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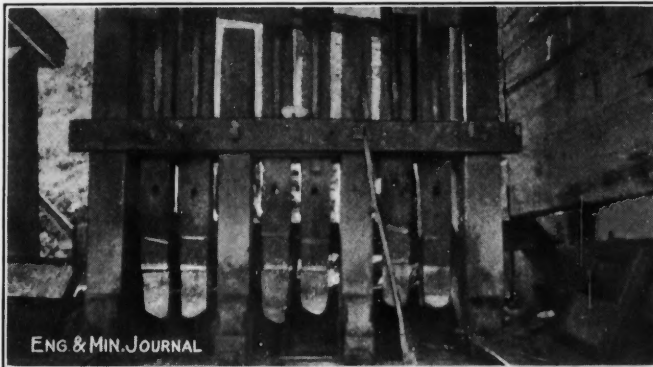
Quartz Mining in Colombia--I

BY RALPH W. PERRY*

SYNOPSIS—Production of gold from quartz mines has been undervalued, the placers being credited for the major part of the output. The topography and geology of the departments of Antioquia and Caldas are described, the river and mountain systems, character of the deposits, native methods of working above water level and crushing in wooden stamps and recovering gold in sluices without mercury.

American interest in gold mining in Colombia has been wholly in the placer mines, notwithstanding the fact that quartz mines have yielded in the last century

cause that has contributed to the low estimate is that the small steady shipments from the quartz mines have been overshadowed by the big cleanups from some of the rich placers, without taking into consideration that these big cleanups are irregular, and that the steady small production from the quartz mines in the course of a few years is larger. This will appear clear if individual comparisons are made between any well known placer and quartz mines. By no stretch of the imagination can any placer mine be credited with any such production as the \$20,000,000 of the Zancudo mine. While the Zancudo has few rivals, there



TYPICAL WOODEN-STAMP MILL

nearly as much gold as the placers. The most reliable estimate, that of Vicente Restrepo, made 30 years ago, would place the production of gold to date at \$900,000,000, of which \$400,000,000 has been produced since 1800. During the last century, the departments of Antioquia and Caldas have probably contributed two-thirds of the total and considering their small area, there are few districts in the world that can show such a past record, and such few signs of exhaustion.

QUARTZ MINES PRODUCE MORE GOLD THAN PLACERS

To placer mining two-thirds of the present production is popularly attributed, but it is beyond a doubt that the amount of gold won from quartz mines has been greatly underestimated. At the beginning of the last century, the gold production of Colombia was decreasing, but with the introduction of wooden stamps in 1827, when quartz mining may be said to have commenced, a great gain was made and has been sustained to the present. One

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PACK TRAIN IN THE MEDELLIN VALLEY

are others that have produced several millions, without being worked below the water level.

THE DEPARTMENTS OF ANTIOQUIA AND CALDAS

The departments of Antioquia, and of Caldas which was formerly a part of Antioquia, occupy an area of approximately 25,000 square miles in the north central part of the republic, between the Atrato and Magdalena Rivers. Except for small areas bordering these rivers and the Gulf of Uraba, the country is mountainous, being traversed by the two western ranges of the Andes, which are here separated by the Cauca River. The Cordillera Central, lying between the Magdalena and Cauca Rivers, is, in these departments, an extensive plateau extending from the southern boundary of Caldas toward the north, having an elevation of 6000 to 8000 ft. and cut by numerous valleys to a depth of several thousand feet below its general level. The trend of most of these valleys is east and west, but the most extensive, under the various names of the Medellin, Porce, and Nechi, has a northeastern course, nearly parallel to the Cauca.

This range reaches its greatest elevation to the east and northeast of Manizales, a considerable area there having an elevation of over 10,000 ft. Except in the southern part of Caldas, where the mountains of Ruiz and Santa Isabel reach heights of over 14,000 ft., there are no prominent peaks. The surface of this plateau is broken, but the mountains have only slight elevations above the plateau level. This plateau slopes rapidly from Yarumal toward the north, but the country back from the river still maintains its mountainous character, although the elevations are less.

The Cordillera Occidental, or western range, is lower and is lacking in the plateau-like character of the other range. The eastern slope is abrupt and the greatest elevations are reached within a short distance from the Cauca valley. The general elevation of the crest of the range is from 5000 to 8000 ft. with some peaks reaching elevations of 12,000, but the greater part of the range is much lower. On account of its precipitous eastern slope, the principal drainage is toward the Atrato River, which receives several important tributaries from the department of Antioquia. The tributaries of the Cauca in these departments are short and unimportant in both ranges, but the Porce River rising within a few miles of the Cauca and emptying into it in the extreme northeastern corner of Antioquia drains a large territory in the northern plateau. The Magdalena has some important tributaries with their source in the central range.

The principal ports of entry are Puerto Berrio on the Magdalena River, Caceres on the Cauca, and Zaragoza on the Nechi. Puerto Berrio, which serves the greater part of Antioquia, is connected with Medellin, the capital, by 130 miles of narrow-gage railroad, 25 miles of which is uncompleted but paralleled by good wagon roads. The mining districts of Guamaco and Remedios are reached through Zaragoza. Caldas receives most of its imports by trail, 60 miles from Mariquita to Manizales, the capital of the department. Mariquita is connected by a short railroad with Dorado, the head of navigation on the lower Magdalena. The trip from the coast to any of these ports can generally be made in eight days and the return voyage in three. There is talk of a railroad from Medellin to the Gulf of Uraba, which would give a direct outlet to the sea, and one not much longer than the present railroad to the Magdalena.

Most of the quartz mines are at elevations exceeding 2000 ft. and the climate is generally healthful, although at the lower elevations, fevers are not uncommon. Water power is abundant and electricity can nearly always be developed within such reasonable distances of the mines as to be economically employed. Timber, for mining purposes, is plentiful and in some districts could be employed for fuel, but like all tropical wood is of low calorific value. There are four seasons each year, the months of June, July and August, December, January, and February being in the dry season and the other six months the wet season. The wet season is characterized by heavy and continuous rains, although there are wide variations from year to year. There is much less precipitation in the dry season and the rain generally falls at night, but no general rule will apply to every season. Some dry and some wet seasons resembling each other, either in lack of rain or an abundance, but these exceptions are rare. There is little change in the tem-

perature from one season to another and in all districts the climate is mild.

Transportation is the greatest drawback to the development of industry, as it must be done by packing, but the trails and the roads are being improved. A large part of the country can be reached from the railroad by short trails. A wagon road is being constructed down the Porce River from the railroad station of Botero and when finished will place Anori and Amalfi in easy communication with the railroad. Shipments of heavy machinery should be timed so that advantage can be taken of the dry seasons for moving it, and it should be sectionalized.

GEOLOGY

The Cordillera Central consists essentially of a granite core in places changed to gneiss, surrounded on the sides by slates, schists and some limestone, probably triassic or cretaceous. These rocks are intruded by later



CLEANING SLUICES AFTER A MILL RUN

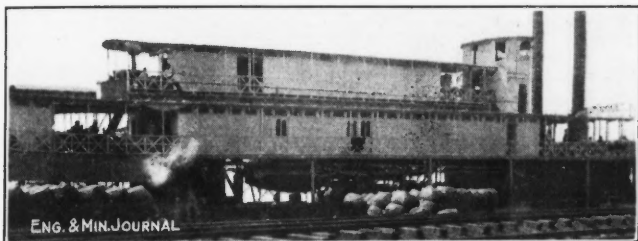
eruptives and it is in connection with these eruptives that the most important orebodies are found. There are numerous lenses and stringers found in the granite, sometimes of great richness, but of limited extent. In places these stringers are in such numbers and so close together that they have formed deposits extensive enough to be worked on a considerable scale, and their decomposition has left residual deposits of value.

The most pronounced development of the schists is on the eastern and western flanks of the range, although there are exposures of older schists in the central part of the range, with which, however, no important orebodies are associated. The Zancudo mine and the best mines in the Puerto Berrio district are on or near contacts of the schists and eruptive rocks. The coal and iron mines of Amaga are in these schists. The country near Manizales is made up principally of eruptive rocks, probably of tertiary age, in which are found the mines Cascada, Colcanes and Union. These mines show some resemblance in the character of their ores to veins of the same age in

Nevada. There are numerous remains of volcanic cones in the Cauca valley and to a less extent on the eastern border of the plateau, and the volcano Ruiz in Caldas was probably in eruption in comparatively recent times.

The Cordillera Occidental has much the same structure as the other range, but is characterized by a much greater development of igneous rocks other than granite. Exposures of these rocks occupy considerable areas, while in the central range, they are present mostly in the form of dikes. There are apparently fewer and less persistent orebodies in this range, although it contains some of the most important mines. The western slope is slightly developed, and with more knowledge may prove to be as rich as the other range.

The plateau region in the vicinities of Santa Rosa, Anori, Amalfi and Rio Negro is covered by extensive alluvial gold deposits, presumably of quaternary age. It is to be especially noted that the most important placers in Antioquia are found in the Porce, Nechi, and Nare Rivers, which with their principal tributaries, have their source in these districts. The Porce, while being gold bearing to its source, has been much more productive below its junction with the Rio Grande, a river as large as the Porce and with its whole course in the district of Santa Rosa. Since these deposits may be called quaternary, it is evident that this plateau has been greatly elevated since that period. Springs issue from the granite in



RIVER STEAMER SUCH AS NAVIGATE THE MAGDALENA

many places, their waters carrying sodium chloride. The water from these springs is warm and has a strong odor of hydrogen sulphide.

The rock is decomposed to depths ranging from a few feet to 200, the granite being decomposed to greater depths than other rocks, and this, together with the vegetation, makes prospecting exceedingly difficult, the outcrops of large veins being almost indistinguishable on the surface. Sulphide ores occur close to the surface, sometimes within a few feet, and the oxidized zone in veins in the granite seldom extends to as great a depth as the zone of weathering. While the sulphides are apparently unaltered, the gold is easier to recover above the water level than below it, by the methods in use.

MINING METHODS

Local conditions have caused the development of some mining methods that seem antiquated and defective, but they are the natural result of these conditions and are perhaps the most efficient that could have been devised to meet them. The first impression of the country is almost sure to be disappointing, unless one is fortunate enough, first to examine some of the mines, which are worked according to more modern ideas. This naturally arises from the comparatively large number of operations where a ton or so of ore per day from some of the innumerable stringers is treated, the lack of ore blocked

out in the mines with larger veins, and the inaccessibility of the old workings which are usually caved. A great many of the best veins are now worked out to the water level and the old openings now being caved, nothing remains to show the existence of such a vein. It speaks well for the mines when so many can still continue to produce, abandoning each shoot and vein as water level is reached, the number of mines working below water level being so few that they will be mentioned in the description of each district. This circumstance has given rise to the belief among those unfamiliar with the country, that the veins become impoverished at depth, but from several instances that have come under my observation and a knowledge of the economics of the country, I believe that the reasons for this abandonment have no relation to the grade of ore. Most of these mines have been worked with the simplest equipment, costing little, the small amount of power used being developed by inexpensive waterwheels, and treating a few tons of ore per day from which a small profit is gained. While this ore can be extracted from this decomposed zone, without draining the workings, a profit can be made on any scale of operations, but if the owner is obliged to install expensive power machinery and pumps, he is also obliged to enlarge his entire equipment to cover the extra expense. He must also change his methods of mining to insure a supply of ore for this extra equipment, and change his method of treatment with which he is familiar for one of which he is ignorant, since he has been accustomed to save the free gold only, and below the water level he cannot expect as large a yield per ton. These methods applied on a large scale would be cumbersome and probably a failure, as will be readily understood from their description. Moreover the profits won from mining have been obtained in such a long term of years, that it has been invested in other operations or scattered so as not to be available, even if the owner desired to invest the capital needed.

The Antioqueñan is not venturesome in business, and the prevailing high rates of interest and the profits to be gained in other pursuits are more attractive to the local investors than the investment of large sums in mining equipment and development. With few exceptions, all of the mines have been worked through tunnels, which from the deep decomposition of the rocks can generally be driven in soft rock without powder. These tunnels are driven from 10 to 20 ft. below one another, and as much ore as possible extracted, pillars being left as necessary. Each level is worked out and allowed to cave as another is opened, no reserves of any kind being kept. The tunnels are driven cheaply in this surface rock, it generally standing well and requiring no timber or little for the time it is in use, so that it is probable that if powder is needed to sink on the vein, 100 ft. of tunnel can be driven cheaper than 10 ft. of winze can be sunk. Another reason for adopting this method lies in the fact that the walls will not stand without heavy timbering for any length of time. At most of the mines that have reached firmer rock a greater distance is left between the tunnels, if they are of considerable length. In the important districts, it is a common sight to see hills with tunnels so close together and so numerous that they resemble a honeycomb.

If hard rock is encountered before water level is reached, as is frequently the case, and the tunnels are

long, further work is abandoned after following the ore down on the vein as far as ventilation permits. Little work has been done where the rock is so hard as to require blasting, and I have seen large, well formed veins of good ore in several mines which the owners would not touch. The former high cost of powder was responsible for this, and the prejudice against its use has not been overcome. As little powder as possible is used in breaking ore and in reality the ore encountered in this zone of decomposed rock requires little, there apparently having taken place some movement in the vein, that has fractured the ore at this horizon.

Holes are seldom put in to greater depths than 18 in. and from $\frac{1}{8}$ to $\frac{1}{4}$ lb. of powder used per hole, a charge loosening the rock so that it can be removed with a pick. This manner of using powder is cheaper than the ordinary way, when coupled with cheap labor, but the rate of advance is necessarily much slower. Where a number of of stringers occur close together, the following method of working has been used with great success, if water is available at sufficient elevation; the entire side of the mountain is washed down and the ore and gold caught in sluices at the foot of the mountain and sent to the mill. When water is plentiful, it is cheap and efficient.

Labor is good, the peons being more docile than Mexicans and not so addicted to drunkenness. Miners are paid from \$0.50 to \$0.75 per day and unskilled labor about half as much, the wages differing in each district.

MILLING

The milling methods show high recoveries made without the use of mercury. A typical plant for the treatment of ores consists of a wooden stamp mill, directly connected to an overshot waterwheel 20 ft. in diameter, containing from three to twelve stamps, dropping 40 to 60 times per minute. The cams are curved blocks of hardwood, attached to the shaft of the waterwheel, this shaft being a round timber from 1 to 2 ft. in diameter, carrying short pieces of steel shafting in each end which revolve in iron or wood bearings supported on heavy timbers. The shoes generally used are of cast iron, 7 in. square and 11 in. long, weighing 125 lb. The stems are timbers 6 in. square and 13 ft. long, with semicircular guides sliding in grooves cut in the transverse timbers of the battery frame. The total weight of the stamp is 250 to 300 lb., depending on the timber used. No dies are used under the stamps, the space between the posts being filled with sand and rock to the desired height, giving a drop of about 8 in. The screens are made by punching holes in a piece of tin, ordinarily taken from an oil can. These mills will crush 600 or 700 lb. of ore per day to a fineness corresponding to a 20-mesh screen; automatic feeding would give a much greater capacity. The usual equipment of arrastres is to have one for each three stamps, run by the same kind of wheels and placed below the mill so that the same water is used for driving them. Two arrastres, 5 ft. in diameter are usually driven by one wheel through bevel gears made of wood and make 6 or 7 r.p.m., crushing by drags of hard rock attached to cross arms of the spindle carrying the gears. The sand is fed to the arrastres in charges of 300 lb. each and ground for 12 hr., using just enough water to make a thick pulp. One of these mills of 10 stamps and a double arrastre can be erected complete for \$1200 and will treat on an average four tons per day.

GOLD-SAVING APPLIANCES

The gold-saving appliances simply consist of launders the same width as the batteries, set at an inclination of 8 to 12 in. in 10 ft., and having shallow grooves cut in the bottom boards by drawing a sharp iron instrument in all directions across. In some instances where more care is used to save as large a proportion of sulphides as possible, blanket strakes are used, and cleaned up frequently. A large proportion of water is used in crushing, as high as 30:1 being not uncommon. This is necessary to keep the sand from settling in the launders, and to have the smallest amount of solids possible in the pulp, the finest gold settling much better in a rapidly flowing stream of clear water than in a slower current heavily charged with solids. These launders are cleaned up from two to four times per day, depending upon the richness of the ore. In cleaning up, the battery is shut down and a stream of clean water run through it and over the launders, while they are brushed toward the foot. In this way most of the sand is washed off, the gold remaining in the grooves and is brushed into a batea and reserved for the final separation. The batteries are cleaned up each week and their contents treated with the product from the launders and the charges from the arrastres in a launder like those in front of the battery, but having the following modifications. This launder is about 14 in. wide and at its upper end, has a partition sliding in grooves forming a box about 14 in. square and 6 in. high. A series of holes are bored in this box 2 in. above the bottom of the launder. All the material reserved for this treatment is charged into this box with a stream of clear water, being agitated with the hands, from time to time, until most of the sand and sulphides are carried through these holes and the outflowing water is perfectly clear. All coarse rock from the battery clean-up is removed by hand, the partition taken out and by carefully regulating the flow of water, a rich concentrate is left in the launder, and brushed into a batea for the final separation of the gold.

Great skill is shown in the manipulation of the batea, and though most of the gold is extremely fine, little escapes. The tailings from the batea are amalgamated by hand and what gold escapes then is later recovered. As little mercury as possible is used in amalgamating, frequent examinations of the pulp being made to determine the necessary quantity. As large a proportion of sulphides as possible is reground in the arrastres, after being caught in settling boxes placed below the launders.

The extractions naturally vary according to the ore, but have probably averaged 70%. Mills treating oxidized ores frequently make extractions of 90%. Due to the increasing quantity of sulphides being treated now, the extractions are decreasing and the great increase in the amount of work necessary to save the gold from these ores limits its application to ores of better grade than the average. If a mine is short of ore, the accumulated sand is ground in arrastres and a small amount of gold recovered. This accounts for the absence of tailings dumps on mines that have been working for years. At present the better mines are installing iron stamps, but still save the gold in the same manner.

Assays are seldom made, the recovery of gold furnishing the only means of estimating the value of the ore.

(To be concluded.)

Mineral Analysis of Ores

BY E. L. LARISON*

SYNOPSIS—In working out processes for the treatment of ores it is often desirable to determine the mineral composition of the ore being treated. A method of making such a determination, with a high degree of accuracy is herein described. The mineral analysis of ores is a subject of interest to metallurgists and mining engineers; literature on the subject is not so available as might be desired.

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A mineral analysis of an ore is distinguished from a complete quantitative analysis in that it reports percentages of the component minerals instead of percentages of the elements. Mineral analyses are of value, especially in working out new metallurgical processes. They often clear up difficulties and obscurities that an ordinary complete analysis would not do. I have no doubt that in geological work also, they may be of value.

It is not my idea to attempt, in this short article, anything like the presentation of a complete set of rules and methods for making mineral analyses. The subject is not only broad, but practically every ore will present its individual problems. The working out of these often involves a thorough knowledge of analytical chemistry, with proficiency in mineralogy, the use of blow-pipe, glass and bone spoon, together with a large measure of ingenuity. I will describe the work done on a copper-sulphide ore which is of average complexity, and mention a few practical aspects, endeavoring to indicate in a general way what may be done with almost any mineral combination.

MINERALS RECOGNIZED IN BROKEN PIECES OF ORE

The ore was obtained as a sample from good-sized lumps which were examined with a glass, by simple tests for hardness, etc., before being broken. In this way, it was quite easy to detect chalcopyrite. Pyrrhotite was plain, manifesting magnetic characteristics. Pyrite was also a possibility, though the sulphide was so massive that it could not be identified with certainty. Calcite and dolomite with its curved faces, were well established. Quartz was plain, muscovite and biotite easily seen. Other silicates which were decided to be the fibrous amphiboles could be distinguished, though it was not easy to name the varieties precisely. However, as their composition and characteristics do not greatly differ this was not very important.

Upon grinding the sample and panning down, a considerable quantity of magnetite was discovered and some of the previous observations further confirmed.

Next, a complete quantitative analysis was made by usual methods, the results of which are recorded in the table. Following this, a two-gram sample was treated with 10% hydrochloric acid and warmed for several hours. The solution was analyzed with results as hereinafter to be shown. The residue was treated with nitric acid, and its solution analyzed. The residue from the nitric acid treatment was weighed, then the total silica (SiO₂) was determined in it. To determine magnetite a second

sample was treated with nitric acid and the insoluble residue containing the magnetite and silicates was treated with hydrochloric acid and the solution assayed for iron. To differentiate between calcite and dolomite a separate sample was treated with cold 10% hydrochloric acid and the solution assayed for calcium (Ca), which represented calcite.

THE BASIS FOR MINERAL CALCULATION

The following facts of mineral solubilities give basis for the calculations: Pyrrhotite, calcite, sphalerite, magnetite and dolomite are quite readily dissolved by warm dilute hydrochloric acid. Chalcopyrite is more slowly soluble and only completely dissolved by longer treatment than was given. Pyrite is insoluble in hydrochloric acid, but is decomposed and dissolved by nitric acid. Magnetite is insoluble in nitric acid, but soluble in hydrochloric acid. Calcite is soluble in cold dilute hydrochloric acid, while dolomite is not, but is soluble in warm hydrochloric acid.

Taking the result of the hydrochloric acid solution analysis, copper is figured to CuFeS₂; chalcopyrite. The presence of magnetite being known, the sum of its iron and that of the chalcopyrite is subtracted from the total and the remainder figured to Fe₇S₈. Zinc is figured to ZnS. Calcium soluble in cold dilute hydrochloric acid is figured to CaCO₃ and the rest of the Ca soluble in warm hydrochloric acid is figured to dolomite. The nitric acid solution: Cu is figured to chalcopyrite; remaining iron to pyrite. The residue contains quartz and several silicates. From the known composition of these silicates we derive the fact their silica (SiO₂) content is close to 50%. This, of course, may be 1 or 2% high or low, but it is accurate enough. By getting the total weight of silicate residue, and from it deducting total silica (SiO₂), we derive the weight of the combined bases, which we previously estimated as being 50% of the silicates, i.e., the combined silica equals the combined bases. By subtracting combined SiO₂ from total SiO₂, free SiO₂ is obtained. The mineral percentages follow:

	Per Cent.	
Pyrite.....	5.82	
Pyrrhotite.....	29.50	
Magnetite.....	7.73	(Mn found with this added 0.34%)
Chalcopyrite.....	7.89	
Blende.....	4.23	
Calcite.....	2.16	
Dolomite.....	3.56	Excess Mg 0.08% added
Quartz.....	15.59	
Silicates.....	22.74	
Total.....	99.22	

There are several features valuable in a practical way in such an analysis. The silica, lime and magnesia, which are in condition available for fluxing, are shown. A comparison of mineral analyses of several such ores showed quite clearly that the widely varying amounts of magnetic oxide appearing in mattes made, were due to similar variations in magnetite content of the different ores. Some of the modern concentration methods, such as the magnetic, flotation, etc., make considerable variations in the processes to deal with pyrite or pyrrhotite, and in many instances the behavior of ores can be accurately forecasted by a mineral analysis. This idea of segregating the mineral components of an ore, or an ar-

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tificial product is by no means new, but I think that it has probably been developed more in organic and phar-

TABULATION OF RESULTS OF ANALYSIS OF AN ORE

	Hydrochloric Acid Solution	Nitric Acid Solution	Residue	Totals	By Analysis
Cu.....	1.52	1.20	.....	2.72	2.74
Fe.....	25.61	3.78	1.02	30.41	30.37
S.....	.....	.....	.....	.....	18.87
SiO ₂.....	.....	.....	26.96	26.96	26.96
CaO.....	2.91	.....	.....	6.63	6.70
MgO.....	0.83	.....	2.09	2.92	2.97
Mn.....	0.37	.....	.....	0.37	0.34
Zn.....	2.83	.....	.....	2.83	2.80
Al ₂ O ₃.....	.....	.....	2.91	2.91	2.91

Iron in the residue from nitric-acid treatment of original sample, 5.35%; Cao in cold dilute hydrochloric acid solution, 1.85%. Total residue from acid treatments, 38.33%; SiO₂, 26.96%; bases, 11.37%; free SiO₂, 15.59%.

maceutical work than in the metallurgy of ores, and perhaps its value in the last case has not been fully appreciated.

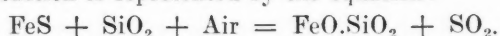
Pyritic Smelting

Pyritic smelting is the practice of few American smelters. The Tennessee Copper Co. and the Ducktown Sulphur, Copper & Iron Co., with plants in Polk County, Tenn., afford probably the best examples of pyritic smelting in America. Ores that are suited to pyritic smelting contain a large amount of iron sulphide. Before pyritic smelting was practiced these ores had to be roasted before smelting. This roasting formed iron oxide and reduced the quantity of sulphur. The iron oxide formed in the roasting was available for slag formation in the blast furnace, and the grade of the matte made was proportional to the extent of the roasting. The advantages that pyritic smelting offers are: (1) The elimination of a metallurgical step, namely, heap roasting. The economy effected here is the cost of roasting, say 35c. per ton of ore, and the elimination of metal losses due to leaching. (2) The saving of interest on the time that the ore remains in the roast yard. (3) Fuel value of the iron sulphide. The economy effected here would be the difference between the coke necessary in the two operations, representing, say 6% of the weight of the ore. (4) The general improvement in working and living conditions by sending the sulphur gases up a stack instead of releasing them in clouds at the ground level.

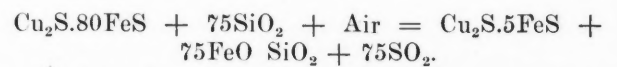
GREATER SLAG LOSS IN PYRITIC SMELTING

Owing to the difference in the character of the slag made, pyritic smelting takes more flux, makes more slag per ton of ore, and thereby loses a little more metal. These disadvantages are, however, far outweighed by the advantages gained. There is also an item of gain in furnace capacity when smelting pyritically.

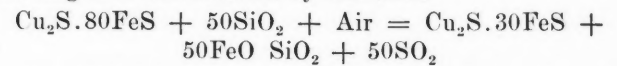
The reactions taking place in the furnace are that FeS₂ loses part of the sulphur by dissociation at a comparatively low temperature. What remains may be regarded, at least for calculation purposes, as FeS. The next reaction is represented by the equation:



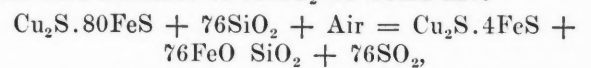
This is the pyritic equation in its simplest form, and from it it will be seen that for every atom of sulphur oxidized an atom of iron must be oxidized. An equation in a more extended form to show the copper and the resulting matte under working conditions would be expressed as follows:



In this form Cu₂S.80FeS may be taken as the ore. It carries 1.75% copper. The Cu₂S.5FeS resulting will serve to represent the matte, containing 21% Cu. The 75FeO SiO₂ is the slag. The ratio of concentration is 21 divided by 1.75, or 12 into 1. By reducing the silica entering into the reaction by one-third



more matte and less slag and matte of lower grade result. The grade is now only 4.45%, and the ratio of concentration only 2½ into 1. This is a violent change in the operation, but any change in the silica immediately alters the grade of the matte. If, in the above equation, the silica were increased to 76SiO₂ we would have



and our matte would contain nearly 25% copper; we would make more slag and less matte. It is in this that pyritic smelting differs from ordinary blast-furnace smelting. The ratio of silica to sulphide iron in the charge is the governing factor in the ratio of concentration. In other words, the more quartz that the pyritic furnace will handle on the charge the higher will be the grade of the matte produced. The limit is reached when a further increase in the percentage of quartz on the charge does not raise the grade of matte. The economic limit is determined by the speed of the furnace, its tendency to form crusts and by the greater copper loss in the slag when making a high ratio of concentration. It is often more economical to make a low-grade matte first and resmelt it than to make a converter matte in one operation.

QUARTZ FINES NOT SUITABLE FOR BLAST-FURNACE WORK

To smelt a heavy sulphide ore a considerable amount of quartz is required. This quartz is, in many instances, barren material. The purer the quartz, the more active it is in the furnace in raising the ratio of concentration. Quartz in which a portion of the silica is combined with alumina is not satisfactory for pyritic work, and may not serve at all if there is much combined silica. Quartz fines, like ore fines, are not suited to the blast furnace and are particularly unsuited to the pyritic process. Quartz which decrepitates rapidly in the furnace is also undesirable. The best results, therefore, would be obtained on a sulphide ore containing a small amount of gangue and a coarse pure quartz flux. With such materials it is possible to obtain a high ratio of concentration. The reagent of most use to the pyritic smelter is his quartz. With it he can control his operation, and the grade of the matte changes as the amount of quartz is changed. This is a general statement and is true within certain limits. With clean sulphide ores and clean quartz a wide range of concentration is possible. It may be stated broadly, that with a 2% copper ore under such conditions anywhere from a 6% to a 40% matte might be made. Below the low limit, the reactions taking place are not sufficient to maintain the necessary temperature unless plenty of coke is used. Above the high limit, the furnace refuses to smelt the quartz, which accumulates in the furnace and eventually causes trouble. With-

Note—Abstract from a paper read by George A. Guess before the Canadian Mining Institute.

in these limits the more quartz that is used on the charge the higher will be the grade of matte made.

If one acquainted with ordinary smelting only were asked how the grade of matte in a pyritic furnace was made to vary he would probably reply that by increasing or diminishing the amount of air delivered to the furnace the matte would be raised or lowered in copper content. In ordinary smelting the air control is about the only control at the command of the metallurgist, and that control is restricted to a narrow range. The average ratio of sulphur to copper in the charge is probably about 3:1. In pyritic smelting that ratio is more nearly 15:1, and the effect of changing the amount of air is slight. This slight effect is due to the increased oxygen efficiency of the furnace when higher-grade mattes are made, that is more of the air blown into the furnace is used, less escapes unchanged, and to the fact that when higher-grade mattes are made the focus of the furnace has a higher temperature and, therefore, makes a more basic slag. The higher the temperature of the focus of the furnace, the lower the ratio of silica to iron in the slag, or the more basic the slag. Siliceous blast-furnace slags form at a lower temperature than the less siliceous or more basic slags. Therefore, in a hot furnace the same amount of silica on the charge will send more iron into the slag than it will in a colder furnace. The result is that if we have two furnaces side by side running on the same charge, the matte from the hotter furnace will be the higher grade. The hot furnace may, therefore, be considered merely as affording the silica opportunity to do more efficient work. The ratio of iron to silica being higher in the slag from the hotter furnace, the same silica is thus able to aid in the oxidation of more iron.

The effect on the grade of the matte of a greater volume of air delivered to the furnace is, therefore, incidental, and is really a result of the higher temperature in the furnace induced by faster running. Part of the heat lost from a blast furnace, as for example the heat carried away by the jacket water, is a function of the time so that as the rate of smelting increases the temperature rises slightly. If it were not for this the temperature of the focus would vary only with the ratio of concentration.

Assuming that we have a sulphide ore with 2% copper and 40% iron, and a 10% matte, which will contain, say 55% iron, is desired, then of the 40 units of iron in the ore 11 units will go into the matte and 29 into the slag. To the charge enough quartz must be added to take care of 29 units of iron. With this correct amount of quartz on the charge, the furnace will make 10% matte. Now if it is desired to make a 36% matte, which will contain about 36% iron, we will have two out of the 40 units entering the matte and the remaining 38 units will be slagged. It is necessary to write a new charge, adding sufficient quartz to combine with the additional nine units of iron. We may call the first charge No. 1 and this charge No. 2. Now if with charge No. 1 on the furnace the air pressure were raised and the tuyeres thoroughly cleaned it might be possible to produce with this charge a 12% matte. We would, however, have a condition that should always obtain, namely, clean tuyeres and as much air as was good for the furnace. If, however, the air remained unchanged and charge No. 2 were put on the furnace, 36% matte would be obtainable. For a ton of No. 2 charge more oxidation is required than for a ton of No. 1 charge. The result will be that with the

air remaining the same, the furnace will smelt at a correspondingly reduced speed, excepting as this may be affected by the greater oxygen efficiency that the furnace may have, due to the new charge.

