44 |
| Am.Sm.&Ref.,com. | 61½ |
| Am. Sm. & Ref., pf. | 97½ |
| Am. Sm. Sec., pf. B | 81 |
| Anaconda | 34 |
| Batopilas Min. | 1 |
| Bethlehem Steel,pf. | 67½ |
| Chino | 37½ |
| Federal M. & S., pf. | 31½ |
| GreatNor.,ore.,ctf. | 31 |
| Guggen. Exp. | 43 |
| Homestake | 116 |
| Inspiration Con. | 14½ |
| Miami Copper | 21 |
| Nat'l Lead, com. | 42½ |
| National Lead, pf. | 102 |
| Nev. Consol. | 14½ |
| Phelps Dodge | 188 |
| Pittsburg Coal, pf. | 85 |
| Quicksilver, pf. | 2½ |
| Ray Con. | 17½ |
| Republic I&S,com. | 19½ |
| Republic I&S, pf. | 78½ |
| SlossSheffi'd,com. | 25 |
| Sloss Sheffield, pf. | 85 |
| Tennessee Copper | 29 |
| Utah Copper | 47½ |
| U. S. Steel, com. | 55½ |
| U. S. Steel, pf. | 104½ |
| Va.Car.Chem.,pf. | 95 |

N. Y. CURB Dec. 16

| Name of Comp. | Clg. |
|---|---|
| Ariz. Belmont | .03½ |
| Barnes King | 1½ |
| Beaver Con. | .32 |
| Big Four | ‡.08 |
| Boston Montana | 5 |
| Braden Copper | 7½ |
| B. C. Copper | 2½ |
| Buffalo Mines | 2 |
| Can. G. & S. | .12 |
| Caribou | .69 |
| Con. Ariz. Sm. | 3/16 |
| Coppermines Cons. | 2 1/16 |
| Davis-Daly | 1⅛ |
| Diam'field-Daisy | ‡.03 |
| Ely Con. | .01½ |
| Florence | .22 |
| Gold Hill Con. | .18 |
| Goldfield Con. | 1½ |
| Greene Cananea | 29½ |
| Greenwater | .05½ |
| Internat. S. & R. | ‡115 |
| Kerr Lake | 4½ |
| La Rose | 1 13/16 |
| McKinley-Dar-Sa. | 1 5/32 |
| Mln. Co. of A. new | 2 1/16 |
| New Utah Bingham | .45 |
| Nipissing Mines | 8 |
| Ohio Copper | ⅛ |
| Puebla S. & R. | 2½ |
| South Utah M&S | ‡3/16 |
| Stand'd Oil of N.J. | 396 |
| Stewart | 1 5/16 |
| Tonopah | 6 1/16 |
| Tonopah Ex. | 1 1/16 |
| Tonopah Merger | .52 |
| Tri-Bullion | ⅛ |
| Tularosa | .50 |
| Union Mines | ‡.08 |
| United Cop., pfd. | ‡3 |
| Yukon Gold | 2 |

LONDON Dec. 8

| Name of Comp. | Clg. |
|---|---|
| Camp Bird | £0 14s 0d |
| El Oro | 0 15 0 |
| Esperanza | 1 1 3 |
| Mexico Mines | 5 7 6 |
| Oroville | 0 11 3 |
| Santa Gert'dis. | 0 17 6 |
| Stratton's | 0 0 7½ |
| Tomboy | 1 7 6 |

BOSTON EXCH Dec. 16

| Name of Comp. | Clg. |
|---|---|
| Adventure | ‡1½ |
| Ahmeek | ‡250 |
| Alaska Gold M. | 20 |
| Algomah | ‡.90 |
| Allouez | ‡30½ |
| Am. Zinc | 16½ |
| Ariz. Com., ctfs. | 3½ |
| Bonanza | ‡.59 |
| Boston & Corbin | ‡.50 |
| Butte & Balak | 3½ |
| Calumet & Ariz. | 60½ |
| Calumet & Hecla | ‡395 |
| Centennial | ‡13 |
| Cliff | ‡1 |
| Copper Range | 33 |
| Daly West | ‡2½ |
| East Butte | 10 |
| Franklin | 2½ |
| Granby | 68½ |
| Hancock | ‡13½ |
| Hedley Gold | ‡29½ |
| Helvetia | ‡.25 |
| Indiana | ‡3½ |
| Island Cr'k, com. | ‡46 |
| Island Cr'k, pfd. | ‡81½ |
| Isle Royale | 17½ |
| Keweenaw | ‡2½ |
| Lake | 5½ |
| La Salle | ‡3½ |
| Mass. | ‡2 |
| Michigan | ‡.60 |
| Mohawk | 39 |
| New Arcadian | ‡1½ |
| New Idria Quick. | ‡2½ |
| North Butte | 26½ |
| North Lake | ‡1 |
| Ojibway | ‡.75 |
| Old Dominion | ‡48 |
| Osceola | 67½ |
| Quincy | 55 |
| Shannon | 5½ |
| Shattuck-Ariz. | 25½ |
| Superior | ‡22½ |
| Superior & Bost. | 2 5/16 |
| Tamarack | 28 |
| Trinity | ‡3½ |
| Tuolumne | .65 |
| U. S. Smelting | 36½ |
| U. S. Smelt'g, pf. | 47 |
| Utah Apex | ‡1½ |
| Utah Con. | 8½ |
| Victoria | ‡1 3/16 |
| Winona | ‡1½ |
| Wolverine | 40½ |
| Wyandot | ‡.50 |

BOSTON CURB Dec. 16

| Name of Comp. | Bid |
|---|---|
| Bingham Mines | 4¼ |
| Boston Ely | .40 |
| Butte&Lon'nDev. | .30 |
| Cactus | .01½ |
| Calaveras | 1½ |
| Chief Cons. | 1 1/16 |
| Corbin | 1½ |
| Cortez | .20 |
| Crown Reserve | 1½ |
| Eagle & Blue Bell | .97 |
| First Nat. Cop. | 2½ |
| Houghton Copper | 2½ |
| Majestic | .23 |
| Mexican Metals | .37 |
| Moneta Porc. | ‡.01 |
| Nevada-Douglas | 1 1/16 |
| New Baltic | .50 |
| Oneco | .80 |
| Raven Copper | .11 |
| Rhode Island Coal | .01 |
| Smokey Dev. | .60 |
| So. Lake | 3 |
| S. W. Miami | 1 |
| Tonopah Victor | .25 |
| Trethewey | .30 |
| United Verde Ext. | .45 |

‡Last Quotation.