EFFECT OF GANGUE MINERALS OTHER THAN QUARTZ

If the sulphide ore contains much gangue that is not quartz, the troubles attending pyritic smelting will be increased. In cases where the gangue consists of silicate minerals containing iron, lime, alumina and magnesia, the sulphide ore in the pyritic furnace seems at times to support two slag-forming foci in the furnace. The upper

TABLE I. ANALYSES OF MATERIALS AND FURNACE PRODUCTS

Material, Tons	% Cu	% S	% SiO ₂	% Al ₂ O ₃	% Fe	% CaO	% MgO	% Zn
P ore.....	1.80	19.0	31.9	3.2	29.5	7.0	3.0	1.7
B ore.....	1.92	29.6	13.6	2.1	37.1	7.0	1.8	2.0
L ore.....	2.05	17.5	37.6	3.1	26.9	6.7	2.2	0.8
Slag.....	0.99	1.4	46.5	4.3	26.0	7.2	2.4	.....
Quartz.....	.....	.....	95.0	2.0	.....	.....	.....	.....
Coke-ash.....	.....	.....	51.0	20.9	16.3	1.5	1.0	.....
Matte from furnace.....	17.2	26.0	.....	.....	50.0	.....	.....	.....
Slag from furnace.....	0.29	1.2	39.0	3.2	31.5	7.7	2.3	.....

one forms slag from the gangue of the ore, a thick viscous ropy slag. The lower one is the ordinary pyritic focus where the thin, hot, typical pyritic slag is made. When these foci coincide, there is smooth running; when they are separated, there is trouble. Analyses of such ropy slag, formed under such conditions, have shown an excessive amount of Al₂O₃, MgO and CaO, which is readily explained by the above assumption. The immediate effect of impure gangue or inferior quartz flux on the ratio of concentration is a striking feature in pyritic smelting. In concentrating, say a 10% matte to converter grade, there may be considerable difficulty in keeping the matte up to grade if the siliceous flux contains appreciable amounts of silicates. Table I shows the analysis of the materials passing through a 22½-ft. blast furnace in 14.9 days. Table II shows the furnace balance sheet.

We have 6613 tons of ore carrying 126.75 tons of copper, or an average of 1.91% copper; copper in the matte is 17.2%. Ratio of concentration then is 9:1; matte, 747 tons; slag, 6335 tons; total fall, 7082 tons; matte fall, 10.5%; coke used, 329 tons on 6613 tons ore, or 7947 tons charge is 5% on ore, or 4.15% on the charge. The air delivered was 474, 606, 700 cu.ft. of free air. The average barometer and thermometer was such that 1000 cu.ft. contained 15.74 lb. oxygen. The blast then contained 3725 tons of oxygen. The tons of oxygen per ton of sulphur in the charge was 2.16. This oxygen was used as follows:

Tons Fe to slag.....	1997
Tons Fe as oxide in return slag.....	92
Tons Fe oxide in ore and coke ash.....	75
	<hr/>
	167
Tons Fe oxidized by the blast.....	1830
Tons S in charge.....	1725
Tons S in matte.....	194
Tons S in slag.....	76
	<hr/>
	270

Tons S eliminated in the furnace..... 1455

Of this amount I will take 90% as burned to SO₂ by the blast. The remaining 10% will be volatilized as sulphur. The work done then by the blast is shown in Table III. If we assume that the furnace gases leave the top of the charge at a temperature of 700° C., and that the slag and matte have a temperature of 1200° C., we may construct the thermal balance sheet shown in Table IV.

The heat furnished by the coke happens to correspond to the heat carried away by the nitrogen, and gives an idea of the heat economies that would be effected if it

were ever possible to furnish a blast of oxygen or enriched air to a furnace. To measure the actual temperature of the focus of a pyritic furnace is extremely diffi-

TABLE II. FURNACE BALANCE SHEET

Material	Tons	Tons Cu	Tons S	Tons SiO ₂	Tons Al ₂ O ₃	Tons Fe	Tons CaO	Tons MgO	Tons Zn
P ore.....	1253	22.55	238	400	40	370	88	38	21
B ore.....	4483	86.10	1329	610	94	1664	314	81	90
L ore.....	877	18.1	153	330	27	236	59	19	7
Slag.....	354	3.5	5	165	15	92	26	8	.....
Quartz.....	980	.....	.....	931	19	.....	.....	.....	.....
Coke-ash.....	54	.....	.....	28	11	9	1	.....	.....
Furnace matte.....	747	130.25	1725	2464	206	2371	488	146	118
Furnace slag.....	6335	1.83	76	2464	206	1997	488	146	.....
Flue gas, etc.....	.....	.....	1455	.....	.....	.....	.....	.....	.....

cult if not impossible. If, however, we assume that in this case the temperature was 1400° C, we have the deductions shown in Table V.

TABLE III. DATA OF FURNACE GASES AND OXYGEN USED

	Tons O Required	Tons Gas Produced	Kind of Gas
1830 tons Fe to FeO.....	523	.....	.....
329 tons coke at 83% C.....	728	1,001	CO ₂
1310 tons S.....	1310	2,620	SO ₂
1164 tons unused oxygen.....	1164	1,164	O
Nitrogen accompanying.....	.....	12,417	N

Of the 3725 tons oxygen delivered there is required 2561, showing an oxygen efficiency in the furnace of 68.8%.

RELATIVE VOLUME FURNACE GASES

	Percentage Volume Furnace Gases
CO ₂	22.7
SO ₂	40.9
O.....	36.4
N.....	44.4

These 2712 thousand ton-calories are absorbed by the descending charge from the ascending hot gases and make with the net calories in the charge a total heat sufficient to raise the temperature of the focus to 1400 C. This extra heat amounts in this case to 342 calories per unit of charge. This way of stating the situation is for the purpose of calculation only. It is needless to point out that the charge could hardly carry 294 calories per unit. This heat performs several endothermic reactions in the furnace.

The tonnage smelted during this period of 14.9 days is an average tonnage. It will be noticed that a considerable quantity of slag is smelted; this was "ladle skulls" and "cleanup" from the converter floor. Such slag charges were considered almost a necessity for a furnace smelting green ore; having no fuel value, they increased slightly the amount of coke on the charge. They also reduced the percentage of SO₂ in the furnace gases. At a later period in order to maintain a high SO₂ content, this slag was all smelted with the low-grade matte in the concentration furnace, and the green-ore furnaces were found to do just as well without slag charges. There was the added advantage that the copper in this returned material went immediately from the furnace to the converters, without being handled again as low-grade matte.

In the calculation based on this furnace duty, 1830 tons of iron are oxidized to FeO and combined with SiO₂ and 1455 tons of sulphur are eliminated in the furnace, of which amount I have taken 90%, or 1310 tons, as burned to SO₂. This percentage has served to interpret the gas analyses, which were a constant check on the furnace operation. If only the sulphur corresponding to FeS were burned, this figure would be $\frac{32}{56} \times 1830$, or 1045 tons. The remaining 410 tons of S, being the free molecule driven off by the heat, would escape as elemental sulphur. This I do not consider to be the case. I consider that a large portion of this free molecule of sulphur

is burned by the oxygen of the blast to form SO₂ before escaping at the top of the charge. The furnace tops were quite tight and there was maintained such a back pressure in the furnace flues that no false air could find access to the furnace gases. It will be noticed that there are three types of ore, P, B and L, of which B is high in sulphur. These ores were not mixed but kept separate, and each ore was charged in turn with its accompanying quartz and coke. The total ore given in one charge was 15,000 lb., and it was all of one class. It would take from two to three hours for a charge to reach the focus of the furnace. If, therefore, a pyritic furnace does not make any SO₂ until the ore reaches the focus of the furnace, there would be no immediate effect on the analyses of the furnace gases when pyrites are charged. This is not, however, the case. Five minutes after the charge has been dropped the gases will invariably show a higher SO₂ content when B ore has been used, than when the P ore or L ore has been used. I see no explanation for this thoroughly demonstrated fact, except that part of the sulphur, dissociated from the FeS₂, is burned in the upper part of the furnace by the oxygen of the blast. The analyses of the furnace gases and calculations based on the output of the blowers both show that there is oxygen available, so why shouldn't it oxidize some of this sulphur?

TABLE IV. HEAT BALANCE SHEET

Heat Leaving the Furnace	Thousand Ton Calories
1,001 tons CO ₂ @ 700°C. mean sp. heat 0.267	187
2,620 tons SO ₂ @ 700°C. mean sp. heat 0.195	358
1,164 tons O @ 700°C. mean sp. heat 0.2235	182
12,417 tons N @ 700°C. mean sp. heat 0.2559	2225
747 tons matte @ 1200°C. mean sp. heat 0.17	152
6,335 tons slag @ 1200°C. mean sp. heat 0.26	1978
Jacket water	499
Total heat.....	5581
Heat Available	Thousand Ton Calories
329 tons coke @ 6750 calories.....	2220
1830 tons Fe oxidized and slagged @ 900 calories.....	1647
1310 tons S burned to SO ₂ @ 2160 calories.....	2830
Total gross heat.....	6697
From this we might deduct 600 tons CaO and MgO heat absorbed being difference between heat in the carbonate and in the silicate at value for CaO, say.....	300
75 tons Fe as Fe ₂ O ₃ difference between the heat in the oxide and in the silicate.....	119
Total endothermic reactions.....	419
Gross heat.....	6697
Net heat.....	6278
Heat accounted for.....	5581
Unaccounted for 11.1%.....	697
Net heat, 6278; total charge, 7947 tons.	
Calories per unit of charge, 791.	
Heat furnished by coke 2220 or 35.3% of net heat.	

TABLE V. TABULATION OF HEAT BALANCE SHEET DEDUCTIONS

Tons	Thousand Ton Calories Necessary to Heat Products of Combustion to 1400° C.
Slag 6,355 @ 0.26	2300
Matte 747 @ 0.17	178
CO ₂ 1,001 @ 0.344	482
SO ₂ 2,620 @ 0.265	934
O 1,164 @ 0.2366	386
N 12,417 @ 0.2705	4710
Total heat necessary.....	8990
Total heat available.....	6278
Extra heat needed, being heat brought to the focus by the charge.....	2712
Heat in gases at 1400° C.....	6512
Heat in gases at 700° C. Table IV.....	2952
Heat brought to the focus by descending charge.....	3560
Heat lost.....	2712
Heat lost through jacket water.....	848
Unaccounted for.....	499
	349

Leadville's Production of ore in 1913, according to the "Herald-Democrat," was 16,984 tons of carbonate, 121,676 tons of sulphide, 21,450 tons of siliceous, 83,275 tons of oxidized iron, 52,689 tons of blende, and 157,286 tons of calamine.

Cyanide Plant Accounting

By DONALD F. IRVIN*

SYNOPSIS—A description of the method employed by the Tigre Mining Co., for recording operations and checking production at reduction works, especially the bullion from the cyanide plant. "Bullion-plus-tailings" is used in preference to the "tailings-assay" method, after a trial of both, but three checks are maintained upon the computation.

Metallurgists have made, for some time past, comments upon the relative worth and accuracy of various methods of metallurgical accounting, especially in cyanide plants, the chief point of difference in opinions being the acceptance of bullion returns as a basis of computation as against ton-assays upon the ore treated. On the whole, the first method seems to have few supporters, judging from what has been published, although it is evidently a wide-spread custom, according to the statements of the one who disapproves it. Perhaps the chief objection raised is the apparent inability to trace loss or theft, and it is conceivable that under certain circumstances that would have great weight.

The ton-assay system, *per contra*, on the admission of its own supporters, is erratic and not readily to be interpreted at monthly intervals. For example, we have the case of the reduction plant in Sumatra¹, wherein a variation of 65 to 125% recovery was not unusual in any one month. It is possible that such results would require a high order of explanatory powers to satisfactorily enlighten the board of directors of any company.

A certain thrifty manager of a reduction plant in the United States utilized this well known peculiarity of the cyanide process to reduce his fixed charges in the following manner. After his mill superintendent had been in charge of operations for some time, he would confront the latter with the fact that the bullion recovery did not check with the current solution assays; the guileless superintendent, feeling upon his mettle, would stake his salary upon the outcome, and as in nearly every case, there would be the usual discrepancy, the superintendent would forfeit a month or two of salary, along with his position, making place for another innocent.

"BULLION-PLUS-TAILINGS" METHOD

In view of the apparent interest in the subject, and lack of agreement on a standard method, it may be of interest to present the system of metallurgical accounting in use by the Tigre Mining Co., which uses both systems: the "bullion-return" as a basis of computations and the "ton-assay" as a check. Since a part of the product of this company is shipped as picked ore and table concentrate, computations of recovery must include those items, and the total range of products of the reduction plant at El Tigre are picked-ore, picked-waste, concentrate, bullion and cyanided tailings.

The sequence of records in the metallurgical accounting begins with the daily mill report, which embraces the tonnage treated daily, and the running time of the dif-

ferent branches of the mill. The weights entered upon this form are obtained from automatic-recording weighing machines, and represent ore plus moisture. Each product recorded is sampled and moisture determinations made in the assay office, so that the tonnages as entered show dry weights. Since all calculations must be based upon the true tonnage of ore treated in the reduction plant, it is seen that this sheet is the foundation for all following estimation.

The mill-assay sheet (daily) and the bullion, precipitate and special analysis sheet (occasional) furnish complete information on the value and character of the various mill products, and are the work of the assayer and his crew of helpers and samplers. Nearly all of these assays are vital to the construction of the preliminary metallurgical report, which is made up bi-monthly, and which is a valuable aid in obtaining knowledge of the 15-day production, and also an earlier knowledge of the month's product, than is afforded by the regular metallurgical monthly report sheet. It is additionally valuable as a good record of the assay values of the various products formed in the mill, which is requisite for the check upon the bullion summary. The different products assembled in the preliminary statement are sampled in nearly as many different ways, and it is well to consider them so as to assign a value to the statement as a whole.

VARIOUS SAMPLING METHODS IN PRACTICE

The sorted high-grade and sorted waste are grab sampled; the ore to stamp mill is sampled automatically in a revolving sampler of the slotted-cone type; the concentrate is sampled by the "cheese-trier" method, after each binful has been drawn out upon a cement floor, for further drying, before sacking and weighing; the stamp-mill tailings is sampled by a Scobey sampler, mechanically operated; the dump tails are uniform and are sampled six or eight times on each of the three shifts, by hand, while dropping into feed hopper; the bullion is sampled, while molten, by dipping; the precipitate, by the same method as concentrate, and the cyanide tailing is sampled by hand, in the tailing sluice, at each discharge of the filter presses. Pregnant solutions are sampled by dropping a weighted bottle into sump tanks, but barren solutions are sampled by drip method.

The various assays, upon which the preliminary statement depends, are made up from these samples, with the exception that no average assay is recorded for the bullion, since the total gold and silver content is the essential in that item. Though not in accord with the experience of others who have written on this subject, this statement often shows that the sum of the bullion plus precious metal in the tailings, exceeds the sum of the precious metal in the stamp mill and dump tailings. The automatic samplers are arranged for a favorable and regular operation, so that no variation can be ascribed to mechanical imperfection.

Intermediate between the assay-office daily sheet and the preliminary metallurgical statement, occur the two summaries of the daily operating reports; one for the milling department and one for the cyanide department,

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¹"Calculation of Extraction in Cyanidation," discussion by George Simpson, Jr., "Eng. & Min. Journ., Dec. 27, 1913.

upon which are entered, as the names signify, the daily assays of the products handled, tonnages and any other essential data. The summary of the mill calls for tonnages and assays for gold and silver exclusively, but that of the cyanide plant includes assays and titrations of solutions, moisture determinations, sizing tests, a list of supplies used, and is further amplified occasionally. It now includes a record of temperatures on the pulp during agitation, and a record of the amount of weak, barren solution run to waste. A column of "Remarks" serves as a daily log of the more important occurrences, not in the line of routine, such as dates on which tube mills are relined, elevator belts are replaced, etc.

CONTINUOUS TREATMENT USED

No record whatever is kept of separate charges of pulp under treatment, as the continuous system of treatment is in use. Four other records are the monthly statements, which deal with summations, and are not an aggregation of daily reports. Two of these concern the cyanide plant; the monthly statement of chemical consumption, which distributes the quantities used, in terms of different units of measure, and the cyanide treatment sheet. The others are monthly statement of the milling costs, and the metallurgical statement, which embrace both milling and cyaniding.

The cost sheet is simple, though complete, and enables a thorough inspection and analysis of monthly costs to be made, both easily and quickly. Systems of cost keeping are as varied as the organizations that use them, so one form may not receive the approval of every one. At the base of all cost sheets, the important factor is an accurate distribution of labor, and supply items, by the various foremen who are empowered to issue requisitions and sign time checks. Large items, such as power, tube-mill pebbles, or lump cyanide cannot go astray, but such as pipe fittings, rough lumber or day labor can easily be mischarged, and thus throw seriously askew any system of cost keeping.

Information concerning the purely technical side of treatment is satisfied by the monthly statement of chemical consumption, which gives light on the quantities required under varying conditions, and with varying units of measurements. As well as furnishing a means of keeping to the mark, technically speaking, it enables the purchasing agent accurately to forecast the requirements of the mill and cyanide plant.

The metallurgical statement is an interesting sheet, which finally establishes the character of the work done by the reduction plant, and preserves the figures of the actual quantities produced during the month. This sheet departs from the system of the "ton assay," and its figures upon tailings and bullion are made the base of all computation. Hence the figures that are entered under average assay, and total content will not be necessarily the same as those in the preliminary statement, for the tailings from the concentrators. This is, as has been said, the point of disagreement, and neither plan merits consideration, save upon comparative figures obtained in practice.

METHOD OF COMPUTATION DECIDED BY COMPARISON

After prolonged experience, the Tigre company, has found that the "bullion-plus-tailing" plan represents more nearly the real conditions than does the "ton-assay"

plan, in spite of the theoretical accuracy of the latter and the theoretical chances for error in the former. Naturally, this was obtained by a parallel column test of long duration, and the results of several months are included in this statement. These data are compiled in the monthly cyanide-treatment sheet, whereby the recovery (theoretical) is completed in three ways, and compared with the recovery (actual); the latter bearing a valuation, for comparative purposes, of 100%. The three theoretical methods embrace: (1) The ton-assay value, according to preliminary statement, of the dry pulp coming to the cyanide plant and entering the tube mills; (2) the ton-assay value of pulp leaving the tube mills and entering the agitator battery, after being properly corrected for daily assay value of contained circulating solution, and the moisture ratio of the pulp; (3) the ton-assay value of solutions handled and precipitated.

It should be stated here that the ore treated is essentially a silver ore, both in weight and value, as the ratio of silver to gold by weight varies from 250, or 300:1. The following tabulation of recovery figures for the cyanide plant covers the months of April to July, 1913, inclusive, a representative period of operation, and shows the relation of the values and quantities required by the three theoretical computations to the actual value and quantity of bullion recovered. The figures are the average for the four months, in percentage:

	Gold	Silver	Combined Value
Pulp assay.....	100.0	100.0	100.0
Cyanide heads.....	92.0	90.2	90.4
Solutions.....	83.6	96.9	95.3
Bullion.....	83.1	94.5	93.1
Tailing.....	11.1	10.9	10.9
Bullion plus tailing.....	94.2	105.4	104.0

In this table are noted several interesting features, one being that the recovery estimated by the solution assays is uniformly higher than that actually obtained; both for the silver and the gold, the average observed difference being 2.4% in terms of silver, 0.5% in gold, and 2.2% by combined value. In all cases, percentages are expressed in terms of the contents as per pulp assay. However, in the case of the figures from the preliminary metallurgical statement, and those from the cyanide heads, the combined value contained in pulp, per assays, is exceeded in actual bullion recovery plus tailings, by 4% and 13.6%, respectively.

Again, in comparing the recovery of gold by all methods, as against silver, we find the surprising fact that the actual silver recovery in bullion plus tailings exceeds the average assay contents (by pulp assay, cyanide heads and solutions) by 9.7% and the gold by 2.3%. Reducing all three estimated quantities to a basis of combined values recovered, the table shows that the average combined value by assay in pulp is 8.8% less than the real recovery plus tailing. The combined value of bullion plus tailing is higher by 4% than the contents obtained from the pulp-assay figure, which is the highest one of the figures obtained by the ton-assay method. The high proportion of silver present causes the figure for combined value to follow closely the figures obtained for silver alone. Finally these questions are suggested: Why do the solutions show incomplete recovery? Why does silver show greater proportionate recovery than gold?

As a partial explanation, I would say that as the solution figures have no correction factor for the loss incurred in handling and smelting the precipitate, which is 1%.

and as the slag from the smelted precipitate is shipped to the smelter, after being crushed and concentrated on a Wilfley table, that the combined deductions from the bullion account, due to these two items, will trace out most of the 2.2% difference. Homogeneous solutions are easier to sample than pulp, hence solution assays are, or should be, truly representative of the metals precipitated, in all cases. Granted that such is the case, solution assay estimates do not furnish a check on any loss of pulp or solution, occurring before the pregnant solution enters the sump, and therefore cannot be used for an exclusive basis of calculation. Troubles due to incomplete precipitation, and the resulting accumulation of metal in the solution are unknown at El Tigre, so that there is a quite uniform stock of silver and gold carried from one month to another, which obviates any considerable error from that source in computation.

The excess value of silver by assay is due to some obscure cause when it is recalled that silver and gold assays are made from the same samples throughout, from pulp to bullion. May it not be due to some steadily operating factor in assay routine, which tends to give a small plus value, and which is detected only when observing the totals? The over-recovery of silver is so much greater than the gold, both by value and weight, that it is harder to give an adequate reason for it; certainly it would not be the same one for both metals.

Since the cyanide tailings are approximately — 200-mesh and the head assay is crushed to 100-mesh only, it may be that the fire assay is not as efficient in the latter case, and likewise, the existence of comparatively coarse grains of silver sulphide in the head sample may make it more difficult to sample and assay than with the low-grade slime tailing.

The same explanation was advanced by A. G. Cadogan for difficulty experienced in satisfactorily sampling gold ore of 0.5 oz. grade. It would be interesting to learn the experience of other operators who use automatic samplers under similar conditions. From 1 to 2% of the 9.7% total excess silver may be accounted for by a small quantity of pulp from a settling pond near the mill, that was introduced into the cyanide plant below the automatic samplers, but aside from that item, there is no apparent reason for such a large plus recovery.

If the ton-assay method were the sole basis of computation, it is easy to see that a monthly recovery of 104 to 106% in the cyanide plant would become an absurdity, and would cause the average assay figures in the metallurgical statement to be valueless as a guide or reference, and it would certainly follow as a consequence of the use of the ton-assay method of calculation, without other checks.

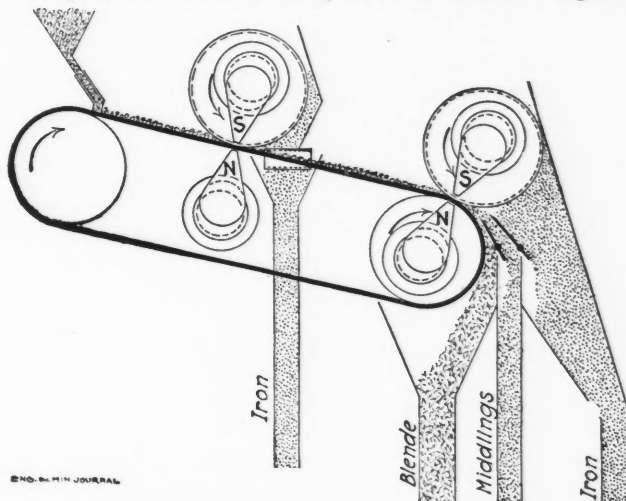
Since the figures in this article were collected, a change in milling methods has been made, that should be noted in connection with this discussion. Tailing from the stamp mill now reaches the cyanide plant in two separate streams, being divided in the stamp mill for concentration separately as sand and slime on Wilfleys and Deisters. Hence, it now requires an approximation for the percentage of each kind of pulp, whereas formerly they were mingled with one product in stamp mill after concentration, and a separate classification was made in the cyanide plant as well. Furthermore, reconcentration of the reground sands from the tube mills has been perfected and the quantity of concentrate thereby recovered should

be added to the heads to cyanide plant, in order to check with the pulp-assay figures or the same amount may be subtracted from the pulp-assay figures.

The Magnetic Separation of Blende from Pyrite*

Before describing in detail the operating methods at Sakiet-Sidi-Youssef, where a lead-zinc-iron ore is being treated, I will note some particulars concerning the conduct of similar operations in a few European localities.

At Lazihütte, near Beuthen, Upper Silesia, a galena-blende-pyrite ore is concentrated by usual hydraulic methods, yielding marketable galena, marketable blende (42% Zn), and another blende product containing 17% Zn. This last, after drying, crushing, roasting and screening into two sizes, is treated on two Humboldt separators, yielding rich blende (42% Zn), middlings and a magnetic product. The middlings of both sizes are together



MAGNETIC SEPARATION OF BLENDE AND PYRITE

treated on a third separator giving similar products. The recovery of zinc at this works averages 75 per cent.

At Lohmannsfeld, near Neunkirchen, Germany, the washery produces, in addition to galena concentrate, a mixed product containing 15 to 22% Zn, the remainder being spathic iron. After drying, crushing and screening into four sizes, this material is treated on double Wetherill separators. The blende is entirely devoid of iron; hence roasting is not required, the separation being based alone on the different permeabilities of blende and siderite. The first separation is made at a belt speed of 40 in. per min., with 12 amp. and 65 volts. The second stage is at 25m. per min., with 15 amp. and 65 volts. The blende product assays 40 to 45% Zn. The capacity of the magnetic plant is 3.5 tons per hour, the cost of operation being 1.75 fr. per ton of crude ore, not including amortization. The cost of the installation was 125,000 francs.

At Pierrefitte, near Lourdes, a magnetic plant was set up in 1911 to enrich the blende concentrates of the sand tables, which were not able to yield a product carrying more than 32% Zn, although the jig concentrates were marketable. The magnetic plant has a capacity of 25 tons

*Note—Translated from a paper in "Bulletin" de la Société de l'Industrie Minérale, October, 1913, by Pierre Andre, mine manager, at Sakiet-Sidi-Youssef, Algeria.

per day, its method of operation being very similar to that at Sakiet, about to be described. Roasting at this plant is very superficial.

At Ingurtosu, Sardinia, a washery treating blende-siderite ore yields a blende concentrate (47 to 50 % Zn), and a so called poor blende, carrying 42 to 45% Zn. This last, after roasting in an Oxland furnace, is passed to a Wetherill separator, giving a 50% Zn product. Here they are now installing a Krupp magnetic concentrator (Ullrich system) operating on wet ore.

At Sakiet-Sidi-Youssef, the mill ore is first treated in a Humboldt washer of 10 tons per hour capacity. The average composition of the ore is 13% Zn, 6% Pb and 7.5% Fe, the latter being all in the form of pyrite; the dissemination of the three sulphides is so intimate that the coarsest size on which concentration is attempted is 3.25 mm. The gangue includes shaly limestone, dolomite, calcite, baryte and shale. The blende is amorphous, and when of high grade has a light-brown color and assays 55% Zn. The poorer blende is ferruginous, of a blackish color, and picked fragments may assay from 15 to 35% Zn, with no tangible difference in appearance. This ferruginous blende is the great source of trouble in the mill, which will scarcely yield a 30% Zn concentrate, without greatly diminishing the capacity. It is this zinc product which is enriched magnetically. When the mill feed runs particularly rich, say 15% Zn, the washer will yield a marketable product of 38 to 40% Zn, and a poorer product for magnetic treatment.

The low-grade blende, passing from the washery, is dried in a chamber, which also serves as a dust collector, and is heated by gases from the roasting furnace, on their way to the stack. The dried material, now containing less than 2% moisture, is elevated to a trommel with 2-mm. holes. Oversize is conducted through rolls of 700 mm. diameter and 150 mm. width, and thence back to the same trommel. Undersize slides through a launder to one or two roasting furnaces, and escaping from the furnace passes through a cooler. The roasted and cooled ore is elevated to a trommel having 1-mm. and 3-mm. holes; oversize (of which there is usually only a little) returns to the first rolls. The ore of less than 1-mm. size passes to one belt of the magnetic separator, and that of 1 to 3 mm. to the other belt. From each size of ore, the separator makes four products: (1) Strongly magnetic iron; (2) a more weakly magnetic product; (3) a mixed iron-zinc product; (4) blende.

[Omitting here the detailed description of dust evacuators, ore distributors, elevators and rolls, as given in the original article, it is enough to say with regard to the roasting furnaces that they resemble in practically every particular the well known MacDougall furnace, of five hearths.—EDITOR.]

The cooler for roasted ore is composed of a bundle of 16 iron tubes, 7 in. long, and of 70 mm. diameter, through which the ore passes. Each tube is encased in another tube of 110 mm. diameter, acting as a water jacket. The whole apparatus slopes 7° and is rotated at 8 r.p.m. The water enters at the lower end and escapes at top; 6 to 8 cu.m. per hour are required.

The magnetic separator is designed by the *Métallurgische Gesellschaft* and built by the Humboldt firm, at Cologne. Its peculiarity is that it combines the principles of the Wetherill and the Edison types, as separately applied in the United States. It is a duplex machine,

having one belt for fine and one for coarser ore, as stated above; the belts are of rubber, 350 mm. wide, and are inclined 12° downward. The first magnet on the under side of the belt has its poles pointed upward, one pole serving for one belt, and the other pole for the other belt. Above it is a similar magnet, oppositely oriented, the traveling belts passing through the air gaps between the two pairs of poles. The second pair of magnets, having four poles and two air gaps, is similar to the first pair. Around both of the upper magnets and the second of the lower magnets are revolving metallic drums, the latter serving only as a pulley for the traveling belt, which passes, at the opposite end of the machine, around a wooden drum. The cylinders on the upper magnets, which are so adjusted as almost to touch the traveling belt, are corrugated in the form of a helical groove, which serves to overturn the layer of ore at the moment it is passing through the field, thus permitting a clearer separation of magnetic from nonmagnetic particles. Each pole has a beveled edge, 340 mm. long, the eight poles being exactly similar.

The ore is deposited automatically in a thin layer on each belt, the thickness of the layer being adjustable, and is carried into the magnetic fields at a speed of 53 in. per min. In the first field, the most permeable grains are deflected upward against the rotating cylinder, to which they adhere long enough to be thrown on top of the cross-belt, which carries them outward to a hopper. In the second field, the remaining most permeable grains are thrown farthest, into their receptacle, the middle product into its compartment, while the nonmagnetic blende drops straight down into its hopper. Thin iron sheets, adjustable in position, assist in making a sharp separation between products.

The magnetizing current is supplied by a small dynamo at 40 volts, 7 to 9 amp. going to the first field and 10 to 12 amp. to the second. The possible adjustments of the apparatus are:

- (1) Intensity of magnetization; effected by introducing resistance into the field currents.
- (2) Distance from upper poles to the layer of ore.
- (3) Air gap between poles, by turning one or both magnets in the same field.
- (4) Position of the guiding vanes at the discharge end.

The entire magnetic plant requires about 45 hp. for its operation. The work is conducted by seven operatives, of whom only one is a European, and one a boy. The cost of operation, although at the time of writing it was not in full swing, appears to be about 6 fr. per ton treated, of which 20% is for labor, 24% for supplies, repairs and furnace fuel, and 56% for motive power, the last item being high on account of the abnormal cost of fuel at the mine.

The recovery by magnetic separation; on the basis of 100 tons of feed containing 33.36% Zn, is as follows: First iron product, 10.44 tons, containing 17.63% Zn; second iron product, 5.52 tons, containing 19.71% Zn; middle product, 11.25 tons, containing 27.38% Zn; blende concentrate, 65.44 tons, containing 41.86% Zn. Assuming nothing saved but the 42% blende concentrate, the recovery of zinc would be 82%, but by mixing the middlings with the concentrate, the zinc contents of the product would be 40%, while the recovery would be 91% of the zinc in the feed.

The most delicate point in the whole operation is the roasting process. While oxidation must be sufficient to create a magnetic iron mineral, it must not be allowed to proceed so far as to reduce the sulphur in the blende below 21%, which is the percentage required by the operators of zinc-roasting furnaces.

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The Working of the Norwegian Concession Laws

SPECIAL CORRESPONDENCE

The exploitation of Norway's natural resources in mines, forests and water power practically ceased with the promulgation of the concession laws of 1909. The provisional laws which had been passed during the five previous years had, it is true, rendered overseas capital somewhat shy in dealing with Norwegian ventures, but that period was activity itself compared with the general stagnation which now prevails. So far as mining is concerned, the cause is due not so much to the royalties imposed on dressed ore and the numerous stipulations in respect of share transactions, management and staff, as to the drastic clause whereby freehold claims and prospects are, by transfer, converted into 50- to 65-year leaseholds, at the end of which period the property and mining equipment are expropriated by the state without compensation.

A natural result is seen in the recent decision of the Dunderland Iron Ore Co. to resume work on a reduced scale rather than attempt to realize on its freehold on terms that would have been disastrous to the prior liens. And, as with that company, so with others which having run out of working capital (mainly owing to the scare induced by these laws) are choosing between the devil of reduced operations and the deep sea of the auctioneer's hammer.

In the case of prospects, a foreigner may, subject to the mining laws, try as many as he chooses, at the risk of being refused a subsequent concession, or granted one on impossible terms. For exploitation purposes, per claim, he may in the meanwhile (unless otherwise sanctioned) mine only 1000 cu. m. of rock annually. Here the risk to promoters, who have paid over moneys to peasant holders on practically no security, is real indeed; and in several instances where considerable amounts have been laid out in purchase and exploitation they have been compelled, rather than lose all, to apply for a working concession, and chance the luck turning later on. Long leasehold working options on a commercial basis likewise necessitate a concession, and a preconcessional proposition granting such would come under the new law as regards expropriation. There is no way out of the *impasse* by any conceivable ingenuity of the promoter. They have failed even in London and Manchester. The object of the government and the general sense of the country is that these natural resources shall be reserved for posterity, and, of course, incidentally, that foreign monopolists may be controlled. That the latter might be scared away into other fields for their operations does not appear to have entered into their calculations to the extent that it does now—when the thing is done.

The action of these concession laws is particularly unfortunate in its bearing on copper-iron pyrites—at pres-

ent the most important mineral asset of the country, and especially so at a time when a new railroad is traversing sections of the Trondhjem district, wherein large deposits of these minerals have been located. In Nordland, also, coastal finds of pyritic bodies have been numerous. But the concessional terms for operating them are not sufficiently inviting for business. As an instance, the Rødfjeld pyrites mines, in Mo, near Dunderland, were recently asked to accept the following conditions for a concession: a 50 years' lease with expropriation; 4c. per ton on all ore exported, or dressed for smelters, for the first 10 years; after which the rate for each following 10 years to be fixed by mutual agreement, or arbitration; the company to bind itself to supply, on demand by a native buyer, and within two years' notice, 50% of the yearly output of the quality of ore which he (the native buyer) may require for home-refinery requirements—though this condition shall not be operative if the company itself refine at least 50% of its output in Norway; should the increase of operations necessitate a larger police force, the company shall defray the cost of same; the company may only appoint a mine foreman who has passed his examination at the School of Mines; and in a law case pending between the company and Mayor Krefbing, wherein the latter disputes the company's rights to a number of the claims the company is required to give security for \$11,000, which the result may render the company liable to pay. After the foregoing, it would really almost seem that the clause whereby the company is further required to pay a sum down "once and for all times" of \$80 was quite superfluous—not to say gratuitous. However, the only answer that could possibly have been vouchsafed in the circumstances was: "Nothing doing." Statistically considered, the mines continue to show an annual increase in output, a fact which is due mainly to the large preconcessional pyrites and copper propositions doing fairly well, and the Sydvaranger iron mines, though not yet arrived at the dividend stage, contribute largely to tonnage totals. Actually, however, and if we except the postconcessional Grong copper proposition on the Swedish border, the undoubtedly large mineral reserves of the country have been lying fallow, and will certainly continue to do so while the present law is in operation. As regards water-power, the position is identical with that of mines.

A leading Christiania banker, Herr Kielland-Torkildsen, in a recent earnest appeal to his countrymen (since published in the press) has stated the position from the point of view of the commercial interests of the country as against that of the mossback, the socialist, and the professorial elements responsible to a large extent for the recent restrictive legislation. After an exhaustive review of the position of the foreign loan markets, and a reminder that neither the state, the communes nor the land banks have been able to negotiate a loan for a considerable time, except at rates that would have been prohibitive, he goes on to say:

Our industry has for a long time been fighting hard to maintain its position. None but the banks know what difficulties some of our largest undertakings have had to encounter to balance accounts. The workmen's demands for higher wages and less output of work have rendered it extremely hard for us to compete with more favorably circumstanced competitors abroad. We have waited for those more favorable conditions when profits could be devoted to more than merely paying wages, and when they arrived the workmen still craved a higher wage, and the state reduces their working hours and increases taxation. Where is all this leading to? . . . With 1905 a new era commenced for Norway. All

looked roseate ahead of us when we took up the work which the separation from Sweden entailed upon us. The world's most powerful states acknowledged and admired us. . . . Our financial position was satisfactory, and it had begun to dawn on our people as well as the foreigner what immense development possibilities the hitherto so little noticed Norway actually possessed—with a large area, her long coast line, her forests, her minerals, and her enormous water power. These were riches which, if properly utilized, should have made Norway both powerful and wealthy. . . . How have we made use of the time? How have we made use of the brilliant opportunity which the fates have placed at our disposal? . . . There are vast riches slumbering in Norway's fjelds and waterfalls. But we are without the means to exploit this wealth ourselves. The sums required to regulate our waterfalls are quite too colossal. And we shut the door against capital, and let our young men seek that home in America and other lands which could have been found here were it not for the barriers of all kinds which have been set up against development.

However, there is some hope to be seen; among a number of bills to be brought up during the present session of the Storting will be some for the revision of the present concession laws in respect of mining, waterfalls, forests, electric power, the regulating of catchments, and the conservation of peat lands.

On Nov. 7, last year, a crowded meeting of Storting members and others was addressed by Herr Michelet—the Nestor, an old man eloquent of Storting debate. The subject was "Our Waterfalls and Foreign Capital." He laid great stress on the fact that although the leases of these falls to foreigners were terminable, there was always the danger that foreign governments would step in, to the extent even of a naval demonstration, to enforce their renewal in the interests of their investing subjects. His recommendations were: (1) No further large waterfall concessions to foreigners; (2) any future concessions to be more drastic in their conditions; (3) special easements to native companies. The views of the speaker were enthusiastically indorsed by the meeting, and bills in relation thereto will be brought in during the present session of the Storting.

On Nov. 12, the *Vossische Zeitung*, of Berlin, printed a leading article on the commercial position as between Germany and Norway, and after alluding to Norway's rapidly increasing trade since 1905, and the fact that England's lead had been captured by Germany since 1911, goes on to say:

In German commercial circles the opinion has been arrived at that the politico-financial relations between the two countries require revision, and to this view the government must eventually adhere. The commercial dealings between Germany and Norway are based upon two old treaties, which must be renewed. As regards the Norwegian concession laws, they contain difficult conditions for foreigners to comply with, and are quite of a protectionist stamp. Several of these conditions have a scary effect on foreign capital, and especially will English and German capital, as a result, keep aloof. No special degree of importance can be attached to Norwegian capital. A long period must elapse before Norwegians can, of themselves, exploit the riches which their land conceals. The country possesses an insufficient number of men who are qualified to lead in these undertakings. The community of engineers and workmen is insufficiently educated for industrial enterprise. Yet, despite this, they (the Norwegians) seek by every possible means to keep the foreigner out, and set up obstacles in his way. An economical policy of this kind is not to the interests of the country. Neither is it to the interests of foreign countries. One might have expected from a country with only 2½ million inhabitants that it would not adopt an unhealthy and unjust attitude of chauvinism toward a nation like Germany.

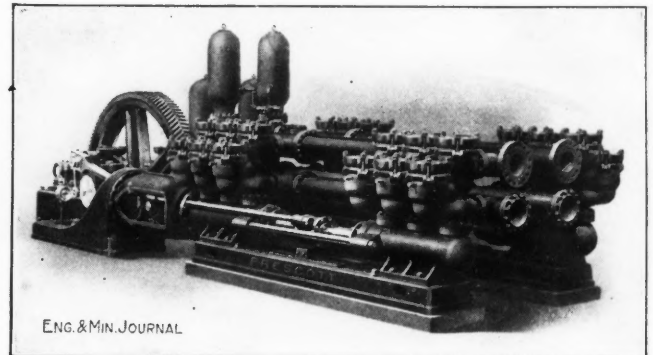
The acidity of the article doubtless arose from the not very successful results of German enterprise in Norway since the onerous conditions of the concession laws were imposed. It contains, however, a distinct note of

warning, which, in view of the recent French attitude and the feeling gradually becoming apparent even in England, cannot but have some appeal to a country dependent to so great an extent on the commercial suffrages of its powerful neighbors.

Whether the Prime Minister, Herr Gunnar Knudsen, emulating the commercial policy of the late President Lopez, of Paraguay, will take his courage in both hands and with his back to the wall defy the retaliatory machinations of the foreign monopolist, the events of the present Storting session alone may reveal. The position is Homeric. It is certainly a little pathetic, and whatever the outcome of the contest—if a contest there will be—little Norway must, at least, be credited with the courage of her convictions.

Motor-Driven, Duplex, Horizontal-Plunger, Mine Pump

The horizontal, duplex, power-driven, plunger pump here illustrated is a fair example of what may be assumed as the standard power-driven machine on the iron ranges. Two machines of this type with 6½-in. plungers and 36-in. stroke were recently ordered from the Fred. M. Prescott Steam Pump Co., for one of the largest Michigan iron mines. These pumps have each a capacity of 1000 gal. per min., against 1000-ft. head, at 49 r.p.m. They are driven by induction motors of 580 r.p.m., full-load speed, through cast-steel herringbone single-reduction gearing. The spurs are cast in halves and bolted



MOTOR-DRIVEN PUMP, 1000-GAL., 1000-FT. HEAD

and the pinions are cut from solid blanks, a high efficiency in use being obtained. In choosing the type of pump for this installation, the centrifugal was eliminated on account of low efficiency, a wire-to-water efficiency of 60% being practically the best obtainable. In the case of the various types of power pumps, while much higher overall efficiencies were obtainable in general, certain features of design, accessibility and the efficiencies guaranteed finally resulted in the selection of the type illustrated. The overall, wire-to-water efficiency of these machines under the purchaser's tests showed better than 80%, and this satisfactory figure was maintained over some period of time. The possibility of mining at a greater depth and the probability of a decrease in water with depth, rendered some sort of arrangement for changing capacity highly desirable, so that the pump could be used at a greater depth for less capacity and still operate with the same motor. This was provided for by using a centrally packed design and a crosshead which admits of plunger changes.

Details of Practical Mining

Form for Missed-Hole Reports

By B. H. SMITH*

An ingenious method for reducing the probability of missed-hole accidents was adopted in sinking the Monarch-Pittsburgh shaft, at Tonopah. The idea is not entirely new, having been used in the Cœur d'Alenes previously. A blank form, as shown, was placed in a conspicuous place of the change house, and in the rectangle a plan of the holes in the shaft bottom was made. The shift coming off after blasting, marked rings around the dots representing the holes which it was suspected had missed, and each member of the shift signed below. The

FAILURE TO MARK AND SIGN REPORT WILL BE CAUSE FOR IMMEDIATE DISMISSAL

MISSED HOLE REPORT
MONARCH-PITTSBURGH EXTENSION MINING COMPANY

TONOPAH, NEVADA, _____ 191__
SHIFT _____ TO _____

SHAFTMEN WILL MARK HOLES BELIEVED TO HAVE MISSED FIRE. IN DIAGRAM BELOW
DRAW A CIRCLE AROUND MISSED HOLES

TOTAL MISSED HOLES. 3

OFF GOING SHIFT
SIGN HERE

ON COMING SHIFT
SIGN HERE

FORM FILLED OUT TO SHOW THREE HOLES MISSED

shift coming on also signed at the bottom as an indication that each member had examined the diagram.

Two purposes were served by this device. (1) The new shift was forced to receive information of the possibly dangerous holes; (2) the liability of the company to damage suits was decreased, since the signatures of the men would show that they were aware of the presence of the danger.

The usual method of leaving the record of suspected holes on a blackboard for the new shift to read, is never satisfactory. The shift which has just blasted is usually in too much of a hurry to chalk up the missed holes and the shift coming on frequently does not bother to read anything that has been written.

*Superintendent, Monarch-Pittsburgh Extension Mining Co., Tonopah, Nevada.

Data on Miami Churn Drilling

By H. P. BOWEN*

Since the early part of 1910, the Miami Copper Co. has done about 44,500 ft. of churn drilling, consisting of 73 holes ranging from 336 to 941 ft. in depth, and averaging 605 ft. Of this drilling, 36,500 ft. was in a more or less silicified schist, 6300 ft. was in granite or granite-porphry, and 1700 ft. in the Gila conglomerate, which overlies the schist on some portions of the property.

Practically no difference was found between drilling in the granite and in the schist. In the conglomerate, little difficulty was experienced until water was encountered. The water caused the sides of the holes to slough off somewhat, rendering drilling progress extremely slow. Holes that were put down through any great depth of conglomerate and into the underlying schist, were particularly slow and expensive to drill, due not only to the difficulty in passing through the large fault which separates the two formations, but also to the excessively shattered condition of the schist immediately below the fault. In the schist and granite the water level tends to follow the top of the zone of secondary enrichment and in many cases is coincident with it, but in the conglomerate it occurs much nearer the surface.

The drilling was done with three No. 23 Star traction drills, equipped with No. 24 boilers and derricks, although for most of the time only two of the machines were in use. The holes were started with a 10-in. bit succeeded by the following sizes of casing and bits until the desired depth was reached: 10-in. bit followed by 7 $\frac{5}{8}$ -in. casing; 7 $\frac{5}{8}$ -in. bit followed by 6 $\frac{1}{4}$ -in. casing; 6 $\frac{1}{4}$ -in. bit followed by 4 $\frac{1}{4}$ -in. casing; 4 $\frac{1}{4}$ -in. bit.

Eight holes were drilled with one string of tools to an average depth of 558 ft. Using two sizes of tools, 35 holes reached an average depth of 577 ft., and with three and four strings of tools, 21 and nine holes, respectively, reached average depths of 647 and 654 ft. In only three of the holes, all of which passed through several hundred feet of conglomerate before entering the schist, was it found necessary to ream to reach sufficient depth. These holes averaged 740 ft.

The small use made of the 4 $\frac{1}{4}$ -in. tools is shown by the following percentages: 65% of total footage drilled with 10-in. tools; 24%, with 7 $\frac{5}{8}$ -in. tools; 8%, with 6 $\frac{1}{4}$ -in. tools; 3%, with 4 $\frac{1}{4}$ -in. tools.

Taking the holes in which the different-sized bits were used: 10-in. tools drilled an average of 397 ft. per hole; 7 $\frac{5}{8}$ -in. drilled 157 ft.; 6 $\frac{1}{4}$ -in. drilled 122 ft.; 4 $\frac{1}{4}$ -in. drilled 105 ft.

Using only the actual drilling hours, the following advances were made with different sized bits: 10-in., 2.56 ft. per hr.; 7 $\frac{5}{8}$ -in., 2.04 ft. per hr.; 6 $\frac{1}{4}$ -in., 2.00 ft. per hr.; 4 $\frac{1}{4}$ -in., 1.63 ft. per hr.

A comparison of the drilling speeds of a string of 10-in. tools at various depths shows that the expected slow-

*Miami Copper Co., Miami, Ariz.

ing up in depth occurred: 0-100 ft. 3.56 ft. per hr.; 100-200 ft., 2.98 ft. per hr.; 200-300 ft., 2.33 ft. per hr.; 300-400 ft., 2.23 ft. per hr.; 400-500 ft., 2.23 ft. per hr.

The following weights of casing were used: $7\frac{5}{8}$ -in., weighing 20 lb. per ft.; $6\frac{1}{4}$ -in., weighing 13 lb. per ft.; $4\frac{1}{4}$ -in., weighing 9 lb. per ft.

Besides being cheaper this was much lighter and easier to handle than the heavier drive pipe, but the latter proved most satisfactory in the deeper conglomerate holes in which it was necessary to resort to driving the pipe. While all the holes were not cased, some required several strings of casing and in all 42,950 ft. was used. In other words, nearly a foot of casing was put into the ground for every foot of hole drilled. This was subdivided as follows: $7\frac{5}{8}$ -in. casing, 55%; $6\frac{1}{4}$ -in., 31%; $4\frac{1}{4}$ -in., 14%.

Most of this casing was used over and over again and is still serviceable but in seven of the holes some was either lost or was so badly battered as to render it worthless. For every 100 ft. of $7\frac{5}{8}$ - and $6\frac{1}{4}$ -in. casing put in the holes an average of $4\frac{1}{2}$ ft. was lost while for the $4\frac{1}{4}$ -in. casing, the loss was a little less than 1%.

When the work was first started, a sampler was stationed at each machine. Later on it was found that one man could satisfactorily sample two machines, provided care were taken in laying out the work so that the two machines should not be too far apart. An endeavor was also made to have one of the machines drilling in the capping, which is practically barren and is not ordinarily sampled, while the other was drilling in ore, but this could be carried out only a portion of the time.

Starting with a 12-hr. shift working only during the day, the work was changed to two 12-hr. shifts, then to two 10-hr. shifts and finally to 8-hr. shifts; the last change was necessary to conform to a possible interpretation of the new state laws. At first, three 8-hr. shifts were tried, but the work finally settled down to two 8-hr. shifts—from 8 a.m. to 4 p.m. and 4 p.m. to 12 m. in winter and from 7 a.m. to 3 p.m. and 3 p.m. to 11 p.m. in summer. Of these different working arrangements, that employing the two 10-hr. shifts was apparently the most satisfactory under the different scales of wages paid, but sufficient work was not done under the 10-hr. schedule to prove it entirely. The following scales of wages were paid for the different working periods:

	12-Hr. Shift	10-Hr. Shift	8-Hr. Shift
Foreman ..	\$200.00 per month	\$200.00 per month	\$200.00 per month
Samplers ..	100.00 per month	100.00 per month	100.00 per month
Drillers ..	6.00 per day	5.50 per day	5.00 per day
Helpers ..	4.80 per day	4.40 per day	4.00 per day

Taking a number of representative holes, an advance of 1.7 ft. per hr. was obtained for the 8-hr. period as against 1.5 ft. per hr. for the 12-hr. period. This will give a charge of \$0.90 per ft. for the 8-hr. shift and \$0.79 for the 12-hr. shift. The cost per foot for the 8-hr. period would be also increased by the additional cost of hauling coal, casing and supplies.

The use of three 8-hr. shifts, when the condition of the hole does not require it, is decidedly uneconomical. Besides the objections incident to the graveyard shift, is the fact that when it comes to moving and to setting up the machine, to casing or to removing casing, a crew of four men is amply sufficient and these jobs occurred so frequently that it proved impossible to lay off one shift at such times and yet keep good men.

The subdivision of the drillers' and helpers' time shows the following percentages of the whole working time chargeable against the various operations:

Drilling and sampling, 69.80%; moving and setting up, 11.15%; casing, 6.25%; removing casing, 8.40%; fishing for tools, 2.10%; repairs, 2.00%; delays, 0.30%.

Under the heading of "delays" are included only those interruptions which cannot rightly be charged up as drilling, such as failure of the water-supply, etc.

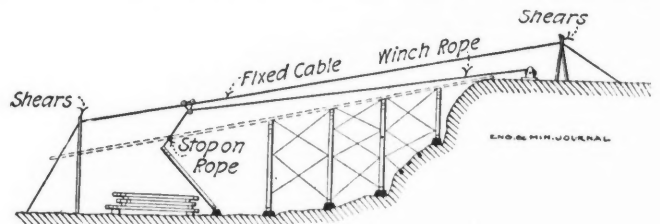
A drill road for a No. 23 Star machine should be 9 ft. wide on the solid ground and have a grade limit of about 15%. The machine will take heavier grades than this, particularly on a straightaway pull, but they are hard on the machine and should be avoided when possible. Conditions here necessitated the moving of about a cubic yard of material per running foot of road.

Drilling with 10-in. tools in a dry hole, the drill will average about 100 lb. of coal and 100 gal. of water per hr., and this amount should prove ample except under unusual conditions.

Erecting Trestle Bents with Cableway

BY A. LIVINGSTONE OKE*

The diagram shows a convenient method that I have seen adopted for erecting quickly a long series of trestles to carry an inclined gravity tramway down a steep hillside. The carpenters built the trestles on the site, starting



PROFILE OF TRESTLE AND CABLEWAY

with the last on the lower end of the section and stacking them in ascending order. Meantime, a wire-rope cableway was erected by means of two sheaves, so that the lowest point of the rope was above the finished tramway level. A winch was set at the upper end, as shown. The winch-line operated over a carrier sheave running on the fixed rope; it has a weighted hook at its end and a stop placed a few feet above it. The hook was used to take hold of the bent tops and the rope pulled by the winch raised the bent. The stop catching on the sheave, brought the bent back to the required position, once it was swinging clear of the ground. The bent was temporarily fastened in a vertical position by extending running planks from the top of the bent last erected, until the permanent bracing was put in.

Centrifugal Pump Thrust Bearing

Some centrifugal pumps installed by the Penn Iron Mining Co., of Vulcan, Mich., were originally equipped with marine thrust bearings. The pumps were of eight stages each, designed to handle 900 gal. per min. against

*Mining engineer, Penzance, Cornwall, England.

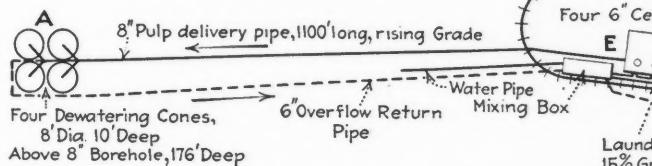
a total head of 1295 ft. (*Bull.*, A. I. M. E., February, 1914.) There were four stages on each side of the motor and each end was equipped with one of the marine thrust bearings. In operation, trouble was had with heating in these bearings on starting and they were discarded for hydraulic thrust rings against which the pressure of the water in the column pipe was automatically applied by a slight thrust motion of the shaft. There was a disadvantage in this due to the fact that the greatest thrust occurred at the time of starting before the impellers became balanced, as when under full head, and at such time the column pipe might be empty or not full enough to supply sufficient pressure.

For this reason on later installations the hydraulic thrust ring was supplied with oil from a separate, small, motor-driven plunger pump. When oil was lacking, it was found that water answered equally well. This method offered the further advantage of supplying a constant quantity at a variable pressure, depending on the thrust.

Bore-Hole System of Sand Filling

The transfer of sand filling underground through bore holes has proved successful on the Rand in two mines, the Robinson Deep and the Simmer & Jack.

The essential features of the system at the Simmer & Jack consist in mixing the sand residue, immediately after car discharge from the vats, with water and a small



amount of permanganate of potash solution; and pumping the mixture through pipes to dewatering diaphragm-cone classifiers placed immediately above the bore hole or other point of lowering, down which the thick sandy underflow continuously descends. The fluid cone-overflow gravitates or is pumped back to the mixing box beside the pump, into which the residue is dumped, thus completing its circuit and serving to transport more residue. The underflow falling down the bore hole into the mine is then conveyed by launder to the stope to be filled, where it speedily drains, leaving a solid mass of sand behind. Any accidental filling of the hole with sand is of temporary inconvenience only, as the turning in of a small stream of water at the top in the evening will result in a clearance by the following morning.

Distinctive features of the system are, that it is applied to current residue; that the residue is transported from the sand plant to the lowering point as a flowing pulp and not by cars, the water performing a circuit; that the lowering proceeds continuously instead of intermittently, and is usually performed by passing a thick pulp through a borehole instead of a more fluid pulp through pipes, thus avoiding wear of the latter; and that distribution of the sand underground is carried out in open launders instead of in pipes under pressure. One portion of the

Note—An excerpt from an article by W. A. Caldecott and O. P. Powell, "Journ." Chem. Met. and Min. Soc. of South Africa, September, 1913.

Simmer & Jack mine requiring filling happens to be nearly below the sand plant, so an 8-in. hole 500 ft. deep has been put down near the residue car track, and a short, steep tunnel from the mixing box to the hole allows the residue there dumped to be carried by a small stream of water as a thick pulp into the mine, without the need of pumping and dewatering. This modification has been more fully developed on the Robinson Deep.

The main features of the surface arrangements at the Simmer & Jack are clearly shown in Fig. 1. This out-crop mine extends over a large area and has been worked for many years. It was hence desirable and economically practicable to lower sand at several points, and the

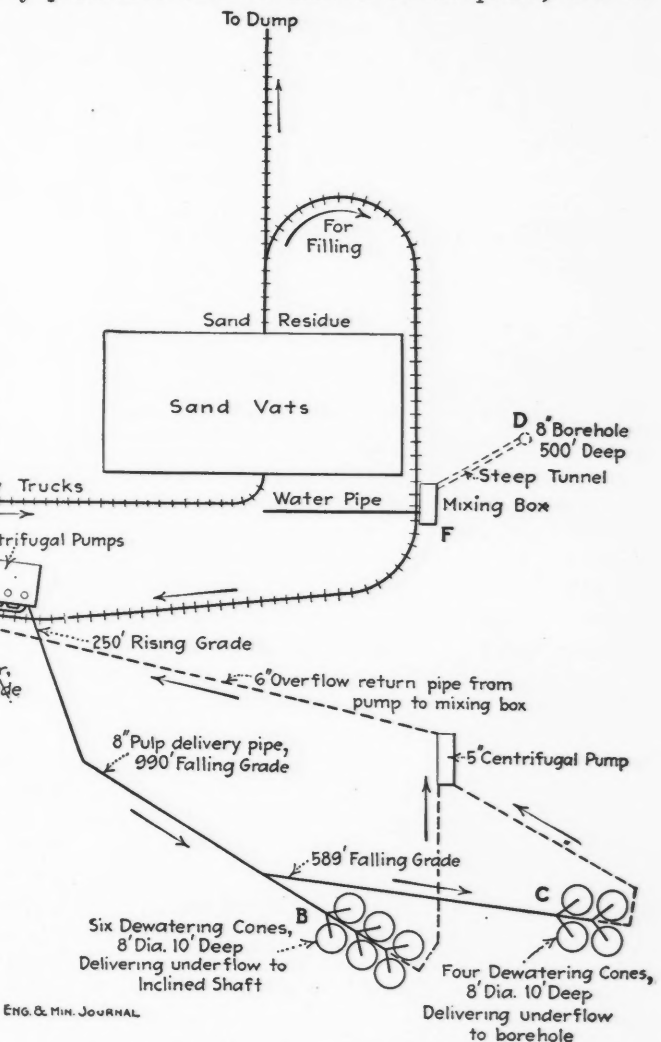


FIG. 1. ARRANGEMENT AT SIMMER & JACK

contingency of employing other points in the future had also to be borne in mind. Under these conditions part of the sand from the residue cars is periodically gravitated as a pulp from the mixing box F down the tunnel and hole D, put down for this purpose. The remaining sand is pumped as a pulp to points A, B or C. From A the cone overflow gravitates back to the mixing box E. 15 ft. long, 8 ft. wide and 6 ft. deep with a steeply inclined bottom, beside the residue track, although the tops of the cones at A are at ground level to saving pumping head. The cones at B and C are above ground, as their location necessitates return by pumping of the overflow to the mixing box. The graded launder about 20 ft. long between the mixing box at E and the pumps serves as an

automatic regulator of the consistency of pulp entering the pumps and prevents the latter from being choked, as extremely thick pulp will not flow down this launder. The empty cars in every case return to the sand plant.

As the local conditions at the Robinson Deep are different, it was decided after consideration to modify the system somewhat. The greater depth and smaller area of the mine rendered it both advisable and practicable to restrict permanently the lowering to one point at the north of the property, Fig. 2. A bore hole, decreasing from 10 in. diameter at the top to 7 in. diameter at the bottom and 1729 ft. deep, was accordingly put down so that all worked-out stopes could be served from it by pulp gravitation underground, and as the upper end of the bore hole was 18 ft. higher than the track under the sand vats and a considerable distance away, it was decided to drive a 4½x6-ft. tunnel from the sand plant at a dip of 20°. This tunnel was 1125 ft. long and intersected the

of this kind, where there is urgent necessity for filling a portion of the area, a temporary barrier of cheap construction may be erected, enabling filling operations to be carried on immediately.

The number of openings due to previous mining operations through these natural barriers is not usually great, enabling large areas to be completely closed at comparatively little cost. For some time the general practice on the Simmer & Jack has been to close up the drift or other openings with a masonry wall provided with drainage pipes. More recently such drainage has been effected through a bed of sifted clinker resting on a perforated platform. It has been suggested that in order to make this drainage still more efficient and permanent, a system might be adopted consisting in starting a drain with coarse material, such as rock 9 in. in diameter, and gradually working up with rock of diminishing size and finally with clinkered ash until the fineness of the material

TABLE I. COSTS FOR NINE MONTHS

Period	Tons of Sand Lowered		Average Surface Cost		Average Underground Cost		Average Total Cost	
	Total	Average Per Month	Per Month	Per Ton of Sand Lowered	Per Month	Per Ton of Sand Lowered	Per Month	Per Ton of Sand Lowered
October, 1912 to June, 1913, inclusive.....	172,535	19,171	\$1308	6.736c.	\$2540	13.108c.	\$3848	19.844c.

bore hole at 390 ft. from the surface, so that a thick pulp could be gravitated direct from the sand plant through the tunnel and bore hole into the mine without the need of pumping or dewatering the pulp. The open end of the tunnel is directly under the residue track and just clear of the vats so that the residue after dumping from trucks, and receiving the addition of a small stream of water and permanganate solution, descends as a 28% moisture pulp till it comes to the rest in the desired stope underground. This installation cost a good deal more in capital expenditure upon the tunnel than the Simmer & Jack installation of surface pumps, pipes and cones for a lowering point, but is preferable under the conditions indicated and has the advantage of low surface operating costs, these being merely the short car transport of residue from vats, tipping and returning the trucks, and the addition of a little permanganate. A screen of vertical grizzly bars across the tunnel prevents the bore from being choked by foreign substances. The amount of drainage water to be pumped to the surface from underground involved in sand filling with so thick a pulp is small, amounting only to about a quarter of a fluid ton per ton of dry sand deposited, or 50,000 gal. daily, with a monthly ore tonnage milled of 60,000 tons.

In the operations of sand filling, the permanency of the underground barriers must be considered. If there is a possibility of water finding its way into the filled area, it will not be sufficient to construct a barrier to last little longer than the period of filling and drainage. Such water, except perhaps in the case of flat workings, would in time wash down the sand through any perished parts of the barrier into the lower parts of the mine. The construction of a permanent barrier is costly, but on many mine dikes, faults and unpayable bodies of ore can be utilized so as to serve as natural barriers. On the Simmer & Jack, every advantage is taken of these natural barriers, and areas requiring filling are often considerably extended so as to permit of their use. It sometimes happens that immediate use cannot be made of such a barrier, owing to the fact that all the ore has not yet been removed from the area ultimately to be filled. In a case

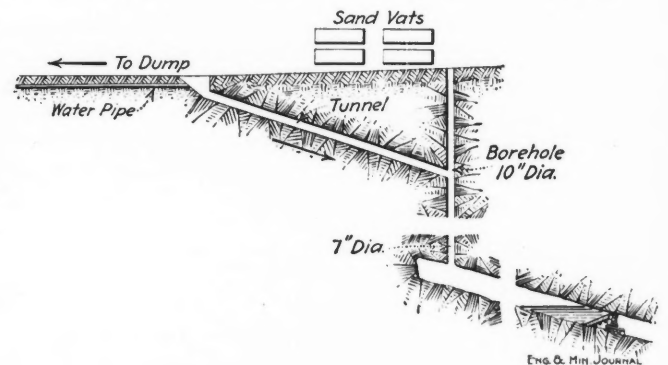


FIG. 2. ARRANGEMENT AT ROBINSON DEEP

to be drained has been reached, Fig. 3. This system has everything to commend it in the way of economy of construction, permanency and efficient drainage, and there is little doubt but that it will be a success in practice. The drainage just described is supplementary to the main drainage, which is effected by means of drainage launders. The drainage launders originally constructed were of wood or iron framing, square in section, covered with coconut-fiber matting. These were found to be not only expensive but liable to collapse, owing to the perishable nature of the matting. The greater portion of the sand has been drained through ordinary square-section box launders perforated with holes. These launders are cheaply constructed, but have two disadvantages. They require constant attention in order to prevent clogging up by sand before the plugging can be accomplished and they are liable to collapse, although, of course, not to so great an extent as the coconut-fiber matting launders. It is now proposed to employ a stouter box-shaped launder of smaller internal area. The perforations will be covered with coconut matting placed over wire meshing. It has been suggested that these might be further strengthened by filling with a core of sifted clinker. Where the drainage at the bottom of the areas is particularly good and the filling material clean sand free from slime, it is possible to dispense with the drainage launder.

Little change in the form of the filling launder has been made on the Simmer & Jack since sand-filling was first started. For a time wooden pipes were employed, as they recommended themselves both on the score of cheapness and the facility with which they could be erected. The use of these has since been given up and the launder at

TABLE II. DISTRIBUTED COSTS FOR ONE MONTH

	Surface Cost		Underground Cost		Total Cost	
	Total	Per Ton of Sand Lowered	Total	Per Ton of Sand Lowered	Total	Per Ton of Sand Lowered
White labor....	\$120.40	0.526c.	\$980.20	4.296c.	\$1100.70	4.822c.
Native labor....	332.30	1.456	295.10	1.292	627.00	2.748
Supplies.....	259.40	1.136	365.50	1.600	624.50	2.736
Workshops....	585.70	2.566	302.70	1.324	888.00	2.490
Power.....	228.70	1.000	.....	.....	227.80	1.000
Total.....	\$1526.50	6.684c.	\$1943.50	8.512c.	3468.00	13.796

present used is stouter than originally employed and wears better. It is also deeper in proportion to its width so as to prevent overflow of pulp. The bottom is lined with hard wood and the corners provided with hardwood

Underground Surveying with Balloon

In mines handled on the room-and-pillar system, or by some other method involving large open chambers, considerable difficulty may be encountered by an engineer called upon to make a survey after work has been carried on for some time. The back is high and almost inaccessible, yet a complete survey would necessitate obtaining the outline of its surface. In the *Cornell Civil Engineer*, December, 1913, John C. Trautwine, 3rd, notes an ingenious method employed by him in iron mines. It was not given a fair test, but promised success. It consisted in using a captive balloon, with a light stadia rod attached to its lower end, illuminated by an electric light, or with a pair of small electric lights thus attached and accurately spaced. The balloon actually constructed leaked too badly and required much care to handle. The one

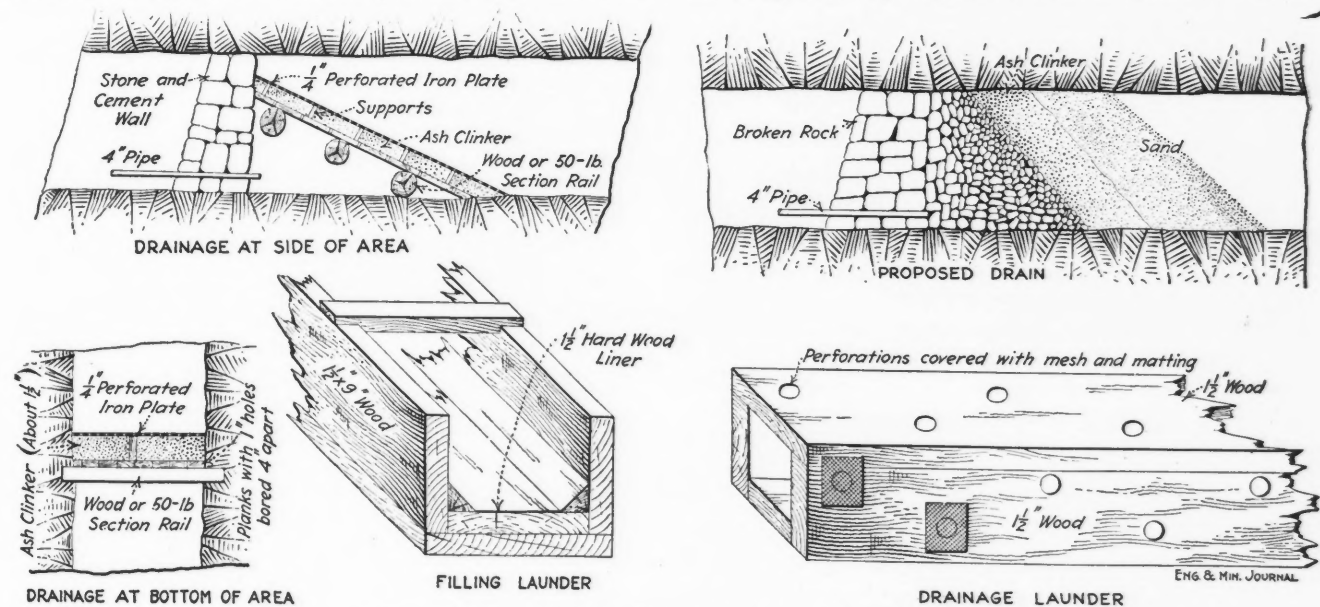


FIG. 3. DETAILS OF LAUNDERS AND BULKHEADS

fillets, which can be renewed when worn. In future the hardwood lining will be replaced by old rubber belting.

Where the dip of the workings is not sufficient to carry the pulp freely along the launders, water is added from some underground source of supply. This is preferable to using water to thin the pulp at the underflow of the cones or mixing box situated at the top of the bore hole, as the water has subsequently to be pumped to the surface.

The cost of filling per ton of sand residue lowered, varies considerably from month to month, owing to fluctuations in the tonnage, and the expenditure incurred underground in providing for current as well as future requirements. The costs incurred on the Simmer & Jack Proprietary mines during a recent period of nine months, are given in Table I. Table II illustrates more detailed operating costs for lowering 22,541 tons of sand during the month of November, 1912. These average costs include a considerable amount expended on preparatory work on areas where a large amount of filling remains to be done. It is probable that the monthly tonnage lowered will be increased soon. These two factors should appreciably decrease the cost per ton of sand lowered in the future.

used was made of rubber cloth, weighing $\frac{3}{8}$ oz. per sq.ft., was about 6 ft. high and 5 ft. in diameter, weighed about $3\frac{1}{2}$ lb. and displaced about 5 or 6 lb. of air, thus affording a net lifting force of about 2 lb. Illuminating gas is too heavy and pure hydrogen must be used; this comes in steel cylinders which can be taken underground. The balloon was controlled with a fish line and reel. Hydrogen being explosive when mixed with oxygen, only electric lights were permitted near the balloon. Care is necessary to keep the balloon clean, as a small accumulation of mud will prevent its rising.

Single-Screw Wire-Rope Clip

The single-screw wire-rope clip shown in the *JOURNAL* of Apr. 4, 1914, p. 709, is an invention of A. Livingstone Oke, and should have been credited to him.

In **Electric Blasting Underground** on a large scale, it is good practice to handle the shots in groups, the detonators in each group being connected in series, but the various groups themselves being connected in parallel. (*Journ. Chem., Met. & Min. Soc. of South Africa*, October, 1913.) The number of detonators in series is governed by the voltage of the circuit to be used, the number of groups in parallel is controlled by the current available.

Details of Milling and Smelting

Suspension Types of Ore Bins

New designs for ore bins are always interesting and in many of the recently built large concentrators departures from long held conceptions of ore-bin design have been noteworthy. Flat bottoms have taken the place of inclined-bottoms; bins of steel, of steel and concrete, and of reinforced concrete have superseded wood; a cylindrical bin is no longer a novelty. However, the Baker type of suspended bin, illustrated in the accompanying photographic views and drawings, differs from most familiar designs in that the weight hangs from instead of resting upon the supporting structure.

At first glance it would seem that the field for such a type of bin would be restricted to small plants and small capacities, yet large steel companies are installing these bins for coke, ore and limestone, signifying that there is no such restriction and that such bins are being installed of enormous capacity. Four installations especially

In the Baker design, the suspension principle is utilized in the support of the containing structure, and the hopper-bin principle in the design of the bin bottom. The bin is supported by the usual construction of bents consisting of columns connected by a horizontal cross girder or strut. The containing structure is supported by two girders set at slight inclination from the vertical, the angle of inclination being dependent upon the height and width of the container. Steel suspension rods are attached to the inclined girders. These suspension rods support structural frames of triangular shape, the lower ends of two rods being attached to two corners of each frame. The bin lining, whether of wood, concrete or steel, is laid on the rods and structural frames. The length of rods and the depth of the triangular frame is so proportioned that a true parabola having the width and depth of the bin, will quite closely approximate the location of the suspension rods and frame after they are erected. The bin lining supported by the rods is per-

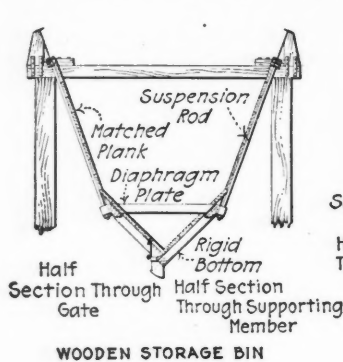


FIG. 1.

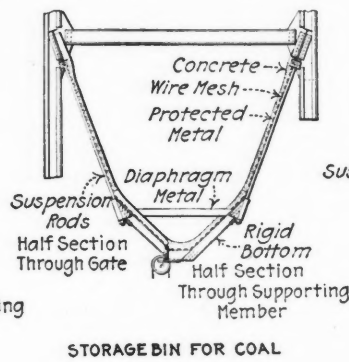


FIG. 2.

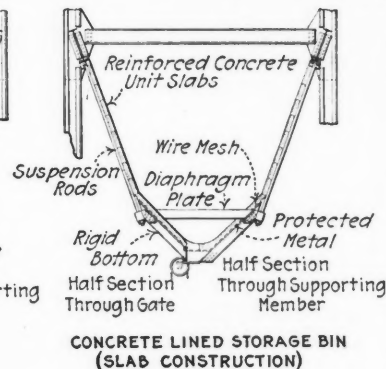


FIG. 3.

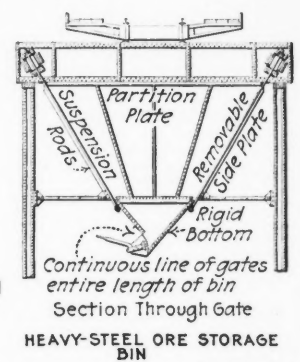


FIG. 4.

CROSS-SECTIONS OF SEVERAL TYPES OF SUSPENDED COAL OR ORE BINS

worthy of mention are those at the plants of the Detroit Iron & Steel Co., Detroit, Mich., the Ironton Iron Co., Ironton, Ohio; Marting Iron & Steel Co., Ironton, Ohio; and the Clinton Iron & Steel Co., Pittsburgh, Penn. These four installations comprise about 50 bins, and have a capacity of more than 5000 tons.

Although the Baker bin, designed by Robert E. Baker, of Cleveland, Ohio, may be classified as a bin structure of the suspension type, it is in reality a combination of two well known forms of bin construction, the suspension and the hopper type. It is recognized that the suspension bin affords the most economical use of the construction material, as the containing structure is supported by materials in tension, no effort being made to resist bending.

Bins of this type are, as a rule, built with the containing structure approximately parabolic in cross-section. It is also generally recognized that the hopper-type bin, although more expensive to build than the suspension type, is more satisfactory in operation. The construction may be such as will permit the complete discharge of all materials contained in the bin.

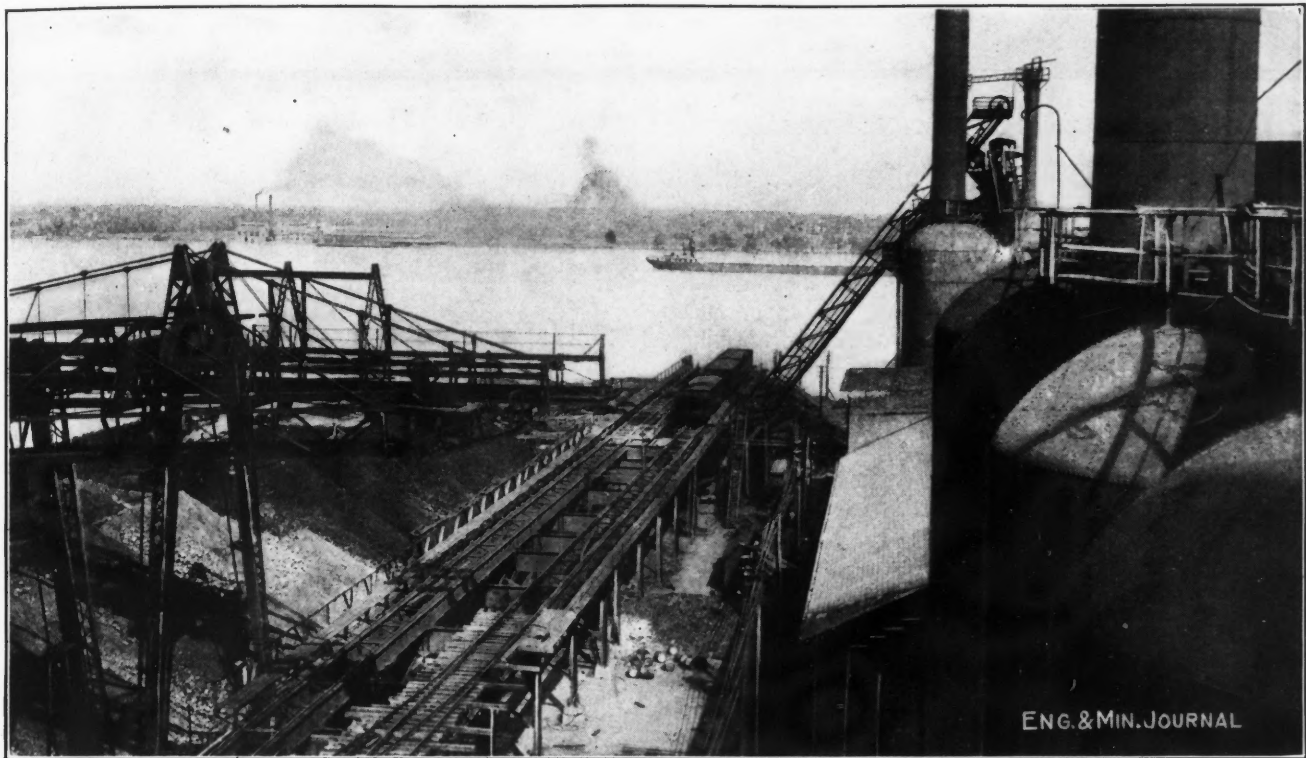
mitted to bend. The structural frames being of rigid construction support the bottom lining rigidly.

It is apparent that this design offers some distinct advantages. The sides of the bin supported by the suspension rods are at a steep angle, 60° or more from the horizontal. The bottom lining may be built at an angle from the horizontal sufficient to insure the movement of material. The bottom being rigid may be provided with discharge gates at intervals as desired, or may have a single discharge opening running the entire length of the bin and controlled by a continuous line of gates. These features insure a free-flowing bin which may be completely emptied without resorting to hand labor or mechanical appliances to loosen "hangups." The bin may be built of wood, concrete, or steel, or a combination of these materials.

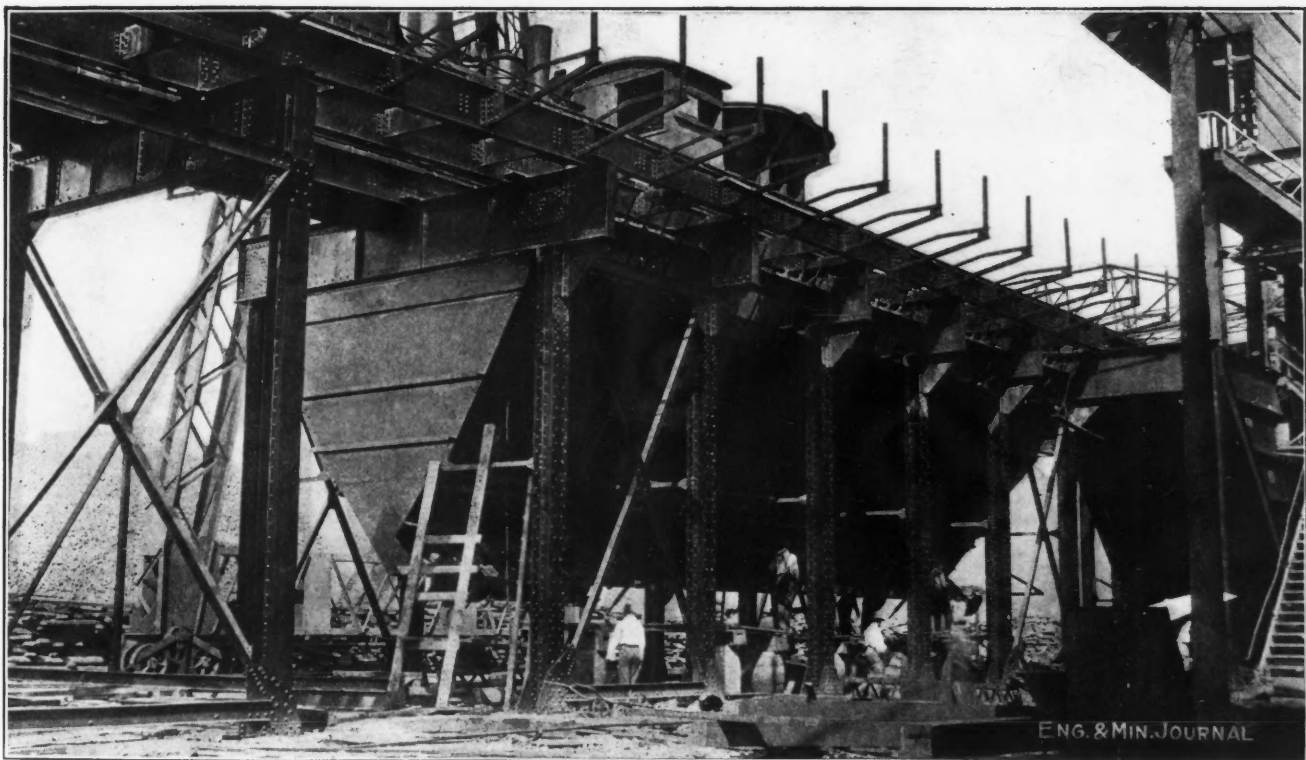
An example of this is the figure in the accompanying sketch showing a cross-section of a concrete-lined bin, the concrete lining being laid on sheets of protected metal. The lining supported by the rods is subject to bending, and to avoid cracking the concrete lining is provided with a series of grooves, these grooves being after-

ward filled with an asphaltum compound. The bending, therefore, takes place at the lines where these grooves are provided, leaving the concrete lining at other places

desirable to use steel for the entire construction. Such bins are made of a maximum capacity of 12 tons of iron ore per foot of length. The first cost of this type of bin con-



SUSPENDED ORE-BIN INSTALLATION AT AN IRON BLAST-FURNACE PLANT



DISCHARGE SIDE OF SUSPENDED ORE-BIN INSTALLATION AT A STEEL PLANT

intact. The bottom lining is rigidly supported, and cracking of concrete is, therefore, prevented.

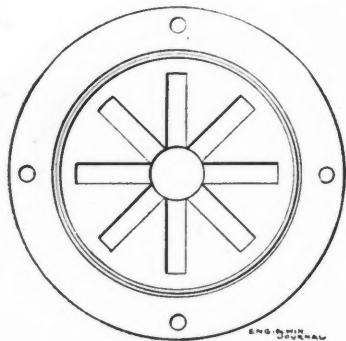
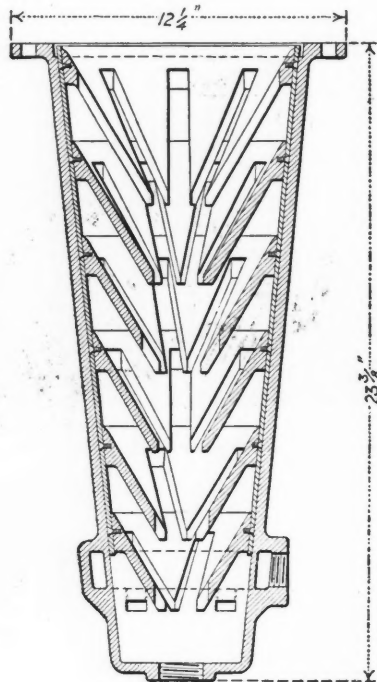
Where the bins are used in conjunction with an iron blast furnace, the severe service requirements make it

struction is said to be as low as any of the older forms. Owing to the fact that the parts are largely shop built, the erection may be made in a remarkably short space of time.

Mining & Metallurgical Machinery

Deister Hydraulic Classifier

Among the new devices which have lately been offered to mill operators, the Deister classifier may be mentioned as one likely to be of service. It is intended to be fastened to the bottom of a launder, and consists of an outer cone, in which is placed a number of smaller cones, which are slotted from apex to base, the upper cones



DEISTER HYDRAULIC CLASSIFIER

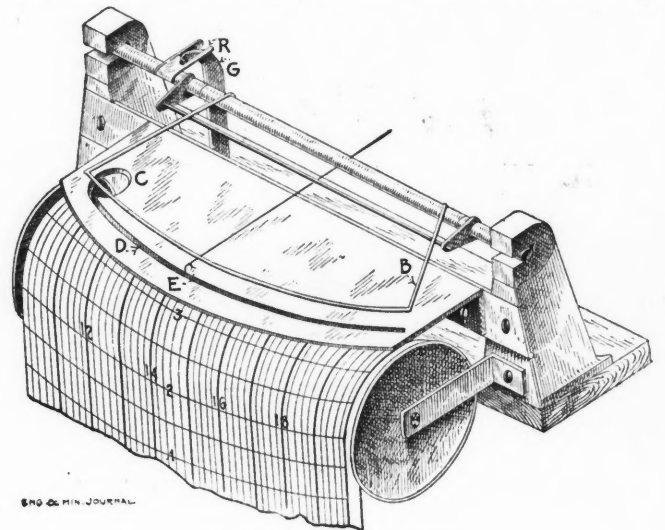
containing a greater number of slots than the lower. These slots are staggered, so that none of the openings occur directly over or under each other.

Near the bottom of the principal cone, an annular chamber is formed in the casting, through which water under pressure is let into the cone chamber, passing through small holes. The discharge is in the apex of the cone. The device is simply a hydraulic cone, but the advantage is that the upward moving water is so broken up that there is no possibility of a current, and all parts

of the cone are able to classify with equal efficiency. They are inexpensive and can be used in large numbers and easily placed at most convenient points. It is said that many are in use at the Miami mill, giving encouraging results. The cones are made by the Deister Machine Co., of Fort Wayne, Indiana.

New Pyrometer Recorder

The problem of automatically recording the readings of thermoelectric pyrometers has always been more or less difficult. A troublesome feature has been the ink pad, which has not always been satisfactory because of blurred dots or dashes appearing on the record, or perhaps dashes being made where dots should have been, and *vice versa*. Patent claims have been filed by the Thwing Instrument Co., 445 North Fifth St., Philadelphia, Penn., covering



PYROMETER RECORDER

a new type of recorder for use on such pyrometers, and known as the "Capillary Ink Pad" recorder.

As shown in the sketch, a horizontal plane of brass, mounted above the drum carrying the chart, contains a circular ink well *C* and a V-shaped groove *D*, the position of the latter corresponding to the arc through which the needle *E* travels. The groove is open at the bottom permitting the needle *E* to be depressed through the groove upon the chart below. As the inkwell *C* is filled, the ink spreads by capillarity to the other end of the groove, a film of ink separating the needle and the chart. The depressor arm *G* is attached to a lever on the face of the clock, the clock also being used to drive the drum carrying the chart. Underneath the depressor lever is a contact wheel having regularly spaced teeth, with a gradual rise and abrupt drop. As the lever travels on the rise of the tooth, the arm *G* is raised, tilting the lever so that the bar *B* is brought down upon the needle *E*, which passes through the ink in the groove and records a dot upon the chart. As the depressor bar reaches the summit

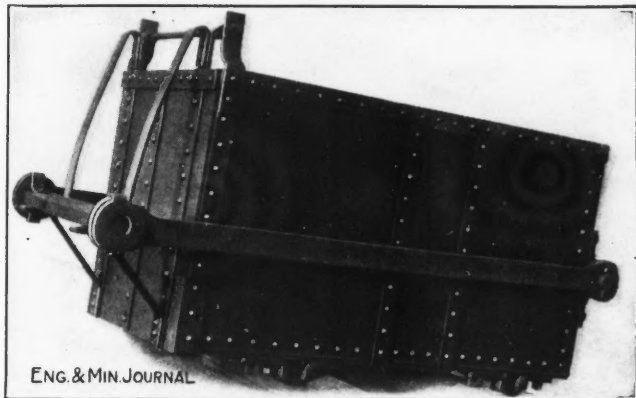
of the tooth, it drops abruptly into the bottom of the next tooth, drawing *G* downward and causing *B* to rise, permitting the needle *E* to swing freely above the chart *D* and to assume a different position corresponding to any change in temperature measured by the thermocouple. The ink will not follow the needle down to the chart, neither can it be jolted through the groove by excessive vibration. As the time required to make a dot upon the chart need not be more than a second, a long period of time can be allowed the needle to assume a temperature position before a second record is made, or a large number of records per minute can be made.

Several advantages are claimed for such a recorder over one which must return periodically to an ink supply placed at one side of the chart. The frequency of record is higher with the capillary type of ink pad, as the needle is always in circuit with the thermocouple and is always at the correct position for temperature record, it being merely a matter of the frequency with which it is desirable to depress the needle. With the capillary ink pad, which has been used for about a year, it has been possible to secure practically a continuous line of the rising and falling temperature, with three records per minute.

✱

Skip-Car with Automatic Door

The accompanying illustration represents a skip constructed by the Orenstein-Arthur-Koppel Co. for an Adirondack iron mine. It is apparently intended for operation



ENG. & MIN. JOURNAL

SKIP FOR FLAT INCLINE

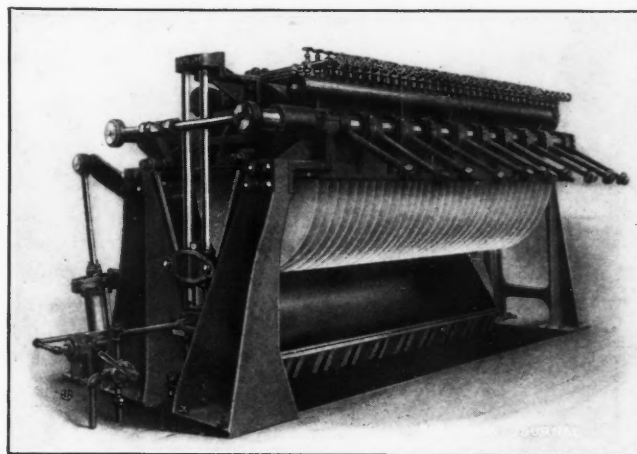
on a flat incline and has its top open and its front closed. Dumping takes place through the front which is normally closed by a swinging door. The side bars are pivoted at the rear or bottom as usual and the cross-bar pressing against the straps projecting from the door keep it pressed tightly against the skip body. When the skip swings down to dump, the cross-bar slides up the spring straps on the door and the door hinged at its top, swings out and allows the ore to discharge. On starting to lower, as the skip regains its normal position, the cross-bar slips down on the straps and locks the door; the straps are looped out to form a stop, so that the bar cannot drop too far. The capacity of the skip is 68 cubic feet.

✱

There Are 14 Draeger Helmets in The *Cœur d'Alenes*, distributed, according to the 1913 Report of the Mining Industry of Idaho, as follows: Hecla mine at Burke, three; Green Hill-Cleveland mine at Mace, two; Morning mine at Mullan, two; Last Chance mine at Wardner, two; Bunker Hill & Sullivan mine at Kellogg, five.

The Sweetland Self-Dumping Filter

The filter here described has for a filter body a cylindrical shell with filter leaves of circular form spaced from 3 to 5 in. from center to center (depending upon the thickness of cake to be formed), the plane of the leaves being at right angles to the axis of the cylindrical shell. Since the ends of the shell are flat, no void space remains in the filter chamber after the cakes are formed, other than the small feed channels at top and bottom, which serve to distribute the slime pulp, or sludge, and wash water. Therefore, in operating the filter, it is only necessary to force the sludge into the filter body until the cakes build up to the necessary thickness, then shut off the sludge-feed valve and simultaneously open the wash-water valve. Of course, a barren-solution wash may be applied if desired, in which case the cakes are first formed, then



SWEETLAND FILTER PRESS

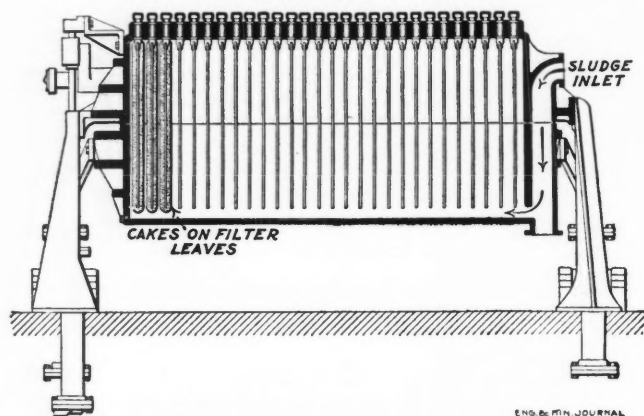
the sludge-inlet valve is closed and barren solution is turned in until the strong liquor is displaced. Finally the wash-water feed valve is opened, and wash water forced in until the barren solution is displaced. The filter is usually operated at 40 to 50 lb. pressure per square inch, and in no case does the pressure drop nor does the stream of effluent cease from the time cake forming commences until washing of the cakes is finished. The washing of cakes is positive and rapid, and no preliminary washing by decantation is required.

The mechanics of the filter are simple. The filter shell is divided on the horizontal center line into two halves, one of which carries an inserted gasket to seal the joint. The upper member carries the filter leaves, each of which is held in place by a cap nut on top. Each leaf discharges its filtrate into a main conduit through a pipe connection provided with a shutoff cock and glass delivery tube. The lower member is hinged to the upper one so as to swing open to allow the cakes to be discharged into a car or conveyor under the filter by reversal of current in the leaves. Even reversal of current is not absolutely necessary for discharging, since the leaves are so readily accessible to the operative from alongside the open filter that he may quickly discharge the cakes by means of a flat paddle inserted between the leaf and cake.

If desired, the moisture in the cake may be reduced to a low percentage before discharging by means of compressed air, so that where water is scarce little is lost

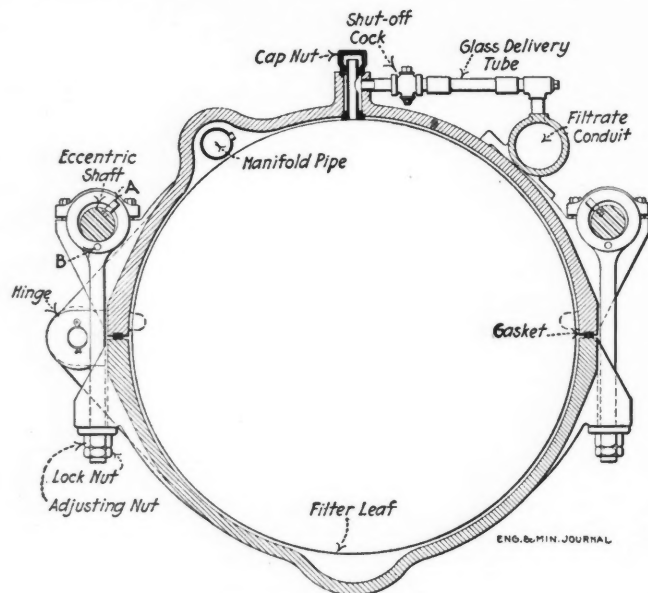
in the cakes. If the cakes are of granular material, they may slide off the leaves immediately when pressure is released, so that they follow the lower member of the filter body as it opens and the contents are dumped when the lower shell is inverted.

The two halves of the shell are locked in closed position by means of bolts mounted on eccentric shafts. These



THE SWEETLAND FILTER PRESS

bolts are operated simultaneously by a half turn of the eccentric shafts, which either tighten or loosen all the bolts, depending upon the direction in which the shafts are turned. A vertical hydraulic cylinder at one end of the filter turns the eccentric shafts by means of connecting-rods extending from the crosshead above the cylinder



SECTION OF PRESS

to the cranks at the ends of the shafts. The lower member is swung open or shut by means of a hydraulic cylinder at either end.

The time required to unlock a filter of 1000 sq.ft. leaf area and swing it wide open is less than two minutes, and the same length of time is required for closing and locking. If it is desired to remove a leaf for repairs or renewal of cloth it is necessary only to remove a cap nut from the top of the stem of the leaf, withdraw it from the filter body and insert a newly covered one. All leaves are alike and interchangeable.

The automatic control of the mechanical operation adapts this filter especially to units of large capacity, although small ones are also built having a lever-operated, eccentric shaft in place of the hydraulic device.

This filter, which is made by the Sweetland Filter Press Co., 1317 Singer Bldg., New York City, has been extensively adopted in the chemical industries where large capacities made low labor costs imperative. A lead-lined press has been installed by the Mellon Institute, Pittsburgh, for experiments in copper metallurgy.

These lead-lined filters promise to be of special interest, since much of the future of the metallurgy of copper, nickel, zinc, and lead, seems to lie in wet methods, where acid solutions will be used which would soon corrode iron.

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New Chloridizing Furnace

A new chloridizing furnace, of the rotary type, known as Sutcliffe's patent chloridizing furnace, is about to be introduced into this country, one having been in operation abroad for some time.

It consists of two separate rotating drums, with the combustion chamber between them. In one drum, into which the mixture is fed, the preheating and oxidizing roasting is effected, while in the second drum the mineral is retained for the necessary reactions to take place. The drums revolve at a slow speed and as the ore is being constantly turned over by the rotary motion, no rables or stirrers are required, and consequently the furnace can be operated at a higher temperature than is ordinarily the case. This is claimed to be a distinct advantage on some ores containing small quantities of precious metals.

The period for the reaction can be varied at will, the mineral being under treatment for 2 to 12 hr. and the temperature varied as desired. In some cases, without undue elevation of temperature in any part of the apparatus the ore can leave the furnace at a temperature of 750° F., permitting, if desirable, further reaction to take place in the wagons. The furnace is of such a form that it can be constructed in either large or small units; thus either 50 or 250 tons per day can be treated in one unit. The operation is automatic from the feeding to the discharge.

In the larger units, where a large mass of mineral is being treated, great economy in salt is effected, as the chlorine has less chance of escaping without coming in contact with the ore particles. Because the labor is confined to oversight, it is claimed the apparatus will permit of low-grade ores being treated on a large scale, which could not otherwise be treated economically. The heating of the furnace may be by either gas or oil.

A Sutcliffe furnace for treating 100 tons per 24 hr. has been installed in Europe at the works of the Usines a Cuivre Hemixem, near Antwerp, on pyritic ore running 3% Cu, and is said to be giving excellent results, the copper contents being rendered soluble down to 0.03%, with fuel consumption 2%. Sufficient acid is being recovered from the condensing tower for the subsequent leaching of the chloridized mineral. The patents controlling this furnace, which is the invention of E. R. Sutcliffe, are in the hands of Sutcliffe, Speakman & Co., Ltd., of Leigh, Lancashire, England, represented in America by the American Grondal Co., 50 Church St., New York.

N. Y. Section Meeting of American Institute of Mining Engineers

The New York Section of the American Institute of Mining Engineers held a meeting at the Engineers Society Building, Apr. 22 at 8:30 p.m. The subject was "Sanitation in Mining and Metallurgical Operations." T. T. Read, secretary of the New York section of the Institute, presided. S. W. Luther, surgeon in chief for the New Jersey Zinc Co., read a paper on the "Organization, Equipment and Results Accomplished at Palmerton, Penn." Mr. Luther stated that his company was endeavoring to select healthy men; all those engaged being, before their employment, examined to see that they were fit for the work they were required to perform. Every month, they were examined to see whether they had any occupational diseases in process of development and every six months a more thorough examination was made to see whether any nonoccupational incapacity or disease had developed. In every case, the intention was not to fit the men to the work so much as to select the work suitable to physical condition of the man.

Many of the diseases found in workers are only occupational in their development, the diseases were already in existence before the men were employed in the work in question. It is the aim of the Zinc company to exclude such men from its employ. It is endeavoring to make the men take an interest in their health and to that end, is distributing Tolman's "Hygiene of the Worker," a book which, being free of technicalities, can be read by most of the men. It is also supplementing it with a book of its own.

In the belief of Mr. Luther, zinc is not poisonous, though it has been often asserted to cause occupational diseases. The so called "zinc shakes" may be due to carbon-monoxide poisoning which, of course, is not uncommon. Copper appears to be the cause of "shakes" among brass workers and not zinc. Apparently zinc oxide causes a drying of the mucous membrane, but pneumonia is rare among zinc-oxide workers. Gastric troubles are declared to be due to oxide of zinc by men who work in the bag room. The trouble seems to occur frequently in workers elsewhere, who are compelled to find another source for the ailment. The tendency is to rate all diseases as occupational.

The company at first thought it impossible to induce the men to wear respirators. After a visit to the Pullman Company, the doctor realized that the objection to respirators was insufficient to make their wearing inadvisable. Where men are notified, on being engaged, that respirators must be worn and the wearing enforced, there is little difficulty in obtaining compliance with the regulation.

With 2000 men regularly employed since 1908, there have been only nine occupational fatalities. There have been several cases of carbon-monoxide poisoning, even though the workers in front of the furnaces are shielded by a moving screen and a hood placed above the furnace front to carry the escaping flame upward and away from the men at work.

There are always eight men in the first-aid squad, taken from all over the works. Regularly, two of these men are replaced by two others till now there are sixty men who have received training. The Schaeffer method of

respiration for immediate, and the pulmotor treatment for later use is taught to all men in the squad.

In the washrooms of the company the *monte-habits* are superseding lockers. A wire basket is provided for the man's dinner pail and four hooks in the bottom of the wire basket are provided for clothes.

C. L. Close, manager of the Bureau of Safety and Sanitation of the United States Steel Corporation, gave a description of the sanitation work of that company and its subsidiaries. He said that the corporation was probably about to cease the installation of wash basins, believing it somewhat ill advised to condemn the common roller towel and then permit a dozen or more to wash in a single basin. Showers will be used instead for such ablutions. At the Lambert plant, of the H. C. Frick Co., a sample house has been fitted and nurses placed in charge. These are teaching the women folk of the villages how to keep house, to cook, to sew, to purchase commodities, to care for the garbage and to reduce the fly pest. The classes in this home are object lessons of great value to the foreign miners.

C. F. Rand was to give an address on the mines of his corporation at Daiquiri, Cuba, but as he could not be present, the chairman read it for him. He stated that in 1901, when operations commenced, the malaria percentage was 123%, some of the men being down twice in one year with the disease. In 1911, owing to preventive measures the morbidity rate was 52%. Then yellow fever became prevalent in Cuba and the United States' authorities took charge of the camps and in 1912 the rate of malaria infection had dropped to 4%. A commodious hospital provided by the company has been abandoned for a much smaller building, though for a long time business for the doctors has been provided by the men from the sugar plantations nearby.

The discussion was mostly on the need for sanitation in mines, ankylostomiasis, tuberculosis in general and silicosis in particular, and even drifted into such alien subjects as accident prevention.

New Bills Affecting Mining Industry

WASHINGTON CORRESPONDENCE

A group of important bills relating to mining are now before Congress, as a result of the work of the past week.

Representative French has reported from the Committee on Public Lands of the House a bill to provide for the disposition of the surface of lands withdrawn, classified or reported as containing phosphate, nitrate, potash, oil, gas or asphaltic minerals. The bill provides that these substances shall make lands eligible for location and entry under the nonmineral land laws of the United States, except that no desert entry shall contain more than 160 acres. Where land is acquired in this way the United States may reserve the right to the deposit of minerals of the kinds specified and may allow prospectors to patent or obtain the right to mine and remove these reserved deposits.

The bill goes on to specify that:

Upon satisfactory proof of full compliance with the provisions of the laws under which the location, selection, entry, or purchase is made, the locator shall be entitled to a patent, which shall contain a reservation to the United States of the deposits on account of which the lands so patented were withdrawn or classified or reported as valuable, together with

the right to prospect for, mine and remove the same, such deposits to be subject to disposal by the United States only as shall be hereafter expressly directed by law. Any person qualified to acquire the reserved deposits may enter upon said lands with a view of prospecting for the same upon the approval by the Secretary of the Interior of a bond or undertaking to be filed with him as security for the payment of all damages to the crops and improvements on such lands by reason of such prospecting, the measure of any such damage to be fixed by agreement of parties, or by a court of competent jurisdiction.

Mr. Gronna has offered the following bill, which has just been reported from the Senate Committee on Public Lands, with an amendment as indicated:

That the application of a person to make entry under the homestead or desert-land laws shall not be denied because he has heretofore made entry or entries under such laws if prior to the filing of such application he has lost, forfeited, or abandoned such entry or entries without obtaining title to the land so entered: Provided, That such applicant shall show to the satisfaction of the Secretary of the Interior that the prior entry or entries were made in good faith, were lost, forfeited or abandoned because of matters beyond his control, and that he has not speculated in his right nor committed a fraud or attempted fraud in connection with such prior entry or entries.

Mr. Foster, chairman of the House Committee on Mines, has offered the following bill:

That the Secretary of the Interior is hereby authorized and directed to establish and maintain in the several important mining regions of the United States and the Territory of Alaska, under the Bureau of Mines and in accordance with the provisions of the Act establishing said bureau, 10 mining experiment stations and 15 mine-safety stations, movable or stationary, the province and duty of which shall be to make investigations and disseminate information with a view to improving conditions in the mining, quarrying, metallurgical and other mineral industries, safeguarding life among employees, preventing unnecessary waste of resources, and otherwise contributing to the advancement of these industries.

Mexican Situation at Yuma

BY LEWIS H. EDDY*

The provisional protection of the communities of Yuma, Ariz., and El Centro, Calif., against Mexican invasion, afforded by Governor Hunt, of Arizona, in ordering the state militia to the Yuma field, pending the arrival of U. S. troops, was as essential to the safety of mining industries as to the irrigation and commercial interests. Immediately upon receipt of the news of the occupancy of Vera Cruz by U. S. naval forces, representative citizens of Yuma appealed to the governor for military protection of Colorado River, realizing that while troops had been sent to Calexico, on the Mexican border, 10 miles south of El Centro, those troops could afford no immediate adequate protection to the Government irrigation system and Colorado River between Yuma and the point where the river ceases to form a boundary between Arizona and Mexico and flows into Mexico. The head-gate of the irrigation canal is within easy reach of the Mexican line. The dam, siphon intake, and the pumping station for the mines in the Ogilby district, Calif., are all within the compass of a few miles. The river runs in a southwest course from the dam to Yuma and then turns abruptly to the west for about five miles, then southwest to the point where Arizona, California and Mexico conjoin.

In the absence of military protection the Mexican soldiers, numbering about 300, stationed in Mexico within 20 miles of Yuma, could easily destroy the entire reclamation system and mine pumping plant in the vicin-

ity of Yuma by dynamite in the hands of a small detachment of men, whose escape to the desert in Mexican territory could not be prevented. The resultant disaster would be inestimable. The entire country embracing the Yuma and Imperial valleys in Arizona and California would be flooded, causing destruction of life and property in addition to destroying the source of water for power, mining, irrigation and domestic use. The Colorado River is now at flood, carrying an enormous volume of water. The 50 miles of levees afford additional opportunity for disastrous work by the Mexican soldiers.

Fortunately few of the operating mines are in the danger zone; but the important operations of the Tumco and American Girl mines in the Ogilby district, 15 miles west of Yuma, on the California side of the river, are dependent upon the pumping plant of the United Mines Co. for mining and domestic use. The plant is situated within a stone's throw of the Mexican line and close by a Mexican customs house, where there are numerous idle Mexicans. The water is taken from the Colorado River and carried by pipe line to the mining camps, a distance of seven miles. Besides the danger of being deprived of water the 200 or 300 Americans, including American-born Mexicans, employed in and about the mines, were under menace from a predatory band of what are known in the region as "bad Mexicans," numbering about 20. These men have recently been supplied with 18 rifles, which have been kept hidden and ready for use. They are unemployed and are chiefly ex-soldiers, who had evidently grown tired of guerilla warfare without profit, and are ready for any depredation that would pay for the trouble. The fortunate feature of the situation has been the loyalty of a number of Mexican miners employed in the camps. These, with the Americans, are sufficient in number to wipe out the bad element in a fair fight, but they are not equal to guarding against assassination, arson and robbery. So the prompt action of Governor Hunt in providing protection at Yuma, almost coincident with the receipt of the news at Tumco and American Girl mines, of the incident at Vera Cruz, gave the miners and operators assurance, and no doubt prevented a raid on the mines.

I visited Yuma and the mining camps Apr. 20 to 23 and made personal inquiry and observation of the situation. There was no excitement, no disturbance and comparatively little serious street or camp talk over the situation. The action of the citizens toward providing for protection was quiet and without public demonstration. Before the militia arrived, citizens assumed the duty of watching the river at the vulnerable points. The interesting feature of the whole situation is the large percentage of American-born Mexicans and Indians in the Arizona militia. They are young men from the public schools and the Indian schools, closely associated in domestic life with the American boys, and without doubt as dependable as the Americans. The people in the Yuma region had good cause for fear of Mexican depredations along the Colorado River, and they would have been unwise to neglect immediate effort for protection. The entire region about Yuma and El Centro has been a danger zone for several weeks. But at the date of my leaving Yuma there was no need of further apprehension. The militia provides sufficient protection at present and will be in readiness to aid the regular army troops should the necessity arise.

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George F. Baer

George F. Baer died in Philadelphia, Apr. 26, aged 71 years, after a short illness, which was, however, the result of conditions which had affected his health for some time. He was born in Somerset County, Penn., and received a fair education at local schools and at Franklin & Marshall College. His first venture was in the office of a local newspaper, of which he became part owner when still under 20 years old. He served with credit for three years during the Civil War. After the war he studied law and was admitted to the bar, in 1868, removing to Reading, Penn., which was thenceforth his home.

In 1870 he was appointed counsel for the Philadelphia & Reading R.R. Co., and from that time on was connected with the company in various capacities. As counsel for the company, he became thoroughly familiar with its business, and in 1893, took a prominent part in the reorganization of the company. At that time he came into contact with the late J. P. Morgan, and ever since had been closely allied with him, and was, in fact, his agent in securing control of and managing the anthracite-coal trade. Under his advice, the Reading secured control of the New Jersey Central and arranged for close affiliation and coöperation with the other anthracite roads. Mr. Baer devised the organization of the Temple Iron Co., in which all the anthracite presidents were directors, so that the Temple board meetings were, in effect, meetings of the anthracite trade, or could readily be made such on occasion.

In 1901, Mr. Baer was chosen president of the Reading and held that position up to the time of his death. At the time of the great anthracite strike of 1902, he assumed the leadership of the operators and steadfastly resisted the granting of the miners' demands. He was by nature and conviction an autocrat, a believer in monopoly and in the divine rights of property, and he would not give up what were really his honest convictions. It was at this time that he used the expressions which were widely circulated and made him a most unpopular man. As published they read: "The rights and interests of the laboring man will be looked after and cared for, not by the agitators, but by Christian men, to whom God, in his infinite wisdom, has given the control of the property interests of the country."

Mr. Baer was always a religious man after his own fashion and belief, and those words undoubtedly expressed his sincere conviction. It was with great reluctance that he gave way to public opinion—in which he did not believe—and consented to accept the arbitration of the Anthracite Coal Commission appointed by President Roosevelt.

In his later administration of the Reading affairs, Mr. Baer resisted all attempts to bring outside influences into the directorate. He also blocked the negotiations for the sale of the Lehigh Coal & Navigation Co. to the New York, New Haven & Hartford, desiring no outside interest to come into the anthracite field.

Naturally Mr. Baer had no sympathy with the agitation against the trusts and big business. He resisted all attempts at railroad and coal-trade regulation, and resented the modern spirit, though he said little about it.

He was an able lawyer, familiar with all the details of the law, but not a great lawyer, since he never took a

broad view. No man knew more thoroughly than he all the business of the company.

Though living part of the year in Philadelphia, he always retained his residence in Reading and was much interested in local affairs. He was proud of his "Pennsylvania Dutch" origin and had quite a collection of books and documents bearing upon the history of his people. He was an active member and former president of the Pennsylvania German Society, a member of the Reading Park Commission and many other civic organizations.

Almost his last public appearance was at the impeachment trial of Judge Archbald, of the Commerce Court, when he was a prominent witness in the defendant's behalf. About a year ago Governor Tener appointed him a member of the Gettysburg Battle Celebration Commission. Several years ago, in remembrance of his early college career, he gave \$50,000 to his alma mater, Franklin & Marshall College.

He was president of the Philadelphia & Reading Ry., the Philadelphia & Reading Coal & Iron Co., the Central R.R. of New Jersey, the Atlantic City R.R., the Reading Paper Mills Co. and the Keystone Coal Co. He was, in addition a director of the Lehigh & Hudson River Ry., the Allentown Terminal Ry., the Pennsylvania Steel Co., the Cambria Iron Co., the Allentown Iron Co., the Cambria Steel Co., the Reading Trust Co. and the Pennsylvania Company for Insurances on Lives and the Granting of Annuities. He was also chairman of the Reading Iron Company.

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Embargo on Explosives for Mexico

WASHINGTON CORRESPONDENCE

It is understood that the orders of the Treasury Department to renew the embargo upon all arms and munitions of war moving from the United States into Mexico is intended to apply also to explosives such as are used in mining, notwithstanding that formerly these explosives were exempted from the general prohibition applied to actual arms, gunpowder and fixed ammunition. This is expected practically to close the lead mines in Mexico. When the embargo on munitions of war was originally issued during the administration of President Taft, the mine operators in northern Mexico secured the exemption of dynamite, so that the continuance of the mining operations was possible. Now this policy is changed, in spite of the fact that the mineral exports of Mexico have constituted over one-half of total exports from that country during the past five years.

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Tasmania Mineral Production in 1913

The mineral production of Tasmania in 1913 is reported by the Department of Mines as follows, the items being arranged in order of descending values: Tin ore, 1967 tons; blister copper, 4569; silver-lead ore, 83,289 tons; gold (including gold contained in blister copper and silver-lead bullion), 33,400 oz.; coal, 55,043 tons; osmiridium, 1262 oz.; copper and copper ore, 1967 tons; tungsten ore, 68; bismuth, 5; shale, 130 tons.

Correspondence and Discussion

Mineral Wastes and Losses

Isn't it about time that the mining engineers and other honest men who are engaged in the production of the mineral wealth of this country rise *en masse* and protest against the slander and ridicule to which they have been continually subject by the officials of the Bureau of Mines in the interests of that bureau?

For instance the director of this bureau says in his last report: "It is a reasonable estimate that the present waste, in large measure unnecessary, of mineral resources amounts to a national loss of not less than \$1,000,000 per day." In other words, the people who are engaged in the production of our minerals throw away, or waste, say \$360,000,000 every year. The total value of all mineral products produced in this country in 1912, in round numbers, was \$2,243,000,000; so that on this basis our mineral losses would amount to only about 16%. Not a very bad figure after all. It would be interesting to know whether the Government itself carries on its business on such a close margin. But after all, does anyone know, and can they prove that even this amount is actually wasted? For instance, in the treatment of a 2% copper ore, say the tailings contain 0.6% of that metal, which cannot be saved, economically, is that a waste? It is a loss, of course, and one which every copper miner would endeavor to reduce; but it is not a waste. And yet what a deal has been said and written, and how cunningly have the ideas of *loss* in the production of a certain mineral, and *waste*, been confused in the public mind. In the mind of a clear thinker the two terms have entirely separate and distinct meanings; but when certain measures are to be carried, and certain impressions created in the public mind it is always easy and convenient to mix them.

It is hardly necessary to refer to the many repetitions made in the report; but one has arrested my attention, viz., the alleged saving in gas and oil effected by the bureau in Oklahoma. For instance, on p. 19, we read: "The result in the latter state (Oklahoma) in a single oil and gas field has been a saving of *natural gas* valued at more than \$10,000,000," followed by the significant clause, "which is more than six times the aggregate cost of the Bureau of Mines since its establishment to the present date." Again, on p. 22, we find: "Thus, for example, with the limited facilities available, the work of the Bureau of Mines during 1913 in stopping a part of the waste of natural gas and oil in Oklahoma has saved to the country a quantity of our *highest-grade fuel oil*, having a value to the people of more than \$10,000,000." It is a rather remarkable coincidence that the saving on gas and oil should come out each to the ten-million mark; but it makes a nice round figure, and rolls easily on the tongue. But it is certainly "some saving" as McCarty, the foreman, would say; and especially are we convinced of it when we look up the statistics on the point, the latest available being those for 1912, and we find that the value of natural gas produced in Oklahoma was in round

numbers \$7,400,000. Assuming that the production for 1913 had the same value, then the bureau takes unto itself the credit of performing the really astounding feat of saving to the people of that state \$2,600,000 more gas than they produced.

In the matter of saving oil the records don't show up quite so favorably. For the year 1912 the same state produced oil to the value of \$34,600,000; and again, assuming that the 1913 production was the same, then the bureau claims only \$10,000,000 of it. But it is stated, however: "That with increased facilities and engineers for carrying on such work the saving would have been twice as great." That is, the bureau would have saved \$20,000,000 worth. This, however, seems rather a modest estimate, and in view of its other notable achievement, it seems not unreasonable to suppose, that by simply adding a few more engineers, it ought to be able to save it all.

In order that the readers may not lose sight of the great importance of the subject, they are again reminded of it on p. 32 of the report which goes on to say: "As it is, however, in many parts of the Oklahoma oil and gas fields the waste of *natural gas* that still continues is equivalent to \$15,000,000 to \$20,000,000 per annum." My, my, how the losses do increase! It would certainly seem to be but a very modest request to ask Congress to appropriate the mere trifle of \$30,000 to \$40,000 to stop this enormous waste, and do it at once, because it seems to be increasing by leaps and bounds the oftener the subject is mentioned.

There must surely be some provision made in the interests of the gentlemen connected with the bureau rendering them immune from the close scrutiny of the postal authorities, or otherwise there might be a pretty state of affairs.

Of course, radium comes in for honorable mention. But after all, what would a government report be worth nowadays without radium? What other element have we that is better calculated to galvanize life into an appropriation bill which otherwise might experience considerable difficulties? Why, everyone knows that we have no substitute, and as long as it occupies its present haloed position in the minds of the general public it pays to work it to the limit.

But when all is said and done it does seem like placing the traditional straw upon the camel's back when it asks for \$40,000 to carry out some "needed investigations of mine ventilation." It does seem a pity that the bureau has hitherto been so cramped in the matter of resources that it has been unable to secure the services of, say one man who can read and translate German, and another who can do the same valuable service with French, and thus open up to the minds of the gentlemen in the bureau that vast mass of knowledge, careful experimental data and conclusions, which have been accumulated by such bodies as the Preussischen Schagwetterkommission in Germany, or the thorough and painstaking labors of such investigators as MM. Mallard and Le Chatelier in

France, not to mention dozens if not hundreds of other physicists, chemists and engineers in Europe. It would, indeed, be interesting to know just what the Bureau of Mines proposes to add to the definite, exact knowledge that has at least been the common property of foreign engineers for a quarter to half a century. This idea of proposing all sorts of investigations and implying that they are undertaken to explore some hitherto unknown subject, when well informed men know that the field has been thoroughly covered years ago, simply to build up a bureau, ought to be discontinued.

ROYAL P. JARVIS.

Knoxville, Tenn., Apr. 7, 1914.

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What Is the Matter with Mining?

It seems to be an almost universally accepted fact that there is something the matter in the mining industry, and that conditions are stagnant or are getting worse rather than better.

Many writers have attempted to convince us as to the causes, yet shedding rays of hopeful light wherever possible. We all want conditions to improve, but few of us can suggest remedies. And not one has been able to suggest or even outline a remedy to cure all the financial ills of the prospector.

To be sure, the dowsing-rod philosophers (bearing degrees of D. Ph. or D. F.) claim that great prosperity may attend their disciples, but these may be dismissed with an anecdote.

Up in Idaho, some years ago, a long-bearded prospector with a short-time grubstake, and a genial Swedish parasite floated into camp. After dinner, he gave us a demonstration with a two-piece, cup-and-ball-jointed divining rod; detecting with unerring accuracy, the location of a twenty-dollar gold piece, temporarily loaned by the inn-keeper. (The owner of the gold piece also kept tabs on same without the aid of a rod.) A nice-looking sample of rock with manganese specks, previously determined by my assayer to be worth about 2.03c. per ton, was pronounced to be "simply lousy with gold or silver, or both." Our whiskered friend, remarking that he had been using his precious instrument for seven years, replaced it carefully in his bandanna, and proceeded on his weary search. As he disappeared down the trail, we observed a reverent silence, broken at last by the drawling tones of the camp humorist, as he remarked: "And the son-of-a-gun is *still* wearin' overalls."

That is one thing that is the matter with the mining industry, and is a point amply covered by Arthur M. Swartley, in the *JOURNAL*, Jan. 24, 1914, under the head of "Ignorance and Dishonesty": Ignorance on the part of "Whiskers," and dishonesty of his companion who manipulated one end of the rod and kept his meal-ticket valid.

When a prospector does find something that seems worth while, but needs capital to develop it to the degree of salability required by the strictly commercial, so called exploration companies, he is often in the position of the protagonist in the serial cartoon, who is invariably confronted by the question: "What you gonna do with it?" It is useless for the prospector to expect Federal aid in the way of indiscriminate wet-nursing of his projects. Such a course would tend to put a premium

on dishonesty. In my opinion, the prospector must depend, as heretofore, upon what may be called the "intermediate promoter." There is plenty of capital available in small amounts throughout the United States, the possessors of which desire to invest in speculative mining ventures. The dishonest promoter has been wont to say of this class of investors: "There's one born every minute." That is just as true as ever, but the unspoken title of classification is scarcely as apt. The little fellows have been so educated by the exposure of the methods of the dishonest promoters and stock jobbers that they have promoted themselves out of the "sucker" class, as far as mining is concerned. The erstwhile fake promoters are either devoting their energies to other branches of industry, living on past proceeds, or struggling for a place in the bread line.

We are now in the transition stage. Innovations in legislation follow one another in a steady procession. The warts, tumors, cancers, appendices and floating kidneys are being excised from our body politic by the carefully sterilized knives of the academic legislative surgeons. In some branches of our national industries, several major operations have been practiced almost simultaneously upon the same patient. Although every precaution has been taken, infection made impossible, and the several operations have been eminently successful; nevertheless the patient has succumbed to "surgical shock."

Although, we may say, generally speaking, that financial bacilli, microbes or germs are injurious to commercial industry, we should not lose sight of the fact that some of these micro-organisms are harmless and others are not only beneficial, but absolutely essential to the life of industry. Legislative surgeons, in their great zeal to sterilize business, often leave business hopelessly sterile.

Let us establish cultures of the bacilli which are beneficial to the mining industry, study them carefully, and distribute sample cultures among the experiment stations in the different mining camps.

The *promoter bacilli* have been recognized and classified from time to time. The beneficial type, if properly cultivated, will thrive to the point of enriching and restoring to health the tissues it works upon. The malignant type, isolated and sterilized, will speedily diminish and approach the degree of extinction. A few of the Robin Hood type will undoubtedly survive to prey upon the stock jobbers, who, under the guise of eminent respectability, have always sought to shift the blame on the promoter, who "deceives" them. Old Robin Hood was a pretty good sport, after all.

New York, Mar. 9, 1914. WILLIAM B. MCKINLAY.

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Leaching at Chuquicamata

In the report of E. A. Cappelen Smith's lecture before the Electrochemical Society, there were the following stenographic errors: On p. 865, col. 2, second paragraph, for "seven shafts," read "several shafts"; last paragraph, for "CaO," read "salt"; p. 866, second paragraph, for "Mn, 0.7," read "Mn, 0.07"; second column, the Chuquicamata tanks are 16 ft. high, not 15; and on p. 876, first paragraph, the drums are lined with stoneware, and not duriron. Duriron linings were tried, but would not stand the solutions.

Ray Consolidated Copper Co.

The initial payment of dividends at the close of the second quarter of the year, and the completion of the concentrator and of all construction and equipment at the mine for the production and treatment of at least 8000 tons of ore daily, were the most important events in the operations in 1913 of the Ray Consolidated Copper Co., at Ray and Hayden, Ariz. The report for 1913 has just been distributed. Since the initial dividend, payments have been made quarterly at the annual rate of \$1.50 per share.

Construction work for the year comprised the completion of the coarse-crushing plant at the No. 2 shaft by the addition of a second crushing unit consisting of an additional crusher and set of rolls making the crushing equipment of this shaft a duplicate of that at No. 1, a modern hospital for employees and their families, and change houses at each shaft. Throughout the last half of the year some important changes were made in the flow sheet of the mill and methods of operation. Other improvements outside of the concentrator were for the further development of water supply, a few dwellings for employees, and the addition of some minor equipment to the power plant. No further improvements are contemplated during the current year, outside of such small items of betterment and maintenance as will be almost wholly absorbed in operating costs. The surface equipment at mine and concentrator now stands as shown in the supplementary views accompanying this issue of the JOURNAL.

The total dividend disbursements amounted to \$1,631,504. A depreciation charge was made against general income, amounting to \$276,727, this being the first year that such a charge has been made; a charge of \$236,739 was also made against general income as a sinking fund for the redemption of outstanding bonds, as required by the terms of the company's general mortgage, which provides for the setting aside of 10c. for each ton of ore treated, commencing with 1913. The new mining laws of Arizona increased the taxation on the property to \$140,320, an increase of nearly \$90,000 over the taxes paid in 1912, amounting to an increased charge equivalent to 1/6c. per pound of copper produced. A noteworthy feature of the year's operations was the "safety first" campaign, causing a marked decrease in the rate of accidents at both mine and mill; the rate of accidents has never been high at the Ray as compared with similar operations of like magnitude. The average number of men employed was 1576 at the mine, and 663 in the mill.

The total gross production of copper was 54,158,309 lb., equivalent to, after deductions for losses in smelting, 52,341,029 lb. of copper, which yielded a revenue of \$7,847,784, or 14.994c. per lb. The silver produced amounted to 70,842 oz., and was valued at \$42,585, and the gold, 467 oz., at \$9352, a total operating revenue of \$7,899,721. Operating expenses were \$5,402,502, and net profit for the year after crediting miscellaneous income and deducting interest on bonds and advances, was \$2,675,193; the balance to undivided profits after deducting dividends, bond redemption and depreciation allowances, was \$530,223. Sales and deliveries of copper for the year were made at the gross price of 15.371c.; or after deducting delivery charges, 15.201c. per lb. The difference between this 15.201c. and 14.994c. quoted above

is due to reducing to a lower valuation the inventory price of unsold copper, at the end of the year, to 14 cents.

At the mine no drilling or underground work was done, for the express purpose of developing additional ore reserves, and no definite extensions of ore reserves were recorded, excepting in the vicinity of the No. 3 shaft in original Ray Central territory, where underground development in the blocking out of ore for mining disclosed an addition of 90,000 tons of ore, containing 3 1/2% copper. The quantity of ore mined, including a small tonnage shipped direct to smelter, was 2,366,007 tons, containing 1.72% copper. The remaining reserve is estimated at 78,380,966 tons of ore, containing 2.2% copper. The total amount of development work done in 1913 was 84,729 ft., a reduction of about 40%, as compared with 1912. This brought the total underground development up to 71 miles, but deducting the openings destroyed by actual mining, the total remaining amounts to 46 miles still open and available for use. In 1913, 10% of the total ore mined was taken from development work, compared with 29% in 1912, and 50% in 1911; 33% of the total ore mined came from mining in active stopes, compared with 45% from such sources in 1912, and 47% in 1911; 57% of the total ore mined was derived from reserve drawing, compared with 26% in 1912 and 10% in 1911. At the end of 1913 it was estimated that there were 5,000,000 tons of ore broken in the stopes.

The cost of mining ore from all sources during 1913 was 73.23c. per ton. This includes all fixed and general charges, as well as the cost of operating the coarse-crushing plant at the mine and loading the crushed ore into railway cars for shipment to the mill. The last two items of cost amounted to 3 1/2c. per ton, so that the net cost of mining proper, including a proper apportionment of all charges of every nature, was a little less than 70c. per ton. The results of completely mining out representative areas of ground have shown productions up to 96% of the total estimated copper content, as calculated from drilling and other development work. It must be said, however, that such results were accompanied by productions of over 100% of the ore tonnage estimated from development, due to natural admixture of low-grade ore.

At the mill, 2,365,296 tons of ore were treated, equivalent to an average of 6480 tons per day. The average copper content of this ore was 1.719%; the average recovery, 66.09%, corresponding to 22.723 lb. of copper per ton of ore. Recoveries were adversely affected by a considerable amount of oxidized ore coming at times from upper levels, and also by irregular operations in last half of the year when improvements were being made. In 1912 the average grade of the ore milled was 1.677% copper, but 22.9 lb. were saved per ton treated. The cost of milling was 51.93c. in 1913. The average grade of the concentrates, of which 53,745,937 lb. were produced, was 18.55% copper. High-grade ore, shipped directly to the smelter, contained 412,372 lb. of copper, bringing the total gross production from all sources to 54,158,309 lb. The average cost per pound of net copper produced, after making allowances for smelting and refining deductions, and crediting dividends from the Ray & Gila R.R. as a reduction of operating costs, but excluding credit from other miscellaneous earnings, was 9.7836c. per lb. This cost includes a charge of 12 1/2c. per ton of ore treated, or over 1/2c. per lb. of net copper for the extinguishment of mine development expense.

Editorials

The Mexican Situation

By the time this issue reaches our Western readers, they will have learned already more or less of the facts respecting the recent events in Mexico and especially will they know that what they have been gathering from their daily newspapers during the last fortnight has been largely not so. The way in which rumor mongers, headline writers and mischief makers generally have been misrepresenting things has been shameful and disgusting.

The established facts are simply that Washington acted, on Apr. 20, with decision, and Admiral Fletcher took Vera Cruz with celerity. Then Washington was unable to make up its mind whether this was an act of war or not. Huerta tried to deceive his people, Carranza behaved bombastically and foolishly, but Villa seems to have displayed good sense. For a few days, there were fears for the Americans who had not come out from Mexico and other places, but at length Huerta let them go and the danger of a general assassination of them passed.

Also passed the lies about the American Embassy being burned, about a Mexican seizure of Laredo; and the nonsense of the sophomores of Yale University and the uniformed rank of the Knights of Pythias, of Illinois, offering their services as volunteers for the invasion of Mexico; and the slump in the stock market which made Wall St. feel that the United States was going into a complete decline.

On Apr. 27, it was announced that both the United States and Huerta had accepted the mediation of Argentina, Brazil and Chile, and in the following days it appeared that there was some hope not only that there would be no war, but also that the whole Mexican trouble might be cleared up.

In the meanwhile, the mining business of Mexico being already at zero, outside of Sonora, could not fall any lower and remained in *statu quo*. Cananea and Nacozari shut down, but that appears to have been out of fear of local troubles in which the stormy petrels of the I. W. W. seem to have been stirring things.

It is never possible to keep a jackass from braying, but incidentally it may be noted that the last fortnight has afforded ample opportunities for natural fools to exhibit themselves, and they have not neglected their chances.

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Revision of the Mining Law

The attention of Congress has been so engaged by other matters that the bill for a commission for the revision of the mining law has not progressed much. However, among mining men and among the engineering societies all over the country the subject is one of active discussion. There are radical differences of opinion. This is exemplified by the vote recently taken in the Mining & Metallurgical Society of America.

As was to be expected, the members of that society

are all but unanimous in the opinion that the mining law should be revised thoroughly, not in a merely piecemeal way; also that the law of the apex should be abolished. That it should be possible to locate a mining claim regardless of a discovery of mineral is also the consensus of opinion.

Upon other important questions, however, there was a very close vote. Thus, one party advocated the holding of a mining claim only so long as the specified development work should be performed, while another party desired to see provision made for the patenting and acquiring of absolute title to the property. The latter party was in the majority, but the vote was so close as to indicate that if the opinion of all mining engineers could be secured that opinion might be either one way or the other.

One party would like to see a uniform type of mineral location covering all classes of mineral deposit, whether lode, placer or anything else; in other words, a location after the manner of the Mexican mining law. Another party desires to see placer locations limited to deposits of loose material above solid bedrock, but with a preference in favor of the locator to any lode that might be discovered on his placer ground. Manifestly, these people do not desire to depart very far from our present distinction between lode and placer locations. This party in the Mining & Metallurgical Society was in a substantial majority.

The above different expressions of opinion illustrate the nature of the problems that a congressional mining commission will have to consider. Indeed, its problems will be a great deal more serious, inasmuch as it is certain that outside of the engineering societies there will not be the same degree of unanimity respecting the desirability of abolishing the law of the apex.

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The Anaconda-International Consolidation

It was announced last week that arrangements have been made, subject to confirmation by the respective stockholders, for the purchase by the Anaconda Mining Co. of all the properties and business of the International Smelting & Refining Co. The stockholders of the latter company are to get 3.3 shares of Anaconda for each share of International, plus a dividend of \$2 per share, the latter being the usual International dividend for the first quarter of the year.

The International Company is capitalized at \$10,000,000, i.e., 100,000 shares of \$100 each. This stock was issued at par, but has since been selling at about \$110@115. Dividends at the rate of 8%, or \$800,000 per year, have been paid. The Anaconda company has an authorized issue of 6,000,000 shares of \$25 each, of which 4,332,500 have been issued. In order to buy the International company, 330,000 additional shares must be issued. The principal stockholder of the International

company is the Amalgamated Copper Co., which owns 43% of its stock. At the end of 1912, the Amalgamated owned about 3,064,000 shares of Anaconda. Amalgamated's interest in Anaconda will therefore be increased by about 142,000 shares if the present pending contract be confirmed.

According to a circular issued this week by the directors of the International Smelting & Refining Co., the construction of the lead smelting works at Tooele, Utah, the purchase of lead ores now in stock at that plant, the construction of the lead refinery at East Chicago, and the money necessary to carry the metals in process, has resulted in an indebtedness of about \$9,000,000, to which must be added about \$2,500,000, required to complete the new smelting plant at Miami, Ariz. Appeal to the company's own stockholders or to the public for the money required to liquidate the indebtedness, or in other words, provide the company with adequate working capital, and the funds for the new construction was not considered to be opportune at this time. On the other hand, the Anaconda company had ample resources, and its acquisition of the International's business was considered to be desirable.

Apparently, the International went into the silver-lead smelting business without adequate working capital, and has been carrying a large stock of ore with borrowed money. Anaconda assumes this obligation and also the building of the new smelting works at Miami, Arizona. Just how these will be capitalized has not been announced. The most profitable part of the International's business has been the Raritan refinery, which has been greatly enlarged since the International bought it and is to be still further enlarged. We gather that the Tooele smeltery has been somewhat of a disappointment so far, but it is a thoroughly modern and excellent plant and ought to do well when conditions improve in the lead market. The Miami smelting works, with long-time contracts for the Miami and Inspiration concentrates, ought to be a profitable plant. All of these plants will henceforth have the benefit of the Anaconda's metallurgical organization, which is the best there is.

The trade seems to have been a matter of necessity on the part of the International company, while the Anaconda management regards it as advantageous from its standpoint. It completes the integration of its business by the addition of full copper-refining capacity for its output and can undoubtedly swell International's net earnings above what has heretofore been realized.

Arizona's Mining Death Rate, 1913

The annual report of G. H. Bolin, state mine inspector of Arizona, contains a summary of the fatal and serious accidents occurring in the state between Dec. 1, 1912, and Dec. 1, 1913. The fatal accidents were 66; the serious, 70. It is not stated on what basis an accident was classified as serious rather than minor, but a reading of the description of each such accident, indicates that they were all exceedingly serious, involving usually a broken member. The two most disastrous accidents were that on the Coronado incline of the Arizona Copper Co., in which 10 men lost their lives, and the cave of the Miami workings, where five were killed by the concussion.

The total number of employees in the state is given at 13,933. It is not stated whether this number is based on payroll or on actual number employed, or whether it has been reduced to the 300,000-man-shift basis. As the figures stand, the death rate was a little under $4\frac{3}{4}$ per 1000. Assuming that the number of employees is somewhat high and is not reduced to the 300,000-man-shift basis, which are probably the facts, and also that some deaths from small mines were not reported, the rate would be much higher. It is high enough, as it is—higher than the average for the United States in 1912, and the rate for the United States is a national disgrace.

The Proposed Elimination of the Finns

We printed in our issue of Apr. 18 a discussion of the tendency in the Lake Superior mining districts to substitute for the Finn miners, members of some other race less fractious. This is not the first mention of this movement; we are not aware how far it has progressed. We are inclined to think that the consummation of this intention is unlikely. At present, there exists among iron and copper mining operators a feeling of deep resentment against the race whose cooperation has made possible the partial success of the labor agitators. But as our correspondent points out, labor is relatively plentiful just now. If labor should become scarce, the present resolution of the operators might be shaken.

If no disturbances take place, the memory of the late troubles will become increasingly less potent. And after all the Finn is an intelligent workman and a good miner.

The closing of many large industrial enterprises in the north of Mexico will result in great suffering among the thousands and thousands of natives who have been employed by them. With no wages coming in, their lot will be sad, indeed. There is no other work for them to turn to, they have no capital wherewith to go into agriculture, the hunting and fishing are scanty, and the opportunities of a bandit on the road are no longer considerable, the country having been so thoroughly skinned already. However, this is one of the things that happen inevitably when industry is suspended.

The suspension of copper production at Aguascalientes, Cananea and Nacozari will cut off all the copper production of Mexico except that of Boleo in Baja California. In 1913, this suspended production came to about 85,000,000 lb., or something like 4% of the world's total. The recent absence of interest in the market by American consumers, however, indicates that a restriction of either 4% or 40% of the world's copper production is immaterial.

From many quarters in the West come reports of increased activity in mining, and best of all the idea seems to be to mine for ore rather than for customers for the properties. Statements by officers of the American Smelting & Refining Co. that it is getting more ore than for some time past are confirmatory of the talk that we hear in the West.

BY THE WAY

The estate of D. O. Mills, who died in 1910, has been officially appraised at \$36,227,391. It is interesting to note some of Mr. Mills' investments in mining and related enterprises. Many of these securities are of high value, though not widely known. The appraiser reports: Cerro de Pasco Investment Co., 8800 shares, valued at \$554,400; Cerro de Pasco Mining Co., 567 bonds, valued at \$510,300; Guanajuato Power & Electric Co., 250 bonds, \$251,550; 1800 preferred shares, \$180,000; 2700 common shares, \$81,000; Alaska-Treadwell, 21,450 shares, \$650,214; Alaska-Mexican, 37,675 shares, \$618,599; Alaska United, 15,475 shares, \$150,571; Black Diamond Coal Mining Co., 14,942 shares, \$112,065; Empire Coal & Coke Co., 273 shares, \$118,776; Lackawanna Steel Co., 5500 shares, \$313,500; Bunker Hill & Sullivan Mining & Concentrating Co., 49,224 shares, \$1,230,600 (par value, \$10 per share); American Smelting & Refining Co., 800 shares, \$82,600; Oriental Consolidated Mining Co., 8572 shares, \$72,862; Standard Oil Co., 600 shares, \$394,600; Tidewater Oil Co., 5000 shares, \$500,000; Nevada Petroleum Co., 56,250 shares, \$196,875; Union Iron Works Dry Dock Co., 133 bonds, \$126,350; Virginia & Truckee Railroad, 31,141 shares, \$622,833. Like most wealthy men, Mr. Mills could not help accumulating some worthless stocks. Among these were 124,500 shares of the Bessemer Consolidated Mining Co.; 4680 shares, Black Warrior Copper Co.; 115,384 shares, British Guiana Gold & Transportation Co.; 8000 shares, British Guiana Gold Concessions Co.; 102,917 shares, Brunswick Consolidated Mining Co.; 12,250 shares, Fairmont Consolidated Mining Co.; 20,000 shares, Holy Terror Mining Co.; 5000 shares, Nevada Salt & Borax Co.; 1000 shares, Pacific Rolling Mills Co.; \$30,000 note of the Exploration Co. of New York. Not all of the "cats and dogs" were mining shares, as witness 6667 shares of Automatic Clerk Co., 2200 shares of the Cotton Picker Co., and others.

The accomplished and entertaining writer of "Wall Street Paragraphs" in the *Evening Post* is puzzled by the apparent contrariness of the markets for copper stocks and copper metal. Thus, on Apr. 28, he wrote:

Today there was a reduction of $\frac{1}{4}$ c. a pound, following other recent reductions. Here we have an evidence of the curious manner in which the price of copper swings. Conditions influencing the copper trade all point to a softening of the market, and prices rise. Conditions influencing the trade point in the opposite direction, and prices fall. At the present time the statistical position is clearly in favor of an advance, and prices fall.

The explanation is that there is not generally any contrariness at all, but simply bad reporting by the Wall St. organs. Thus, the copper market rises to $14\frac{3}{4}$ c. Then demand falls off and prices recede on the selling of those who want to sell. The big producers may not want to sell. Poorly informed reporters quote the market at their last figure. At length, the actual market has declined to a figure where buyers are interested once more. The big producers meet them. Demand continuing, the price advances. The market is mobile, like the stock market, not fixed and periodic, like some commodity markets, automobile tires, for example. The daily newspapers reported on Apr. 28 that the price of copper had been cut to $14\frac{1}{4}$ c. Not so. In fact, the price of

copper advanced on Apr. 28, on transactions by the big producers, to $14\frac{1}{4}$ c. from about $14\frac{1}{8}$ c. on the previous day, there having developed a strong buying demand from Europe. Copper shares also advanced on Apr. 28. Thus there was sympathy and no paradox at all.

James R. Marker, Highway Commissioner of Ohio, is reported as saying that bad roads cost the United States \$7,500,000,000 per annum. He figures that the average cost of hauling one ton one mile on a good, hard road is 8c., while the present average cost is 23c., and in some districts it is as high as 54c. There is no doubt respecting the economy of good roads, but such estimating as Mr. Marker offers takes no account of the capital outlay necessary to get the roads. If the latter be built under the auspices and in the ways that have prevailed in the State of New York, there may be a loss of money instead of a saving. The matter is one of great importance to many mining districts, wherein wagon transportation is a high charge on ore production under present conditions, and where auto trucks can offer but little help until the roads are improved.

The danger of the carbide lamp as a source of accident is not wholly appreciated. While less likely to be the cause of an underground fire than is the candle, it is probably more dangerous around high explosives and is also capable of inflicting more or less serious accidents by itself. Thus, in the March *Safety First*, of the Nevada Consolidated, two minor accidents attributable to carbide are described. In one case, a man was changing carbide in his lamp after dark near an open light when the generated gas exploded and burned his face. In the other case, a quantity of spent carbide was emptied where a leak in a pipe line had made a puddle of water. A laborer threw a rail from his shoulder into the puddle and the mud of exhausted carbide, practically calcium hydrate, was splashed in his face and injured his eyes severely.

There is a recent contribution on the "Copper Industry of the United States" in the *Boston Globe*, which will enlighten the mining geologist. "By reason of peculiarities of climate, the accumulation of oxidized ores since the United States became a nation has been stupendous." The same contribution states that "Their great smelter plant" (i.e., of the Lake companies) "at Lake Linden, Mich., in spite of their utmost efforts to prevent loss, did lose a considerable percentage of pure copper. Sometimes it was of so fine a quality that it floated on the surface of Lake Linden, although if one tried to scoop it up with the hand, it vanished." Related to Macbeth's weird sisters, without doubt.

A head appeared above the hole in the desert, then the shoulders, finally the whole man, and he stood and looked out across the alkali waste, turning in a complete circle to scan the horizon. Then he stooped to call down the shaft. "Come on up, boys, no sign of the boss yet, and if he does come back now with his bloody automobile, it's too late to hoist the muck. Sure, I told him to get a hoist and not a touring car." [Using an automobile as a hoist in sinking on prospects has quite a vogue in certain camps.—EDITOR.]

PERSONALS

H. V. Winchell expects to sail for Europe this week.

W. R. Ingalls has returned from a three weeks' visit to the Northwest.

Erich Benjamin has removed his offices to No. 61 Broadway, New York.

R. E. Cranston, of San Francisco, is in Montana on professional business.

George Farish is examining the Black Bear property near Telluride, Colorado.

Charles M. Rolker has removed his office to 59a London Wall, E. C., London.

Col. John Carson, president of the Crown Reserve Mining Co., Cobalt, Ont., has left on a trip to Europe.

Adolph Lewisohn & Sons announce the removal of their offices to the Adams Building, 61 Broadway, New York.

The offices of the General Development Co., the Miami Copper Co. and the Kerr Lake Mining Co., have been removed to No. 61 Broadway, New York.

Captain B. M. Mitchell, president Conveying Weigher Co., New York, will sail May 6 on a business trip to England and the Continent of Europe.

Persifor G. Spilsbury, general manager of the Aguacate Mines in Costa Rica, will sail from New York on Apr. 30 for a month's holiday in Europe.

H. B. Wooden, general manager of the pipe and tank department of the Redwood Manufacturers Co., has returned from Butte, Mont., to San Francisco.

D. M. Liddell has been elected secretary of the New York section of the Mining and Metallurgical Society of America, taking the place of L. D. Huntoon, who has resigned.

James I. Long has resigned his position with the Alvarado Mining & Milling Co., after five years' service, and will devote himself to his personal business. His residence is in Los Angeles, California.

A. W. Newberry has just completed examinations in Eldorado Cañon, Nev., in Mohave County, Ariz., and in Johannesburg, Calif. He has left the Tumco mine and has as a present address, 321 Story Building, Los Angeles, California.

Wilbur H. Grant, formerly mining geologist for Spurr & Cox, Inc., American Smelting & Refining Co., and allied interests, and the Tonopah Mining Co., of Nevada, announces that he has opened an office as consulting geologic engineer, at 445 Holbrook Building, San Francisco.

Lawrence Addicks will leave soon for Douglas, Ariz., to take charge of the research work of Phelps, Dodge & Co. in connection with the leaching experiments initiated by G. D. Van Arsdale. Mr. Van Arsdale will also leave for Douglas, this week, but will shortly resume charge of the company's research laboratories in New York.

Professor R. H. Fernald, of the University of Pennsylvania, has been appointed a consulting engineer of the Bureau of Mines, in connection with the general technologic investigations now being carried on by the bureau. Professor Fernald will go to Europe to investigate and report on recent improvements in connection with gas producers in the development of metallurgical and power operations.

OBITUARY

Henry D. Pearson, one of the first to discover gold in the Bohemia District of Lane County, Ore., and a pocket hunter of renown in Oregon and California, died, Apr. 3, at the Sisters' Hospital in Bakersfield, Calif., where he had gone for his health.

Benjamin F. Warren died in Brooklyn, N. Y., Apr. 26, aged 68 years. He was born in Philadelphia and graduated from the University of Pennsylvania as a civil engineer. Under his direction the first oil pipe line to tidewater was located and laid across Pennsylvania, and he also supervised the building of pipe lines in Indiana and Illinois. He was connected with the Tidewater Oil Co. for many years.

George Eckard, a well known mining man in the Pinos Altos district, New Mexico, died Apr. 18, at the Silver City Hospital from injuries received from an accident Apr. 16 in the Hardscrabble mine, which was being reopened by him-

self and J. A. Janes. Timbers were being let down an incline shaft and caught on the skidway, the bucket descending empty. Mr. Eckard was the first to ascend from the drift and was struck by the timbers which loosened at the vibration of the cable. Numerous injuries resulted which caused his death. Deceased had been associated with mining in Pinos Altos for many years.

Wesley Smith Guffey died in Pittsburgh, Apr. 22, aged 73 years. Born in Westmoreland County, Penn., he had always lived in Pittsburgh or the vicinity. From the time of the discovery of petroleum in Pennsylvania he was active in exploration and development of oil and gas, and was the first man to undertake the piping of natural gas to Pittsburgh from the Westmoreland County fields. In many of his ventures he was associated with his brother, Colonel J. M. Guffey. He was generally successful and had acquired a considerable fortune. He was active and prominent in politics, but never held office.

SOCIETIES

Lehigh University.—The senior miners and geologists spent Apr. 17 and 18 at Franklin Furnace, N. J. The mine and mill of the New Jersey Zinc Co. were visited, as well as the old open-pit workings, and some neighboring quarries. A visit was also made to Sterling Hill, where the company has recently opened up a shaft. The visits to this most interesting and geologically unique locality are always of interest, and the excellent mining and milling conditions observed are very instructive. There were nearly 30 men in the party, which was in charge of Doctor Miller and Professor Eckfeldt.

Colorado School of Mines.—The 58 members of the graduating class, together with the following members of the faculty, Doctor Traphagen and Mr. Dittus, metallurgy; Professor Wolf and Mr. Chedsey, mining; Professor Hawley, mechanical engineering, and Professor Hazard, electrical engineering, left Denver on Apr. 20 on the annual traveling school conducted by the institution for several years and one of its most important methods of instruction. Doctor Patton, of the geology department, joined the class at Glenwood Springs. Stops to be made as follows: Colorado Springs to study milling practice and the hydro-electric plant; Victor for mining and milling practice; Portland for geology and mining of cement constituents; Cañon City for the separation of complex zinc ores; Shoshone hydro-electric plant; geological and scenic trip to Hanging Lake; Castle Gate, Utah and Brigham mining methods; International (Tooele) copper and lead smelting; Midvale, smelting and geology; Garfield, concentration plant; Butte, Mont., mining and milling; Anaconda milling, haulage, manufacture of refractories. After completing the trip the class will return to Golden on May 19 and the 40th annual commencement will take place on May 22. This trip is required of all members of the graduating class, and is considered to be of great importance in the finishing of the education of a present-day mining engineer. Reports are required on all plants, etc., visited.

Philadelphia Engineers' Meeting.—The scientific and engineering men of Philadelphia are preparing for a mass meeting to be held the evening of May 15 in the Continental Hotel Roof Garden, at which many prominent engineers will give short addresses, while the time will be spent as an informal smoker, in which addresses, music and general entertainment will be the features. As many as 20 national and local societies will be represented, in which there are fully 4500 members in and near Philadelphia. This will be the first of a regular series of general meetings, and no long program will be attempted, but rather a get-together meeting to inaugurate an engineering congress each year.

The speakers who thus far have promised to be present are Doctor Steinmetz, of the General Electric Co., Walton Clark, of the United Gas Improvement Co., president of the Franklin Institute; Doctor Humphreys, president of Stevens Institute of Technology, and James Mapes Dodge, of Philadelphia. Prof. George A. Hoadley, of Swarthmore College, is chairman of the general committee, L. B. Eichengreen, secretary, and C. C. Tutwiler, treasurer. Other members of the committee are Dr. R. B. Owens, secretary of Franklin Institute; J. A. Vogleson, chief of the Bureau of Health; Joseph D. Israel and H. A. Hornor. Tickets may be obtained at \$2 each from C. C. Tutwiler, treasurer, 1630 Real Estate Trust Building, from Dr. R. B. Owens, Franklin Institute, or from the Engineers' Club, of Philadelphia. Members of the national engineering and scientific societies of other cities are cordially invited to join the gathering and will be welcome.

Editorial Correspondence

SAN FRANCISCO—Apr. 21

Fume Situation in Shasta County is more encouraging than it has been for a long time, notwithstanding the recent threat of the farmers to institute proceedings against the Mammoth for alleged violation of the court decree under which the smelting plant and baghouse are operated. The fact is the farmers have nothing to complain about, although the climatic conditions have discolored some of the blades of the new grain which is enough to start something that will not be finished. Fair men who realize that the farming industry is wholly dependent on the operation of the mines and reduction works refuse to pay out any more money to satisfy the wishes of the few remaining members of the farmers protective association who are active against the smelting interests. The attorneys sensibly decline to undertake proceedings unless regularly retained. Some of the farmers are said to be stockholders in the enterprise organized by the inventor of the Field process for desulphurizing copper ores and removing the deleterious gases. The inventor has made a test with the experimental plant installed near Redding, and is reported to have stated that in a two hours' run on 1½ tons of ore he has "taken care of 100% of the sulphurous and other gases." The inventor seems to have worked earnestly and has put up a substantial experimental plant. He treats the ore in a reverberatory furnace, and claims to get rid of the sulphur gases by sending them through a "refrigerating" flue, which takes out all but 1% and that small amount he says is readily absorbed by chemicals, the character of which he does not reveal. Nobody connected with the experiments knows positively what is accomplished except the inventor. The ore used in the recent test was from the Balaklala mine, but the Balaklala company has no connection with the enterprise, and is still experimenting with the Hall process with good hope of success. Whether or not the Field process is ultimately a success it is a welcome experiment, even if it does nothing more than keep the farmers quiet and afford them more time to attend to their crops.

DENVER—Apr. 24

Conflict in the Southern Coal Fields of Colorado has assumed grave proportions. All mining men, metal as well as coal, are closely following the situation, for certain principles are involved that might be applied to metal mining. It is difficult to ascertain positively to what extent the two sides in the controversy are at fault. Strikers maintain a bitter enmity toward the militiamen, whom they outnumber. They are formidably armed and are aggressive. They are wrought up to their present frame of mind by the suspicion that the militia is a tool of the corporations owning the mines. This and the doctrine propounded by John D. Rockefeller, Jr., at the recent investigation in Washington, to the effect that he would rather lose all his investments in coal mines than have them dominated by the unions, has been used as a subject for inflammatory proclamations by the leaders of the unions who have incited their willing but less informed subjects to extreme acts of lawlessness. It is charged by union leaders that the soldiers started this last outbreak but such charges are denied by the military officials. It is hoped that investigations will be made to place the blame for the acts of violence that are now being committed and that such investigations will sustain the integrity of the National Guardsmen. Battles are being fought day and night around Trinidad. Bulletins are being displayed at all newspaper offices. Probably 30 people have died this week either by bullets or fire. Nearly every valuable coal mine in the district has been dynamited and set afire, sometimes with officials entombed, who will receive no mercy at the hands of the strikers. During the absence of Governor Ammons in Washington, the exigencies of administration fell to Lieutenant-Governor Fitzgerald, who ordered a return of the militia to the field from which they were withdrawn just a short time ago. Ammons returned home Apr. 24 and has assumed control, despite demands made by union sympathizers for his resignation. He is criticized not for partiality but for playing a "weak game," whereas it is believed by many that this trouble could have been settled months ago if more emphatic measures had been adopted

by him. The strike is estimated to have cost the state over \$15,000,000, and it would seem that it will cost millions more. But this cost to the state does not compare in significance with the injury that the conflict is doing the state as a whole. It now seems evident that the militia will be unable to successfully put down this reign of anarchy. [Federal troops have been ordered to Colorado by President Wilson.]

SALT LAKE CITY—Apr. 23

Utah Copper Co.'s Production for March is the highest month's output so far made by the company. According to preliminary figures, 12,700,000 lb. of copper were produced. This is an increase of 860,000 lb. over August, 1912, when the production amounted to 11,840,000. The higher output is caused partly by the better grade of ore, which has recently been stripped on the upper levels, rather than to an increased tonnage. The daily output has ranged between 22,000 and 24,000 tons; 20 shovels are working on ore and overburden.

Utah Power & Light Co. Bond Issue is secured by a mortgage, which has lately been filed with the county recorder, providing for the issuance of \$100,000,000 worth of 5%, 30-year, first-mortgage gold bonds. The mortgage is in favor of the Guarantee Trust Co. of New York, and William C. Cox is trustee. It covers every asset of the company, including all power plants, transmission lines, pipe lines, water rights, franchises, rights-of-way and other property; 27 plants in Utah, Idaho and Colorado are included. The bonds are to be issued serially dating from Feb. 1, 1914, the first issue being for \$10,000,000. The bonds are payable Feb. 1, 1944, with the proviso that after Feb. 1, 1919, they may be redeemed at \$105. The purpose of the mortgage is the retirement of short-term notes, though a part of the money derived from the bond issue will be used for extensions and improvements. The company serves the entire intermountain section with power and light, having a capacity for more than 100,000 hp., and 2000 miles of transmission and distributing lines.

HOUGHTON—Apr. 23

Shipments Are Being Increased at the Hancock Consolidated. The working force has been increased until it now numbers 160 men. Shipments of rock are averaging better than 200 tons daily, practically all from development openings. As a matter of fact, these openings are showing a grade of rock which is running better in the stamp mill than was anticipated. The assays from the smelter show rock better than 17 lb. refined copper per ton. Such a showing from the Pewabic lode is excellent. This is particularly good, when it is remembered that this rock included practically all lode matter that comes out in the course of opening drifts and stopes. If the return is maintained at 17 lb. in the general run of the mine, when operations are conducted on a scale of 1000 tons daily, the success of the Hancock is assured. The present shipments are being crushed at the Centennial-Allouez mill. The rock is coming from four lodes, No. 9, No. 4, No. 3 and No. 8. The recent shipments have been heavy from the last two named. The rock cut in recent drifting is somewhat better in appearance than that first shipped.

Development of the White Pine by the Calumet & Hecla company has been an expensive exploration proposition into which great sums have been put for the last six years. The property is in Ontonagon County, in a district that had been generally discredited as far as commercial copper is concerned. The doubters "sat up and took notice" when the Calumet & Hecla optioned the property and now there is evidence that the White Pine eventually will become a producer of merit. The framework for a stamp mill has been built at the Calumet & Hecla shops at Calumet and is now being shipped to the White Pine. It will be erected early this summer. By October, stamping will begin. The mine is at such a isolated place that its development and exploration have been attended by many difficulties, but the fact remains that in this new property the Calumet & Hecla has developed an asset that is likely to play an important part in the dividend disbursements of the future. There are two shafts now fully developed. While the vein is narrow and

Irregular and the copper occurs in sandstone, the fact remains that the ore is rich and presents no stamping difficulties that cannot easily be overcome. Thousands of tons of rock, taken out in development, now are on the stockpile. Thousands of feet of openings have been made and yet the territory is barely scratched. This is one of the properties of the Calumet & Hecla company that is little heard of. It is far away from known and recognized mineralized zones and there is no public interest in the stock of the company, half interest being owned by the Calumet & Hecla and the other half by the land holders, the Longyear interests particularly. Under the circumstances there is no market for any of the White Pine shares nor is there likely to be, both interests being content with the development work and to await returns from the sale of copper.

ISHPEMING—Apr. 25

Bigger and Better Locomotives are to be used by the Chicago & Northwestern in its ore traffic this season. They are known as Class 2. The engines are of modern design and are the first of their kind ever used on the Lake Superior division of the road. The cylinders are 25 in. in diameter by 32-in. stroke. The weight of the engine is 235,000 lb., while the weight of both engine and tender is 400,800 lb. For the last five years preparations for installing the locomotives have been made. To accommodate these engines new tracks had to be laid and new bridges built. From time to time more of the locomotives will be bought until eventually it is hoped that only such engines will be in use on all the freight runs on the division.

A Jones Step-Process Furnace is to be erected at Marquette, the arrangements having already been made for the construction of the plant, which will have a daily capacity of 100 tons. Associated with John T. Jones, the inventor of the process, are J. M. Longyear, of Marquette, Henry L. Higginson, of Lee, Higginson & Co., of Boston, and Seth T. Gano, of Boston. Jones has been experimenting with his furnace for many years and now believes he has reached the stage where it can be operated and be a commercial success. He built his first experimental plant at Iron Mountain several years ago, but had difficulties with the lining of the furnace. Three years ago he secured a lease of the old Kloman mine at Republic and started the erection of a plant there to treat low-grade iron ores, which abound in that district, but the plant was a failure and was never put in operation. A year ago he transferred his operations to Salt Lake City, Utah, where he erected a small plant, which differed considerably from those that he built in Michigan. His work has been followed with interest by mining men of the Lake Superior district and other districts, as it has often been claimed that the iron and steel business would be revolutionized if he could achieve his aim. The furnace that he has now built is almost vertical, instead of horizontal, like the ones built at Iron Mountain and Republic. It is practically a cupola furnace without blast. The tube is brick lined and revolves when in use. The ore is dumped in at the top, as is the fuel, and the product that comes out resembles wrought iron. The gases from either the wood or coal are used to "metallize" the ore, and coke or charcoal is a byproduct. It is claimed that good results have been secured in the treatment of oxide ores, other than iron.

JOPLIN—Apr. 25

In the Movement Against Tuberculosis in the Joplin district, the Anti-Tuberculosis Society has added to its working force another visiting nurse for the Missouri camps and another is promised for the Galena camp at an early date. The most important step so far taken is the donation of a 20-acre tract by Temple Chapman for a tent city and open-air camp for the victims of the disease. The tract lies in the Carterville camp. Steps are being taken to finance this undertaking by the mine operators of the district.

SOUTH PORCUPINE—Apr. 18

A Busy Season at Porcupine is indicated by the activity of the last few months. There is also the prospect of a mild boom on account of the excellent position in which many of the companies are finding themselves. The main center of activity is in the Pearl Lake section, and the results of recent operations in that part of the camp have been encouraging. The Porcupine Crown is showing up well under development and has paid its initial dividend at the rate of 12% per annum. Earnings, however, should be considerably in excess of dividend requirements and if development on the southern part of the property bears out the results of the diamond-drill holes which showed a continuation of the vein beyond the fault, the ore reserves should be materially increased during the coming season. The recovery of the McIntyre mine from difficulties which at one time were believed would result in its going into liquidation, has

been satisfactory. During March, the mill treated 4325 tons, assaying \$12.68 per ton, while shipments of gold bullion for the month amounted to \$52,661. The mill recovery was 7.8%. Efforts are being made to bring the capacity of the mill up to 300 tons per day and with this end in view, additional machinery is being installed. If the company can maintain the grade of the ore and can increase the capacity of the mill, there should be no question of its ability to extricate itself from its financial difficulties. Last year, a total 4171 ft. of development work was done and the ore available for stoping has an estimated value of \$1,245,000. Gold production to date amounts to \$400,868. On the North Thompson, which is now being worked by the Huronian Belt Syndicate, a subsidiary of Erlich & Co., of London, good results have been obtained by diamond drilling and the satisfactory development of the vein which was discovered on the surface leads to the hope that this property may eventually become a profitable producer. The Jupiter is now under the control of the McKinley-Darragh company, of Cobalt, and as this company is amply able to finance all the requirements of the property, there is every reason to believe that this property will shortly join the ranks of the producing mines. So far nothing has been done with the Plenaurum which adjoins the Jupiter, but if the McKinley-Darragh is satisfied with its property, the logical outcome would be to combine it with the Plenaurum. The Schumacher is also developing satisfactorily and as for the Hollinger, this mine is in such an excellent position that little need be said regarding it. The Acme gold mines, which are owned by the Canadian Mines & Finance Co., will, it is believed, eventually be amalgamated with the Hollinger. The ore on this property is of higher grade than the Hollinger, but the veins are narrower. Only a small amount of work is being done on the Miller-Middleton, which is also owned by the same men, and it is believed that a shortage of money is responsible for the small amount of work going on. The ore-shoots on this property are comparatively low-grade, but are believed to be of large extent. In the Dome section of the camp, the chief matter of interest has been the recent decline in Dome stock which has sagged from \$20 per share, which it reached a short time ago, to slightly below \$9. Various reasons have been assigned for the action of the stock, the chief of which seems to be the belief that New York men are manipulating it for their own private ends. This, however, is quite erroneous, for, as a matter of fact, as far as the majority of the principal owners are concerned, the stock has been allowed to take its course and has had no support. The real reason is believed to be a mistaken public attitude regarding the possible earnings of the property. In the last annual report, the ore reserves were estimated a little over 315,000 tons, assaying \$7.50 per ton. During the period, however, from April, 1913, to January, 1914, inclusive, the company treated 117,915 tons of ore which assayed \$8.90 per ton. During this period, the average monthly values were sometimes as high as \$13.68 per ton. It is simply a question of figures as the reserves last year were shown to have an average value of \$7.50, and as the output up to January showed an average value of \$8.90, the balance of the reserves must be lower, and that the drop in the grade was inevitable unless higher-grade ore was encountered in the lower workings. As a matter of fact, the general public appears to have simply looked at the average value as shown in the monthly statements and did not use these figures in connection with those shown in the last annual report. The company is, however, believed to be in excellent position and at the next meeting should show considerable tonnages of medium-grade ore. The addition to the mill will be completed in May and after this is in operation, the monthly earnings should show a considerable increase. The figures for March show a tonnage treated of 14,970 tons, from which was recovered bullion to the value of \$87,657, or an average recovery of \$5.85 per ton. Excellent progress is being made with development of the Dome Lake property, which is now under the control of the Hudson Bay company, of Cobalt. Continuations of some of the veins have been found on the lower levels and the main shaft is being sunk to the 400-ft. level. It is expected that the mill will be ready to resume operations in a short time and that after it is once started, there will be a sufficient supply of ore to maintain a daily tonnage of about 50 tons. Several small properties in the vicinity of the Dome are reported to have been purchased by C. L. Sherrill and interests associated with the Homestake Mines Finance Co. These properties consist of the Little Pet, Fogg and Porphyry Hill. The two former properties are to be purchased on a basis of \$25,000 for an 80% interest in each and for the Porphyry Hill which was formerly a part of the Preston East Dome holdings, the price is \$40,000 for an 80% interest. Preparations have been made to build a plant to enable them to carry on underground development.

The Mining News

ALASKA

ALASKA MEXICAN (Douglas)—In March, 19,698 tons of ore yielded \$46,069, or \$2.36 per ton; net profit, \$13,743.

ALASKA TREADWELL (Douglas)—In March, 83,581 tons of ore yielded \$202,419, or \$2.44 per ton; net profit, \$125,869.

RHOADS-HALL (Fairbanks)—It is reported that this mine will be robbed of rich ore near surface and then closed until railway construction makes lower costs possible.

No. 3 ABOVE, EVA CREEK (Fairbanks)—Suit has been started by Elsie Morse to expel Michael Beegler from No. 3 Above, Eva Creek. Plaintiff also asks damages of \$1000 for illegal possession on part of defendant.

No. 23 GOLDSTREAM (Fairbanks)—Leaf & Carroll, lessees, struck water on Mar. 12 and were driven from mine. A similar mishap occurred several months ago when operators ventured too close to creek, but shaft was recovered at comparatively small expense. It has not yet been decided whether or not another attempt will be made to extract pay gravel already developed.

ALASKA EBNER—Assets were sold at auction last week in New York, under direction of Payson Merrill, as special master, under a foreclosure suit of Guaranty Trust Co. There was only one bid of \$225,000 by bondholders' committee, and property was sold to committee. Property included office furniture, mining machinery at Juneau, Alaska, mines in Madera County, Calif., claims and notes aggregating \$97,000, and shares of stock of these companies: 1,700,350 Bristol Consolidated Mines & Smelting Co., 199,996 Day Bristol Consolidated Mining Co., 100,000 Ebner Gold Mining Co. and 1000 Humboldt Mining Co. Receivers were appointed for company two years ago, when it was stated that liabilities were \$2,000,000. United States Smelting, Refining & Mining Co., through agreement with Chapman committee has been doing development work on Ebner mine at Juneau, and also holds an option on Day and Bristol mines at Pioche, Nev. Option on Ebner expires in March, 1915. No work has yet been done at Pioche.

CHATHAM MINING CO. (Fairbanks)—E. L. Scrafford has a lease and option on property of company, which is owned by E. L. Scrafford, William Burns and Luther Hess, all of Fairbanks. Terms of lease have not been made public, but it is reported that it will run for three years, that royalty is 15%, and that it carries right to purchase for \$66,000. This is third of more important lode mines of Fairbanks to be leased since first of year, other two being Newsboy and Spalding (Reliance). Property comprises 17 claims at head of Chatham Creek, mess-house and bunk-houses at mine, and a 4-stamp mill on placer claim No. 4 Above, Chatham Creek. An adit was started in 1911 by Jesson Bros., who at that time had claims under lease, to tap principal vein at 75 ft. Drifts were turned off at vein, which strikes nearly east and west. These were extended several hundred feet, and in spring of 1912 present owners assumed control. A 4-stamp mill was erected at creek, 7000 ft. from mine. East drift was driven 600 and west drift 400 ft. Stopes were opened, and 5000 tons of ore, milling \$15 per ton, was mined from Oct. 1, 1912, to Dec. 1, 1913. At latter date, ore having been exhausted above adit level, mine was closed down, except for some prospecting work. It was proposed to drive another adit at a lower level, and a winze was sunk by windlass to determine advisability of this course. At a depth of 100 ft. in winze, station was cut and a crosscut started for vein. Water was found, and as no means for bailing had been provided, a new crosscut was started at 80 ft. Some driving has been done on vein at this level, but results of prospecting have not been made public. Scrafford reports, however, that he will at once commence mining "large body of ore that is in sight."

ARIZONA

Gila County

INTERNATIONAL SMELTING & REFINING CO. (Miami)—Footing for 15x200-ft. converter stack at smelter site was completed last week, also retaining wall for receiving conveyors. Pouring of main building foundations is well under way and should be finished by now. Machine-shop tools are all in place, and those in forge shop will be set up as soon as sand floor is finished. Warehouse is completed and is already being used. Smelter management has decided to install Cottrell system for precipitation of fumes, and because of this change, 15x200-ft. converter stack has been placed near middle of converter-dust chamber instead of at one end, as originally planned.

INSPIRATION CONSOLIDATED (Miami)—Haulage drift on 600 level was connected Apr. 21, so that from now on all material and waste going to and from these lower workings will be handled through incline instead of Colorado shaft. Erection of steel for hoist and compressor house is all but finished and storage bin is fast assuming a finished appearance, as "rubber-glass" windows, siding and roofing are nearly completed. Riveting was to start on main concentrator building Apr. 27. Steel erection on three lower benches of concentrator building is finished, as well as supporting columns for mill bin on fourth bench. Hanging of bin plates is now in progress. The 12-compartment oil machine, in experimental mill, was started early in week and is now treating material which eight-compartment machine has been handling.

Mohave County

PIONEER CONSOLIDATED—Development is going forward satisfactorily at Pioneer shaft. When George F. Roth

acquired controlling interest in this property, six months ago, his engineers reported \$375,000 worth of ore in sight, down to 200-ft. level. At that time Treadwell shaft was 340 ft. deep and 35 Parallel shaft 220 ft. No work is being done on these claims now but shaft sinking is going on at Pioneer shaft, and at present is 100 ft. deep. Objective point is 400-ft. level, but it is expected that 200-ft. level will be reached by June 1, and that a 40-ft. crosscut will be driven to vein. There is a small mill on Treadwell claim, but it is not being used. Depending upon results of work at Pioneer shaft, an adequate mill will be built on that claim, but it is not expected that this will be warranted until vein is cut at 400-ft. level.

CALIFORNIA

Amador County

SOUTH EUREKA (Sutter Creek)—Forty stamps have been hung up.

KENNEDY (Jackson)—A miner was killed Mar. 29 while attending an ore chute which carries ore to mill feeders.

ARGONAUT (Jackson)—It is expected that removal of stamp mill will begin in May. It is reported that crosscut from 4000-ft. level is nearing vein.

CONSOLIDATED QUARTZ MINING CO. (Jackson)—Property estimated to be worth \$25,000, on which no taxes have been paid in last 21 years, has been ordered sold by state controller to recover \$7000. Two former sales were advertised, but prevented by legal errors.

Butte County

P. B. STEIFER MINING CO. (Coutolenc)—William C. Pershbaker has brought suit to recover \$50,000 alleged to be due for 10 days' expert examination of Steifer mine.

Fresno County

PACIFIC QUICKSILVER CO.—Suit has been brought in superior court by estate of E. F. Northam to determine title to mining claims included in company's operations.

Inyo County

SALINE VALLEY SALT CO.—Production will be resumed as soon as snow is off mountain over which tramway is built.

INYO COUNTY WATER & POWER CO.—Preliminary application has been made for development on Lost, Walnut, Olancho and Fall Creeks, a total of 525 miners' inches. Cost of project will approximate \$120,000.

CERRO GORDO (Keeler)—Ten tons per day of high-grade ore is being shipped. Oreshoot has been disclosed on 400-ft. level. Three water tanks at mine and two at pumping station have been installed; a 130-hp. boiler is being installed.

WILSHIRE BISHOP CREEK—Material for new milling plant is said to be ready for shipment from Denver. Ten feet of snowslide covers road near mine, which it is expected will be cleared by middle of May. Snow will be blasted and broken up to hasten melting.

TECOPAH CONSOLIDATED (Tecopah)—Result of first year's operations at this property, which was shut down several years ago and reopened in 1912, were lately announced at annual meeting in Philadelphia. Most of the work was done in the Gunsite mine, although late in year operations were started in Noon Day mine. From Gunsite, 10,000 tons were shipped, returning \$128,000, of which \$40,000 was required for freight. Net profits were \$52,000. All work in Gunsite was above the 700 or tunnel level. A concentrator of 25 to 50 tons daily capacity is being planned.

Kern County

VALUABLE WATER IN A SHAFT has been encountered by George Dawson in sinking for development of a quartz vein one mile from Mountain Wells. There is a depth of 25 ft. and pumping has not reduced it. Development of permanent water will be of more value than development of ore at present.

PACIFIC COAST MINING & DEVELOPMENT CO. (Maricopa)—Erection of a stamp mill on this property on Fitzgerald Mountain is contemplated. It is reported that a large block of ore has been developed in a drift from 65-ft. tunnel, 120 ft. below surface.

G. B. (Randsburg)—High-grade ore resembling sylvanite has been disclosed at 250-ft. level in shaft. Character and value of find have not been determined, but it is evident that grade of ore is improving with development. Ore is similar to that in Cripple Creek district, Colorado.

Nevada County

PENNSYLVANIA (Grass Valley, Manager, W. B. Bourn)—It is reported that production in last two months amounted to approximately \$500,000. High-grade ore is said to have been disclosed, but authoritative information is not available. Mine was recently purchased by Spring Valley Mining Co., owner of Empire mine, adjoining. Purchase price is said to be \$500,000. First payment will be due May 1, 1914, and final payment in May, 1916.

Placer County

PACIFIC DREDGE (Auburn)—It is stated that dredge operating on American River at Mammoth Bar is producing \$4000 per month. Boat is owned by Guggenheims, who have another operating at Oroville.

Plumas County

CALIFORNIA MINES CO. (San Francisco)—Articles of incorporation have been filed in Plumas as in other mining counties. Capital stock, \$5,000,000, in \$10 shares. Incorporators are Minneapolis and San Francisco men. Principal place of business, San Francisco.

NORTH CALIFORNIA MINING CO.—Title to 2850 acres of land situated in various parts of Plumas County has been transferred to Western Realty Co., Denver. This is remnant of more than 200,000 acres located in Plumas and Butte Counties under operations of H. H. Yard. Patent to lands failed from opposition of Forest Reserve, State Mining Bureau and local residents of two counties.

San Bernardino County

A STRIKE OF HIGH GRADE IN PROVINCE DISTRICT is attracting attention. Strike was made 25 miles northwest of Fenner, by Thomas Murphy, of Needles.

CALICO (Daggett)—This old silver mine in Calico district is to be reopened and mill will be reconstructed.

BONANZA KING (Fenner)—It is reported that mine, which was a large producer, will be reopened. It is in Providence district.

HIDDEN HILL MINING & MILLING CO. (Fenner)—Incorporation articles have been filed; capital \$100,000. The directors are Frank Crawford, Omaha; Frank Engel, Canada; A. D. Nescus, T. J. Murphy, Needles; Dan Murphy, Los Angeles. Company will operate in Providence district.

Shasta County

DREDGING GROUND IN IGO DISTRICT is said to have been bonded to Guggenheim interests. Recent undertaking by Porter & Thompson to operate ground with a dry-land dredge is reported to have proved unprofitable.

Siskiyou County

A RIVER DREDGE WILL BE INSTALLED on A. E. Akins property on Klamath River near Oak Bar.

COLORADO**Boulder County**

WHITE RAVEN (Ward)—Since railroad blockade in December, ore has accumulated until it has become necessary to haul some of it to mill in wagons. Five 4-horse teams are kept busy getting two cars of ore per week to mill. This is a silver mine, although in a strong lode that has produced gold in neighboring mines.

Lake County

CLEVELAND (Leadville)—Bona lease ships about 200 tons per month to Salida smelter. Ore runs up to \$50.

CASTLE VIEW (Leadville)—Lessee Nicholson has sublet to a group who will mine exclusively for iron ore in oxidized zone.

DENVER CITY (Leadville)—Mine is shut down for official inspection. Said to be in good condition and work will soon be resumed.

GARBUTT (Leadville)—Regular operations were interrupted by burning out of a motor. Work will be resumed as soon as new parts are procured.

PENROSE (Leadville)—Jesse McDonald has secured contracts on all but one of the properties that comprise group to be unwatered and operated through this shaft in Downtown district.

Moffat County

CALAMINE IN NORTHWESTERN PART OF COUNTY has recently been discovered. Ore is of high grade and deposits are promising, but are undeveloped and no one can predict what they will amount to. They are not far distant from projected line of railway.

Park County

PROSPECTORS ARE GIVING THEIR ATTENTION TO URANIUM—Recently carnotite was found in sandstone beds near Garo, while specimens are now coming in from Mt. Silverheels. As snow is still deep in this region, real prospecting cannot proceed for some weeks but there will surely be close investigation of these possibilities during the summer.

San Juan County

SILVER LAKE (Silverton)—Mill is being put into shape for custom work. Ores will be delivered by rail and will be sampled and purchased.

KITTIMAC (Howardsville)—Mine and mill are expected to soon resume work. Property has a strong system of veins with extensive development but litigation and mismanagement have prevented profitable working. Ore is complex sulphide and heretofore a considerable portion of metallic contents has been marketed at no profit and even at loss. It is proposed to install electrostatic separators in mill. There are said to be big reserves ready for immediate transportation to mill over mine's aerial tram.

IDAHO**Coeur d'Alene District**

NATIONAL (Mullan)—Rich streaks of copper glance have been encountered in stopes. Ore also contains gold and silver. Samples were taken from a 6-in. streak opened in a portion of mine where this character of ore was not known to exist, and in other places both native copper and native silver are being discovered in quantities that will increase value of the product materially. New 500-ton mill, started recently, is running nicely. One shift is employed now while equipment is being "worked up," but as soon as machinery is fully adjusted three shifts will be put on and plant operated to capacity. Mine has been extensively developed in recent months, and it is said by engineers who recently inspected property that they thought there was enough ore already in sight to keep mill working at capacity for several years. Mine and mill are connected by an electric railway and hins

sufficient to store both crude ore and concentrates have been built at railway spur, constructed for service of company. Haulage line is protected from snowslides by strong sheds.

CALEDONIA (Kellogg)—Raise from lower tunnel of Bunker Hill & Sullivan mine, connecting with Caledonia, was completed recently. Unit of Bunker Hill & Sullivan mill that is being repaired for use of Caledonia company is almost completed, and it is anticipated that operations at mine will be commenced in a few days. Completion of raise from Bunker Hill lower tunnel into Caledonia workings will facilitate operation of property, as Bunker Hill level is much lower than lowest tunnel in Caledonia and will permit working latter to surface through Bunker Hill. Mining engineers familiar with the Caledonia estimate that the concession granted by the Bunker Hill, permitting physical connections with its workings, is worth not less than \$500,000 to Caledonia company, as it would require at least that much to develop mine to same depth secured by raise. New oreshoots assaying higher than any previously encountered in Caledonia, have been opened at depth in recent weeks, mine is in shape for heavy production and adequate ore treatment facilities are available.

MICHIGAN**Iron**

TRADERS (Iron Mountain)—Operations were resumed a few days ago and a small amount of ore will be mined for shipment this season. Mille mine, near by, has also commenced work.

PENN IRON MINING CO. (Vulcan)—Company has let out 200 men in Vulcan and Norway mines, and it was only a few weeks ago that 75 men were laid off at Republic mine of this company and remainder placed on a working schedule of five days per week.

OLIVER IRON MINING CO. (Ironwood)—Company has laid off 700 men at its Ironwood properties where a force of 2000 was employed. Reduction is due to iron market, there being few calls for iron ore. It is stated that if conditions improve some men will be taken back. Many have departed for copper country, where good miners have little difficulty in getting work.

PICKANDS, MATHER & CO. (Iron River)—General Manager C. L. Lawrence has stated that no sales of ore have as yet been reported to him and if market does not show signs of activity before long it will be necessary to reduce forces. Balkan is now being stripped, which will mean a heavy expense, and ore will have to be sold to pay for work. Many other Lake Superior concerns are in same position and many a manager states that there are dull times ahead.

Marquette County

A GOLD MINE IN MICHIGAN is being sought by a party of Houghton, men who have taken an option from J. M. Longyear, of Marquette, on Sec. 35, T. 49, R. 27, 10 miles north of Ishpeming, and will proceed to explore it in the hope of locating gold veins. It was on this section that the Fire Center mine was operated a number of years ago and where some gold was taken out. There were good indications where work stopped and Houghton men believe that there is a good chance of finding gold in paying quantities. This district has frequently attracted attention from mining men but only one attempt was ever made to do any mining. Property is five miles to north of old Ropes gold mine, which was operated for a few years 18 years ago. Ropes produced considerable gold but much was lost in tailings and some was taken by miners. It was all free milling but veins were not large and pinched out. Some years after workings were abandoned, property passed into hands of Corrigan, McKinney & Co., who were said to have secured almost enough gold from plates to cover cost of mine and equipment. Most of machinery has since been removed. There are many who still believe that paying gold properties will some day be working to north of Ishpeming.

MINNESOTA**Cuyuna Range**

GENERAL CUYUNA CONDITIONS—Shipments have started from Armour No. 2 and Kennedy mines, and preparations have been made to ship at an early date from Rowe mine at Riverton and Thompson mine at Crosby, as well as Pennington mine at Ironton; last three being pits. Ironton shaft of Cuyuna-Duluth Iron Co. continues to stockpile daily, as does Cuyuna-Mille Laes. At Duluth-Brainerd property, shaft sinking continues, it being 136 ft. deep. Northern Pacific railroad line to this property will be completed by June 1. Iron Mountain surface plant is boarded up with no signs of activity; same condition holds true at Armour No. 1. This completes list of activities on north range of Cuyuna aside from usual drilling explorations which continue unceasingly. Most recent notable increases in ore tonnage have been to west of Ironton, where Cuyuna Iron & Manganese Ore Co. has shown up considerable ore of good grade, which extends across property line to Mangan Iron & Steel Co. land, both companies being stock companies with shares scattered widely. To north of Crosby, Northwestern Improvement Co. is said to be adding considerable tonnage to Jamison & Peacock deposit by its drilling on adjoining property to west. No shipments have yet been made from south range, although Barrows mine has a large tonnage on stockpile, and Adams mine, near Deerwood, is hoisting ore daily. Two shafts are now sinking on south range, Wilcox at Woodrow and Brainerd-Cuyuna in town of Brainerd. Neither will hoist ore this season. Many drill rigs are at work exploring in this territory too, but no deposits worthy of note have been encountered recently.

BANGOR (Biwabik)—Labor troubles came to an end Apr. 15, when men accepted terms offered by operators, Pickands, Mather & Co., and returned to work.

ROWE (Riverton)—Large crew now working on construction of trackage in pit, and in a few days shipments will start from Cuyuna Range's third open-pit mine. No statement has yet been made as to tonnage for present year, but trackage facilities are being provided for an exceedingly large output.

MONTANA**Beaverhead County**

BOSTON & MONTANA DEVELOPMENT CO. (Butte)—At a meeting held Apr. 17 at Chicago, between directors of company and A. F. MacArthur, president and Sir Robert W. Perks, chairman of board of MacArthur, Perks & Co., of London, a contract was agreed to whereby English company will build 119 miles of Butte, Wisdom & Pacific R.R. that is to connect Butte with company's mines at head of Wise River. Incidentally this road will open a large mining, timber and ranching district in Western Montana and Southern Idaho. Mining properties of company consist of 28 quartz claims and six placer claims in French gulch and 55 quartz claims in Elkhorn district. At Elkhorn mine a main, two-track tunnel is now being driven from bed of Wise River and will cut all veins in that group at a depth of 1500 ft. below surface. Mines in French gulch are developed by a shaft, tunnels and drifts. Besides mining, company will eventually engage in land and irrigation projects, promote townsites and in general develop all natural resources of territory traversed by railroad. According to an announcement made by W. R. Allen, construction work on railroad, name of which will be changed to Southern Montana R.R., is to start by July 1. Road will extend from Divide through Big Hole Valley to Jackson, with branches from main line to mines in French gulch and in Elkhorn district.

Silver Bow County

PILOT-BUTTE (Butte)—A new oreshoot from 2 to 5 ft. wide, carrying 30% zinc, has been encountered on 2200-ft. level, on which middle vein is being exploited, and which carries from 5 to 9% copper. Sinking is still going on, shaft is 115 ft. below 2200-ft. level. It is expected that 2400 level will be reached in one month. Middle vein, in exploitation of which new oreshoot was encountered, is not in dispute in litigation pending between this and the Anaconda company.

NORTH BUTTE (Butte)—President's report was read at annual meeting Apr. 20, in Duluth. During year there were shipped 462,799 wet tons of ore and 71 tons of precipitates. Smelter returns show a production of 23,318,321 lb. of copper, 1,602,164 oz. of silver and 1567 oz. of gold. Net income was \$1,437,777. During year 19,499 ft. of development work was done, including 779 ft. of sinking in Granite Mountain shaft. An average of 880 men were employed at the mines and an average of 1342 tons was hoisted daily.

CORBIN (Butte)—At annual meeting held at Boston Apr. 21, plans were to be discussed for resuming active operations at Gambrinus mine, company's property in west-side residence district of Butte. At meeting ratification of acts and transactions of officers and directors were to be considered in connection with raising of \$75,000 recently borrowed to make final payment on Gambrinus claim. Permission was also to be asked to borrow additional money for development work and payment of existing debts.

BUTTE & ZENITH CITY (Butte)—Newly installed station pump is handling satisfactorily present water, amounting to 275 gal. per min. This permits steady progress in development work on 500-ft. level which so far has traversed two veins and will soon reach Paint and Corinthian veins. A 165-hp. hoist and two compressors have been installed and are ready for operation. After reaching Paint vein, crosscutting south from shaft to American vein in Jersey claim will be started as well as shaft sinking to 1000-ft. level.

BUTTE DULUTH (Butte)—Company has authorized expenditure of \$100,000 for installment of 60 additional cells in electrolytic department. Complete plans had already been prepared for new plant and as soon as advice was given that necessary funds were available, a contract was let and a large force of men put to work grading for new cell house. This, with Dorr thickeners and leaching apparatus now being installed and with new crushing plant soon to be completed, will bring entire plant up to the 1000 tons per day capacity. Electric equipment, consisting of power line, transformers, switchboard and generator is nearly completed. The d.c. generator will have a capacity of 3600 amperes at 350 volts. Superintendent Sherwood is said to estimate ore now available by open-cut method of mining at 15,000,000 tons.

EAST BUTTE (Butte)—According to report for 1913, 105,071 tons of ore were mined, milled and smelted, 71,569 tons of which were first-class ore, assaying 6.31% copper and 33.502 tons second class, assaying 2.7% copper. Net earnings amounted to \$531,772, equal to \$1.29 per share, resulting from a production of 14,401,108 lb. of copper at a cost of 11.04c. per lb. At end of 1913 company's liability exceeded its current assets by \$667,556, a decrease in liabilities of \$436,141 for year. During year surface plants were extensively improved, chiefly by increasing concentrator capacity from 300 to 600 tons per day and by an equivalent increase in smelting department and introduction of improved methods. Main shaft on Pittsmtont property was sunk 110 ft. deeper and approximately 1250 ft. of drifting was done on 1500-ft. level. Judging from last year's operations it seems quite likely that company will be able to liquidate its remaining indebtedness this year.

NEVADA**Churchill County**

NEVADA HILLS (Fairview)—Statement for March, 1914, was as follows: Tons milled, 1425; gross value, \$25,589; loss in tailings, \$3924; expenses, \$22,979; net loss, \$1314. Small tonnage milled was due to shortage in water supply. New pipe line was completed Apr. 10, and put in operation. Mill is now treating 140 tons daily. Sinking in main shaft is nearly completed, and station is being cut on 800-ft. level.

Elko County

OIL EXCITEMENT SOUTH OF ELKO recently resulted in staking of 8580 acres. Drilling has been done before, but operations were not carried to sufficient depth. Geological map of this district is being made by George J. Shoup for Ely men.

Esmeralda County

NEW JERSEY MINES CO. (Goldfield)—A 40-hp. electric hoist will be installed and a shaft will be sunk from 400- to

600-ft. level. South crosscut on 400-ft. level has cut vein which is 27 ft. wide, and drifting west is in progress.

BOOTH MINING CO. (Goldfield)—Assessment of 2c. per share has been levied. Development work during last year amounted to 1360 ft., and consisted in sinking shaft from 300- to 500-ft. level, crosscut on this level to vein, also winze and raise from this level. Oreshoots assaying from \$3 to \$25 were cut; at one place 8½ ft. of \$12 ore was opened.

Lander County

GLASGOW & WESTERN (Battle Mountain)—It is authoritatively denied that judgment has been handed down in case of Glasgow & Western vs. Scott, Davis, Healy and Van Normand, over title to Homestake and Guy Davis placer claims as reported in these pages, issue of Apr. 18.

Lyon County

BOWEN & MARCHI (Silver City)—This leasing company recently shipped bar of bullion weighing 200 oz. from clean-up at Hamilton-Pollard mill.

Nye County

NEW DEVELOPMENT IN WEST TONOPAH DISTRICT is under way. Merger, Victor and Cash Boy mines have increased forces. Pumping plant of Merger has been moved to Victor shaft, where an additional pump has been installed, making total capacity 400,000 gal. per day. Crosscut will be driven from Victor shaft to second new oreshoot discovered recently, and shaft will be sunk to 1550-ft. level. Merger is crosscutting for new vein from 1170-ft. level. Victor pumping plant may also benefit Midway, which has struck water level. Drifting west in this mine is being done in oreshoot assaying \$7 to \$10.

PIONEER CONSOLIDATED MINING CO. (Pioneer)—A 6-ft. Huntington mill will be installed at once in 10-stamp mill. Mill is now treating 30 tons per day.

SULLIVAN & LONN (Millett)—Winze from "C" level has cut shoot of good-grade ore. Operations have been suspended at this point and tunnel is being driven to cut shoot 100 ft. deeper.

BATH LEASE (Manhattan)—Development work in good-grade ore is being done. Electric sinking pump is lifting 50,000 gal. per day, and this water is being used in placer operations on north slope of Litigation Hill.

MANHATTAN CONSOLIDATED (Manhattan)—Ore from development is being hoisted; drifting on ore in three places being in progress. On 200-ft. level, south drift is in ore assaying \$32. Chutes are being built where raises will be driven. Flow of water is decreasing and station pump is being installed on 200-ft. level so that use of sinking pump can be discontinued.

NEW MEXICO**Eddy County**

ARTESIA COPPER CO. (Artesia)—Sale of mine of this company to E. C. Higgins, N. M. Schester and H. Rohrbough has been reported. A rate of \$5 per ton has been secured to El Paso smelter and regular shipments are expected to be made.

SEVEN RIVERS OIL & GAS CO. (Lakewood)—Prospects for striking either oil or gas are reported as favorable. Drill is down 1000 ft. Oil indications have been strong since first 100 ft. were penetrated. Company is operating at Oil City west of Lakewood.

Grant County

NOVEMBER MINING CO. (Steins)—Company is working newly discovered zinc-carbonate ore.

C. & O. (Pinos Altos)—Suit of C. & O. vs. Bell & Wright for alleged operations on ground under lease by former company, has been settled out of court.

CHINO COPPER CO. (Santa Rita)—Concrete work on crushing plant is progressing rapidly. Two steam shovels are in operation at east entrance to Hearst cut.

STEEPLE ROCK DEVELOPMENT CO. (Steeple Rock)—Properties of this company have been acquired by George H. Utter. Property includes 33 patented claims and a mill site. Deal includes Carlisle group and Jim Crow group, which have been large producers. Ores are complex.

Otero County

TULAROSA COPPER CO. (Bent)—Negotiations are under way for resumption of operations of mine and mill.

Socorro County

ALBERTA DEVELOPMENT CO. (Mogollon)—Arrangements have been made to start regular shipments to custom mill of ore extracted in development.

NEW YORK

INTERNATIONAL SMELTING & REFINING CO. (42 Broadway)—Notice has been sent to stockholders of a special meeting to be held May 26; purpose of meeting being to determine whether a sale and transfer of all properties, business, assets and rights of company shall be made to Anaconda Copper Mining Co. and upon what terms and conditions such sale and transfer shall be made, if authorized. Stockholders will also be asked to vote whether or not company shall be dissolved and business and affairs settled up and adjusted and distribution made to its stockholders.

Herkimer County

GULF MINES CO. (Salisbury)—Company was recently incorporated at Albany with capital stock of \$370,000, to engage in prospecting. Philadelphia men are interested in concern, which has been busy for some time in procuring samples of sand from lands nearby and having samples tested to see if they would produce gold in sufficient quantity to encourage extensive operations. Options have also been secured on various lands in town of Salisbury and in western end of Herkimer County. [Everytime we hear of gold in New York State we think of the elusive gold of the Adirondacks that cannot be found by assay, only by Spanish or other dips.]

OREGON

OREGON BUREAU OF MINES AND GEOLOGY will publish before end of year, 12 principal reports, besides numerous small ones on investigations made in 1913 and 1914. They will deal with building stones, coal resources, clay and clay products, metal mining industry, cement materials and road materials. Bureau was organized June 3, 1913, and most of summer of 1913 was utilized in field work. Coal, oil and gas resources of John Day valley in central Oregon were investigated by Arthur J. Collier and party. This work was carried on in cooperation with Federal survey. Ira A. Williams, ceramist for bureau, is investigating clays of state. Samples of brick of different grades and of drain tile are being collected and complete strength tests will be made. Attention is being given to reported occurrences of clays that may be found suitable for making higher grades of clayware, such as are used in large quantities, but not manufactured in the state. Solon Shedd is making a large relief map of the state. It will show, on horizontal scale of four miles per inch, mountains, valleys and streams in actual relief. George D. Louderback is correlating scattered geological data which has been published. Bureau has made an inventory of quarries, which are more or less developed. There were three parties in metal-mining districts gathering information. Sumpter quadrangle is a rectangle in western part of Baker County, 25 miles east and west by 35 miles north and south, with Sumpter nearly in its center. In 1903 U. S. Geological Survey began a survey of this quadrangle. During 1913 this survey was continued by Government in cooperation with state bureau. The 73 metal mining districts in state cover such a large area that it was impossible with appropriation at hand to do sufficient geological work in each to be of much value.

WASHINGTON

Ferry County

SAN POIL (Republic)—Mine and mill have been sold to the Knob Hill and Hope companies for \$170,000.

WISCONSIN

Zinc-Lead District

LOOMIS (Platteville)—A sinking plant has been installed at this prospect and good ore encountered in shaft.

CLEVELAND MINING CO. (Hazel Green)—Company has resumed work of mill construction on Lawrence property.

CROW BRANCH (Livingston)—A good strike of lead and zinc ore was made in shaft at depth of 76 ft. at this new prospect.

WISCONSIN ZINC CO. (New Diggings)—Shaft has been sunk to orebody on Champion property and construction of a 150-ton mill has been started. The Champion lease north-east of New Diggings, has shown high-grade zinc cuttings in a number of borings.

UTAH

Juab County

TINTIC SHIPMENTS for week ended Apr. 17 were 136 cars as compared to 131 the week preceding.

KNIGHT-CHRISTENSEN MILL (Silver City)—Roaster, which is in operation is not expected to give any further trouble. Some changes and adjustments are to be made in filtering tanks.

EUREKA HILL (Eureka)—An option has been taken on this company's tailings dump by Campbell & Dull, who may treat part of it by cyaniding. Tests have been made. Tailings dump which is largest in Tintic district, contains 200,000 tons, which according to company's records carries 5 oz. silver, with a little gold and lead.

Salt Lake County

THERE HAS BEEN BUT ONE SNOWSLIDE of importance during past season. Precipitation has been about normal, but heavy snowstorms were followed by warm weather, followed by freezing and subsequent packing of snow and ice. Lessees are working at many properties, and a good tonnage is expected for coming summer.

OHIO COPPER (Bingham)—Orders have been placed for new equipment, which is expected to arrive during June. With new machinery mill should treat 3000 tons daily or more. Change, it is expected, will be completed, and new equipment installed by August.

UTAH COPPER CO. (Bingham)—A 10,000-ton leaching plant for treatment of oxidized capping has been authorized; will cost \$2,000,000. Work on first unit of 2000 tons capacity will be started in two or three months and should be completed in 1915; entire plant will be completed two years later. Capping, of which there is 40,000,000 tons contains $\frac{3}{4}$ % copper.

BINGHAM MINES (Bingham)—Ore has been opened on 500-, 800- and 1100-ft. levels of this company's Yosemite mine at Bingham. Best showing is on 800, where vein carries 3 ft. of ore running well in lead, with some silver. The Dalton & Lark is producing 50 tons of lead ore daily, and the Commercial 50 to 100 tons of copper ore. At the latter mine a raise is being driven from Niagara tunnel to connect with old workings. This work will provide needed ventilation. Development is being done in new territory.

Summit County

PARK CITY SHIPMENTS for week ended Apr. 17 amounted to 2,193,080 lb.

SILVER KING CONSOLIDATED (Park City)—Efforts are being made to open wagon road so that shipments can be resumed. Bins are full, and ore has been stored in mine workings.

GRASELLI MILL (Park City)—Work of renovating this mill by a new company is in progress. Some new machinery has arrived, and will be installed. Changes are being made in expectation of treating ore from American Flag and other properties.

CANADA

British Columbia

ATLIN PLACERS—North Columbia Gold Mining Co. and the O'Donnell Placer Co. will employ 150 men this season.

Ontario

HOLLINGER RESERVE (Timmins)—Option held by General Development Co. will not be exercised. Mill run of 200 tons showed ore of much lower grade than was anticipated by previous samplings.

BEAVER (Cobalt)—Annual report for year ended Feb. 28, 1914, shows a production of 762,698 oz., valued at \$438,552. Ore reserves are estimated at 30,000 tons, underground averaging 30 oz. and 15,000 on dump averaging 20 oz. No estimate regarding ore in place is given.

LA ROSE (Cobalt)—Annual report shows that during last year, production fell below that of Princess and Lawson and nothing of much importance has been developed. High-grade ore on property is estimated at 417,000 oz. and unless work on 380-ft. level shows favorable results, outlook is not promising. Lawson produced 708,000 oz. in 1913 and reserves are estimated at 125,000 oz. A new vein has been penetrated by a crosscut on 180-ft. level and shows some ore. Princess produced 909,000 oz. and during year three new veins were developed. Only ore in reserve is on vein No. 12, which has a shoot of high-grade $1\frac{1}{2}$ in. wide and 120 ft. long above 132-ft. level. Production for year was 2,636,000 oz. at a cost of 22.8c. per oz. Combined surplus of old and operating companies is \$1,602,005. Ore reserves are 700,000 oz. less than last year.

NIPissing (Cobalt)—Report for 1913 shows a total production of silver 4,552,173 oz., valued at \$2,756,612. Gross receipts were \$2,804,093 and net receipts \$1,645,108. Expense of production was 24.01c. per oz., which is 6.74c. more than in 1912. This increased cost was due to fact that half the silver was produced from milling ore and on account of lower average grade of ore. Known ore reserves are estimated at 9,510,000 oz., half of which is high grade. Surplus is \$1,259,061. Company received \$26,183 for sales of Cobalt and nickel residues. High-grade mill treated 1200 tons of Nipissing ore averaging 2501 oz. per ton and 632 tons of customs ore averaging 2854 oz. per ton. Low-grade mill treated 77,133 tons averaging 27.18 oz. per ton, making a recovery of 91.85%. Net value of silver produced was somewhat below dividend requirements. Since then, dividend has been cut from 30 to 20% per annum.

MEXICO

Aguascalientes

AMERICAN SMELTING & REFINING CO. (Aguascalientes)—The local and all other plants in Mexico were closed down the week of Apr. 19-25, and American employees of company were ordered to leave country. Company has decided to suspend all operations in Mexico until hostilities in that country are ended. Company had a greater number of employees on its properties in Mexico than any other American corporation. When working its plants at full capacity it has had close to 50,000 men. Since Madero revolt, however, there have been few times when plants could be worked close to capacity. Despite handicaps of revolutions, company has been able to do much work. Some of its largest properties are in territory in which there was recent heavy fighting between federals and rebels under Villa. Villa on occupying different important centers had immediately allowed resumption of operations by plants of several important companies, those of A. S. & R. Co. being particularly favored. There have been reports, however, that Villa followed lines of procedure so common in Latin-American countries of exacting heavy tribute before permitting such resumption of work. With exception of unskilled laborers, majority of employees are Americans. Hundreds of these quit country in last few years. On Apr. 20 there began an exodus of remaining Americans at company's plants at Chihuahua for El Paso, which many have already reached. Late last week scores left Aguascalientes for Vera Cruz by way of Mexico City. They are probably now in Mexico City. Officials have little expectation that properties will remain unscathed. Company is controlled by Guggenheim interests, against which much bitterness has been shown in Latin-American countries, particularly in Mexico. Latest reports are that some 30 Americans mostly smelter employees, attempted to reach Mexico City from Aguascalientes, thence to go to Vera Cruz. They were stopped at Encarnacion, taken back to Aguascalientes and held prisoners at the smelting plant, press dispatches stating they were finally released on payment of a ransom of 250,000 pesos worth of bullion.

Hidalgo

UNITED STATES SMELTING, REFINING & MINING CO. (Real del Monte and Pachuca)—Orders have been given to Mexican management to use own judgment in regard to closing down operations.

Sonora

HELPS-DODGE (Nacozari)—Constitutionalists' representatives suggested that American employees leave just after Carranza statement was promulgated.

GREENE-CANANEA (Cananea)—Mines and works have been closed down. Americans have left country, stores, mines and working now being in charge of Mexican caretakers.

COLOMBIA

PATO MINES, LTD. (Zaragoza)—Little washing has been done since early in March when dredge got into a clay bank and lost pond water. It is understood that rains have started and that dredge will resume as soon as sufficient water has accumulated.

TRANSVAAL

GOLD PRODUCTION in the Transvaal in March is reported at 686,801 oz., which is 40,540 oz. more than in February, but 103,751 oz. less than in March, 1913. For the three months ended Mar. 31, the total was 2,314,064 oz. in 1913, and 1,964,815 oz.—or \$40,612,726—in 1914; a decrease of 349,249 oz., or 15.1%, this year.

The Market Report

METAL MARKETS

NEW YORK—Apr. 29

The metal markets still remain rather quiet, or at least with no special activity. Prices have been variable within rather narrow limits.

Copper, Tin, Lead and Zinc

Copper—The hysterics of last week affected not only the stock market, but also the copper market and on Apr. 23-25 sales were made at 14½c., delivered, usual terms, equivalent to about 13.97½c., cash, New York, the lowest point of the last downward movement. Several millions of pounds were reported sold at that price. It is not unlikely that even a lower price would have been accepted if business had come in sight. In general, however, buyers held aloof, domestic consumers being apparently of the expectation that the metal would break through 14c., delivered to them.

On Apr. 27 there was a distinctly better feeling because of the improvement in the Mexican situation and Europe became a very substantial buyer, one of the large producers taking considerable business at about 14.15c., delivered. The European demand increased on Apr. 28 and there was also some domestic demand, and large transactions were consummated at 14.25c., delivered, usual terms, the largest producers meeting the market at that figure. Good business was done at about the same price on Apr. 29.

The average of quotations for the week is 14.025 cents. The London market, on Thursday, Apr. 23, was £63 15s. for both spot and futures. On Monday, Apr. 27, it advanced to £64 3s. 9d. for spot and £64 5s. for futures, closing on Wednesday, Apr. 29, at £64 2s. 6d. for spot and £64 5s. for three months. The market has been moderately active, with some bear buying.

Base price of copper sheets is now 19¼c. per lb. for hot rolled and 20¼c. for cold rolled. The usual extras are charged and higher prices for small quantities. Copper wire is 15@15½c. per lb., carload lots at mill.

Copper exports from New York for the week were 6188 long tons. Our special correspondent reports exports from Baltimore for the week at 3390 tons.

Imports of copper into France three months ended Mar. 31 were 27,664 tons, an increase of 8258 tons over last year.

Tin—On Apr. 23, the critical situation in Mexico led to general selling of tin in all quarters of the world, in consequence of which the London market declined over £5, spot being quoted £154 5s. and three months £156 5s. In this country, tin was quoted 34¼c. On Thursday, Apr. 24, there was a general disposition to take advantage of the low prices, and in consequence the market abroad advanced to £158 for spot and £160 for three months, and over here to 34¼c. Better prospects with respect to Mexico did not make much of an impression on the tin market, which on Monday, Apr. 27, declined to £157 for spot and £159 for three months. The market continued to fluctuate around these figures, and on Wednesday, Apr. 29, closes at £157 15s. for spot and £159 10s. for three months, with tin in this country selling at 34¼ cents.

Lead—Beginning last Thursday there was an improvement in the lead market and both producers and dealers found themselves able to make sales on the basis of 3.70c. for Missouri brands at St. Louis, buyers apparently having made up their minds that lead was low enough and that conditions in Mexico were about to strengthen the situation in our markets. On Apr. 27, the A. S. & R. Co. raised its price to 3.90c., New York, and outsiders immediately became able to realize 3.80c., St. Louis.

The London market is firmer, Spanish lead being quoted £19; English lead 7s. 6d. higher.

Exports from Baltimore last week included 392,382 lb. lead to Holland.

Spelter—Right through the week spelter was offered at St. Louis at 4.87½c., more being offered at that price than could be sold. The natural result was a further recession in

price and during the last three days sales were reported at 4.85c., St. Louis.

At London, good ordinaries are quoted £21 7s. 6d.; specials £21 15s. per ton.

Base price of zinc sheets is now \$7 per 100 lb. f.o.b. Peru, Ill., less 8% discount, with the usual extras.

Exports from Baltimore last week included 5076 slabs of spelter to Copenhagen, Denmark.

The roasting plant of the new works of the American Zinc & Chemical Co., at Langeloth, Penn., will be ready to start about June 10. The distillation furnaces will be completed later. The company is already contracting for ore supplies.

DAILY PRICES OF METALS

NEW YORK

Apr.	Sterling Exchange	Silver	Copper		Tin Cts. per lb.	Lead		Zinc	
			Lake, Cts. per lb.	Electrolytic, Cts. per lb.		New York, Cts. per lb.	St. Louis, Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.
23	1.8740	58½	*14.50	13.95 @ 14.00	34½	3.80	3.67 @ 3.72	5.00 @ 5.02	4.85 @ 4.87
24	1.8745	58½	*14.50	13.95 @ 14.00	34½	3.80	3.67 @ 3.72	5.00 @ 5.02	4.85 @ 4.87
25	1.8760	59	*14.50	13.95 @ 14.00	34½	3.80	3.67 @ 3.72	5.00 @ 5.02	4.85 @ 4.87
27	1.8750	59½	*14.50	13.95 @ 14.00	34½	3.90	3.80 @ 3.92	5.00 @ 5.02	4.85 @ 4.87
28	1.8765	59½	*14.50	14.05 @ 14.15	34½	3.90	3.80 @ 3.92	5.00 @ 5.02	4.85 @ 4.87
29	1.8735	59	*14.50	14.10 @ 14.15	34½	3.90	3.80 @ 3.92	5.00 @ 5.02	4.85 @ 4.87

*Nominal.

The quotations herein given are our appraisal of the markets for copper, lead spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.15c. apart. 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; of casting copper 0.15 to 0.25c. below. The quotations for lead represent wholesale transactions in the open market for good ordinary brands; 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.

Some current freight rates on metals per 100 lb., are: St. Louis-New York, 15c.; St. Louis-Chicago, 6c.; St. Louis-Pittsburgh, 12c.; New York-Bremen or Rotterdam, 15c.; New York-Havre, 16@17c.; New York-London, 16c.; New York-Hamburg, 18c.; New York-Trieste, 22c.

LONDON

Apr.	Silver	Copper				Tin		Lead		Zinc	
		£ per Ton	Cts. per lb.	3 Mos.	Best Sel'd	Spot	3 Mos.	£ per Ton	Cts. per lb.	£ per Ton	Cts. per lb.
23	26 1/8	63 1/2	13.85	63 1/2	68 1/2	159 1/2	161 1/2	18	3.91	21 1/2	4.70
24	26 1/8	63 1/2	13.74	63 1/2	68 1/2	155 1/2	157 1/2	18 1/2	3.94	21 1/2	4.70
25	27 1/8	63 1/2	13.95	64 1/2	68 1/2	158 1/2	160	18 1/2	4.07	21 1/2	4.70
27	27 1/8	63 1/2	13.85	64	68 1/2	157	159	19	4.13	21 1/2	4.67
28	27 1/8	64 1/2	13.93	64 1/2	68 1/2	157 1/2	159 1/2	19	4.13	21 1/2	4.64

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 latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17c.; £15 = 3.26c. = £25 = 5.44c.; £70 = 15.22c. Variations, £1 = 0.21c.

Exports and Imports of Metals in the United States, two months ended Feb. 28, as reported by the Bureau of Statistics, Department of Commerce:

	Exports		Imports	
	1913	1914	1913	1914
Copper, long tons.....	63,301	81,876	32,331	29,031
Tin, long tons.....	101	93	7,437	6,700
Lead, short tons.....	6,741	1,529	17,887	2,234
Zinc, short tons.....	240	276	5,498	161
Nickel, lb.....	5,290,042	4,913,547	8,778,785	7,405,859
Antimony, lb.....	30,413	.....	4,062,073	2,256,789
Aluminum, lb.....	11,107	.....	5,172,107	2,501,041
Quicksilver, lb.....	11,095	2,633	.....	.....
Platinum, oz.....	250	115	21,447	11,491
Ores, etc.:				
Zinc ore, tons.....	3,036	1,405	10,231	2,437
Zinc in ore, lb.....	264,320	.....	11,589,918	2,038,973
Zinc dross, lb.....	48,690	80,014	.....	.....
Zinc dust, lb.....	59,606	19,612	827,588	1,262,704
Zinc oxide, lb.....	5,183,981	5,241,550	.....	.....

Copper, lead, nickel and antimony include metallic contents of ore, matte, etc. Quantity of antimony ore is not reported. Exports include reexports of foreign material. In addition to the metallic aluminum given above, manufactures of aluminum were exported to the value of \$107,014 in 1913 and \$121,649 this year.

Other Metals

Aluminum—Business has been quiet and the market is rather weaker. No. 1 ingots are quoted at 18@18¼c. per lb., New York. There are reports of lower prices, but they do not seem to be confirmed.

Antimony—The market has been quiet, with only a moderate business. Cookson's is still quoted at 7.20@7.50c. and Halllett's at 6.90@7.10c. per lb. Hungarian, Chinese and other outside brands are weaker all around and 5.75@6c. per lb. is named.

Quicksilver—Trade continues fair and prices are unchanged. New York quotations are \$38 per flask of 75 lb. for large lots and 54c. per lb. for jobbing orders; San Francisco, \$38 for domestic orders, and special terms—usually about \$2 less—for export. The London price is £7 per flask with £6 17s. 6d. asked from second hands.

Magnesium—The current quotation for pure metal is \$1.50 per lb. for lots of 100 lb. or over, at New York.

Gold, Silver and Platinum

Gold—The demand for gold on the open market in London is still strong, although Russia was not quite as active a taker as in recent weeks. For one or two days a premium of ½d. was paid, but for most of the week the price was 77s. 9d. per oz. for bars. In New York, sterling exchange has been up to a point which caused some talk of gold exports, but none have been made.

Iridium—No change is reported in this metal. Quotations are still \$75@78 per oz., New York.

Platinum—The market is quiet but is rather firmer than it was, and prices are unchanged. Dealers ask \$43@44 per oz. for refined platinum and \$46@49 for hard metal. The foreign market is steady.

Silver—The market has been strong, and with an advancing tendency reaching 27¼d. in London, and closing very little below that point. Supplies are likely to be scarce, owing to the Mexican trouble.

Shipments of silver from London to the East, Jan. 1 to Apr. 15, as reported by Messrs. Pixley & Abell:

	1913	1914	Changes
India.....	£2,501,300	£2,096,500	D. £404,800
China.....	166,000	40,000	D. 126,000
Total.....	£2,667,300	£2,136,500	D. £530,800

Exports of gold to India for the week were £306,000, an unusually large amount.

Zinc and Lead Ore Markets

JOPLIN, MO.—Apr. 25

Blende sold as high as \$43, the assay base ranging from \$37@40 and the metal base from \$35@37 per ton of 60% zinc. Calamine sold at \$20@22.50 per ton of 40% zinc. The average price of all grades of zinc, on account of the heavy calamine shipment, was reduced to \$35.36 per ton. Lead sold at \$47 on a base of \$45 per ton of 80% metal content, and the average of all grades is \$45 per ton.

There is a growing sentiment favorable to a cessation of operations on the part of many producers unless a better tone comes to spelter and ore prices. Buyers of high-grade ores admitted this week that the price of spelter did not warrant

the prices paid, but considered it wise to make no further reduction.

SHIPMENTS WEEK ENDED APR. 25

	Blende	Calamine	Lead	Value
Totals this week..	11,951,670	1,212,960	2,233,560	\$283,030
Totals 17 weeks..	177,597,520	11,400,390	30,333,350	4,378,435
Blende value, the week,	\$219,850; 17 weeks, \$3,505,430.			
Calamine value, the week,	\$12,885; 17 weeks, \$128,625.			
Lead value, the week,	\$50,295; 17 weeks, \$744,375.			

PLATTEVILLE, WIS.—April 25

The base price paid this week for 60% zinc ore was \$39@39.50 per ton. Lead sales were heavy in spite of the low price of \$46@48 per ton for 80% ore.

SHIPMENTS WEEK ENDED APR. 25

	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Week.....	3,503,660	640,400	717,900
Year.....	47,862,040	2,012,270	15,308,430

Shipped during week to separating plants, 2,417,200 lb. zinc ore.

MONTANA ZINC ORES

A new supply of zinc ore will come into the market when the Timber Butte Milling Co., of Butte, Mont., begins operations early in June. This output will be handled by Beer, Sondheimer & Co., of New York.

IRON TRADE REVIEW

NEW YORK—Apr. 29

The markets are generally reported unchanged from last week. New orders are small and there is some disposition to draw in. The war excitement has had rather an unfavorable effect upon the whole.

No material changes in price are reported. Unless new orders increase, there is not likely to be much bidding for them.

The pig-iron market is still quiet and uneven. Orders are generally small, and business is on a moderate scale.

It is reported that the Pennsylvania R.R. Co. has given an option on the stock which it owns in the Pennsylvania Steel Co. to W. H. Donner, who represents owners of a majority interest in the Cambria Steel Co. This would point to a probable union of these two large independent steel concerns.

The United States Steel Corporation reports results of its business for the quarter ended March 31 as below; net earnings including surplus over operating expenses and ordinary renewals:

Net Earnings	1913	1914
January.....	\$11,342,533	\$4,941,337
February.....	10,830,051	5,655,611
March.....	12,254,217	7,397,433

Quarter..... \$34,426,801 \$17,994,381

Depreciation and sinking funds..... \$5,798,023
Interest, etc., on bonds..... 5,827,302

Total charges..... \$11,625,325

Surplus for the quarter..... \$6,369,056
Dividends declared..... 12,658,700

Deficit for the quarter..... \$6,289,644

Dividends declared were 1¼% on preferred stock, taking \$6,304,919, and 1¼% on common, \$6,353,781. The net earnings were \$16,432,420 less than in the first quarter of 1913, but \$167,408 more than in the first quarter of 1912. The unfilled orders on hand March 31 were 4,653,825 tons.

PITTSBURGH—Apr. 28

Forecasts of \$18,000,000 as the earnings of the U. S. Steel Corporation in the first quarter have been closely confirmed by the official report of \$17,994,381. The showing is neither better nor worse than was indicated by a survey of trade conditions. Earnings are probably now running at the rate of about \$7,000,000 a month.

There has been a slight further decrease in steel production, but the industry as a whole is still running at about 65% of capacity.

The Bessemer department of the Republic Iron & Steel Co. at Youngstown, which was closed last week, is still idle, but will probably resume very shortly. The openhearth department is operating nearly full. The National Tube Co. will close its entire Riverside plant, Wheeling, May 1, this plant having about 15% of the company's entire capacity. The closing includes blowing out Benwood blast furnace at Wheeling, while one McKeesport and one Lorain stack of the company are also going out.

ECONOMIC GEOLOGY—GENERAL

- 25,117—**GEOLOGIC REPORTS**—Field and Office Methods in the Preparation of Geologic Reports. F. W. Moon. (Econ. Geol., Dec., 1913; 8 pp., illus.) 60c.
- 25,118—**GEOLOGIC REPORTS**—Field and Office Methods in the Preparation of Geologic Reports. W. H. Tomlinson. (Econ. Geol., Jan., 1914; 11 pp., illus.) Deals with commercial petrographic reports. 60c.
- 25,119—**LATERIZATION** in Minas Geraes, Brazil. J. H. Goodchild. (Bull. Nos. 113 and 114, I. M. M., 1914; 24 pp.) Contributed remarks and authors' reply to discussion.
- 25,120—**MAPPING**—Field and Office Methods in the Preparation of Geologic Reports. Sidney Paige. (Econ. Geol., Mar., 1914; 6 pp., illus.) 60c.
- 25,121—**NEW ZEALAND**—List of the Minerals of New Zealand. P. G. Morgan and J. A. Bartrum. (New Zealand Dept. of Mines, 1913; 32 pp.)
- 25,122—**ORE DEPOSITION**—Formation of Mineral Deposits: Precipitation and Stratification in the Absence of Gels. W. P. Dreaper. (Bull. I. M. M., Nos. 113 and 114, 1914; 16 pp.) Original paper and discussion.
- 25,123—**ORE DEPOSITION**—Origin of Orebodies in Replacement Veins of Northern Gilpin. Clyde M. Becker. (Min. Sci. Jan., 1914; 1 p.) 20c.
- 25,124—**ORE DEPOSITS**—Certain Phases of Superficial Diffusion in Ore Deposits. R. A. F. Penrose, Jr. (Econ. Geol., Jan., 1914; 5 pp.) 60c.
- 25,125—**OUTCROPS**—Locating Outcrops with a Transit. Walter S. Weeks. (Eng. and Min. Journ., Apr. 4, 1914; 2 pp., illus.) 20c.
- 25,126—**SECONDARY ENRICHMENT**—Upward Secondary Sulphide Enrichment and Chalcocite Formation at Butte, Montana. Austin F. Rogers. (Econ. Geol., Dec., 1913; 14 pp., illus.) 60c.
- 25,127—**STRIKE AND DIP**, Calculation of. Theodore Simons. (Eng. and Min. Journ., Apr. 11, 1914; 2½ pp., illus.) 20c.

MINING—GENERAL

- 25,128—**ACCIDENT PREVENTION** in Mining. Edward Ryan. (Min. and Sci. Press, Mar. 21, 1914; 1¼ pp.) 20c.
- 25,129—**ACCIDENTS**—Metal-Mine Accidents in the United States During the Year 1912. Albert H. Fay. (U. S. Bureau of Mines, 1913; 76 pp., illus.)
- 25,130—**BOSNIA**—Bergbau und Hüttenwesen in Bosnien und der Herzegowina. P. Martell. (Centralbl. d. H. u. W., Jan. 5, 1914; 1 p.) 40c.
- 25,131—**DRILL STEEL**—Some Smithy Appliances. A. Livingston Oke. (Eng. and Min. Journ., Apr. 18, 1914; ¾ p., illus.) 20c.
- 25,132—**DRILLING**—Deep Diamond-Drill Hole with Light Equipment on Mesabi Range. P. W. Donovan. (Eng. and Min. Journ., Mar. 28, 1914; ½ p.) 20c.
- 25,133—**DRILLING**—Improved Sludge Box for Diamond Drilling. George S. Rollin. (Eng. and Min. Journ., Mar. 28, 1914; ¾ p., illus.) 20c.
- 25,134—**EXPLOSIONS**—Lower Limits of Combustible and Explosive Mixtures of Gases and Air. E. E. Sommermeier. (Journ. Ind. and Eng. Chem., Mar., 1914; 7 pp.) 60c.
- 25,135—**EXPLOSIVES**—Hints to Handlers of Explosives. W. J. Olcott. (Min. and Eng. Wld., Dec. 27, 1914; 1½ pp.) 20c.
- 25,136—**EXPLOSIVES**—Production of Explosives in the United States During the Calendar Year 1912. Albert H. Fay. (Tech. Paper 69, U. S. Bureau of Mines, 1914; 7 pp.)
- 25,137—**EXPLOSIVES**—Recent Developments in Commercial Explosives. E. A. LeSueur. (Journ. Ind. and Eng. Chem., Mar., 1914; 2 pp.) 60c.
- 25,138—**FILLING ORE SACKS**, A Device for. T. R. Archbold. (Bull. 113, I. M. M., Feb. 12, 1914; 3 pp., illus.)
- 25,139—**HOISTING**—Electric Winding. James Gillespie. (Iron and Coal Tr. Rev., Jan. 9, 1914; 1½ pp., illus.) Paper before Assn. of Min. Elec. Engrs. 40c.
- 25,140—**HOISTING ROPES**—Ergebnisse der preussischen Seilstatistik für das Jahr 1912. F. Bürklein. (Glückauf, Mar. 14, 1914; 7 pp.) Results of the Prussian rope statistics for 1912. 40c.
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- 25,142—**MINE FILLING**—The Sand Filling of Mines. W. A. Caldecott and O. P. Powell. (Journ. Chem. Met. and Min. Soc. of So. Afr., Dec., 1913, and Feb., 1914; 5 pp., illus.) Discussion of paper previously indexed. 60c.
- 25,143—**MINE WATERS**—The Determination of the Acidity or Alkalinity of Waters—A Study in Indicators. (Journ. Chem., Met. and Min. Soc. of So. Afr., Dec., 1913; 2½ pp.) Discussion of paper previously indexed.
- 25,144—**MODEL**—A Mining Model to Illustrate Workings at Charters Towers, Queensland. E. O. Marks. (Bull. 113, I. M. M., Feb. 12, 1914; 5 pp., illus.)
- 25,145—**ORE PASSES**—Cylindrical Wooden Ore Passes. Andrew Fairweather. (Proc. Aust. Inst. Min. Engrs., No. 12, 1913; 22 pp., illus.)
- 25,146—**PERU**—Mining in Peru in 1913. Lester W. Strauss. (Min. and Sci. Press, Feb. 28, 1914; 4½ pp.) 20c.
- 25,147—**PROSPECTING**—What is the Matter With Prospecting? Rejoinder to "Symposium" previously published. (Min. and Sci. Press, Feb. 28, 1914; 4½ pp.) 20c.
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- 25,149—**SAFETY**—A System of Mine Discipline and Bonus. J. H. Eby. (Min. and Eng. Wld., Feb. 28, 1914; 1¼ pp.) 20c.
- 25,150; **SAFETY**—Mine Safety in Southeastern Alaska.

- Frederick L. Hoffman. (Eng. and Min. Journ., Mar. 28, 1914; 2¾ pp.) 20c.
- 25,151—**SHAFT GUIDES**—Cast-Iron Brackets or Chairs for Center-Guide (or Runner) Supports in Kintore Shaft, Central Mine, Broken Hill, N. S. W. N. J. Roberts. (Proc. Aust. Inst. Min. Engrs., No. 12, 1913; 12 pp., illus.)
- 25,152—**SIGNALING**—Simple Electric Signaling System at Rosiclare, Ill. H. R. Wass. (Eng. and Min. Journ., Mar. 28, 1914; ¾ p., illus.) 20c.
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- 25,161—**CONCENTRATION** of Complex Sulphide Ore from the Mary Murphy Mine. Dyke V. Keedy. (Met. and Chem. Eng., Mar., 1914; 4¼ pp.) 40c.
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METALLURGY—GENERAL

- 25,170—**ALLOYS**—Report of Work Done at the Bureau of Standards, Pittsburgh, Penn., on Non-Ferrous Alloys During 1913. C. P. Karr. (Am. Inst. of Met., 1913; 32 pp., illus.)
- 25,171—**ALLOYS**—The Non-Ferrous Alloy Test Specimen Question. V. Skillman. (Am. Inst. of Met., 1913; 12 pp.)
- 25,172—**BELGIUM**—Belgiens Berg- und Hüttenwerksproduktion im Jahre 1912. (Oest. Zeit. f. B. u. H., Jan. 21, 1914; 2 pp.) 40c.
- 25,173—**BRASS MELTING**—The Hering Electric Furnace for Commercial Brass Melting. G. H. Clamer. (Am. Inst. of Met., 1913; 8 pp.)
- 25,174—**CORROSION**—The Micro-Chemistry of Corrosion, Part II. The a-Alloys of Copper and Zinc. Samuel Whyte and Cecil H. Desch. (Advance copy, Inst. of Metals, Mar., 1914; 13 pp., illus.)
- 25,175—**FLAMELESS SURFACE COMBUSTION**. W. A. Bone. (Engineer, Mar. 13, 1914; 1¼ pp., illus.) Lecture before Royal Institution. 40c.
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- 25,177—**FLUORITE** in Smelting. Herbert Lang. (Min. and Sci. Press, Mar. 21, 1914; ¾ p.) 20c.
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- 25,179—**REFRACTORIES**—Die Prüfung feuerfester Steine. Gary. (Feuerungstechnik, Mar. 1 and 15, 1914; 7¼ pp., illus.) Testing refractory bricks. 80c.
- 25,180—**REFRACTORIES**—High-Temperature Resistivity of Refractories; a New Method of Measuring with Results for Alundum. Edwin F. Northrup. (Met. and Chem. Eng., Feb., 1914; 2½ pp., illus.) 40c.
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FUELS

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- 25,185—BRIQUETTING—Fuel Briquetting in 1913. Edward W. Parker. (Advance copy, Mineral Resources of the U. S., 1914; 8 pp.)
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- 25,190—OIL-FUEL AND WASTE HEAT. Arthur E. Williams. (Min. Mag., Feb., 1914; 2 pp.) A study of thermal efficiency in connection with the utilization of waste heat of reverberatory furnaces for steam-raising purposes. 40c.
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- 25,193—TESTING OF COAL for Purchase. J. M. Goldman. (Journ. Assn. Eng. Soc., Jan., 1914; 20 pp.) 60c.
- 25,194—WASTE HEAT—Abwärmeverwertung von Gasmaschinen für Fernheizung. (Stahl u. Eisen, Feb. 19, 1914; 3 pp., illus.) Utilization of waste heat from gas engines for long-distance hot-water-heating plants. 40c.

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- 25,199—ELECTRIC FURNACE—Notes on the Gran-Annular Electrical Furnace. Zay Jeffries. (Met. and Chem. Eng., 2½ pp., illus.) 40c.
- 25,200—ELECTRIC POWER—Don'ts for Electricians. (Eng. and Min. Journ., Mar. 28, 1914; 1½ pp.) Reprinted from article by H. M. Nichols in "Power." 20c.
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