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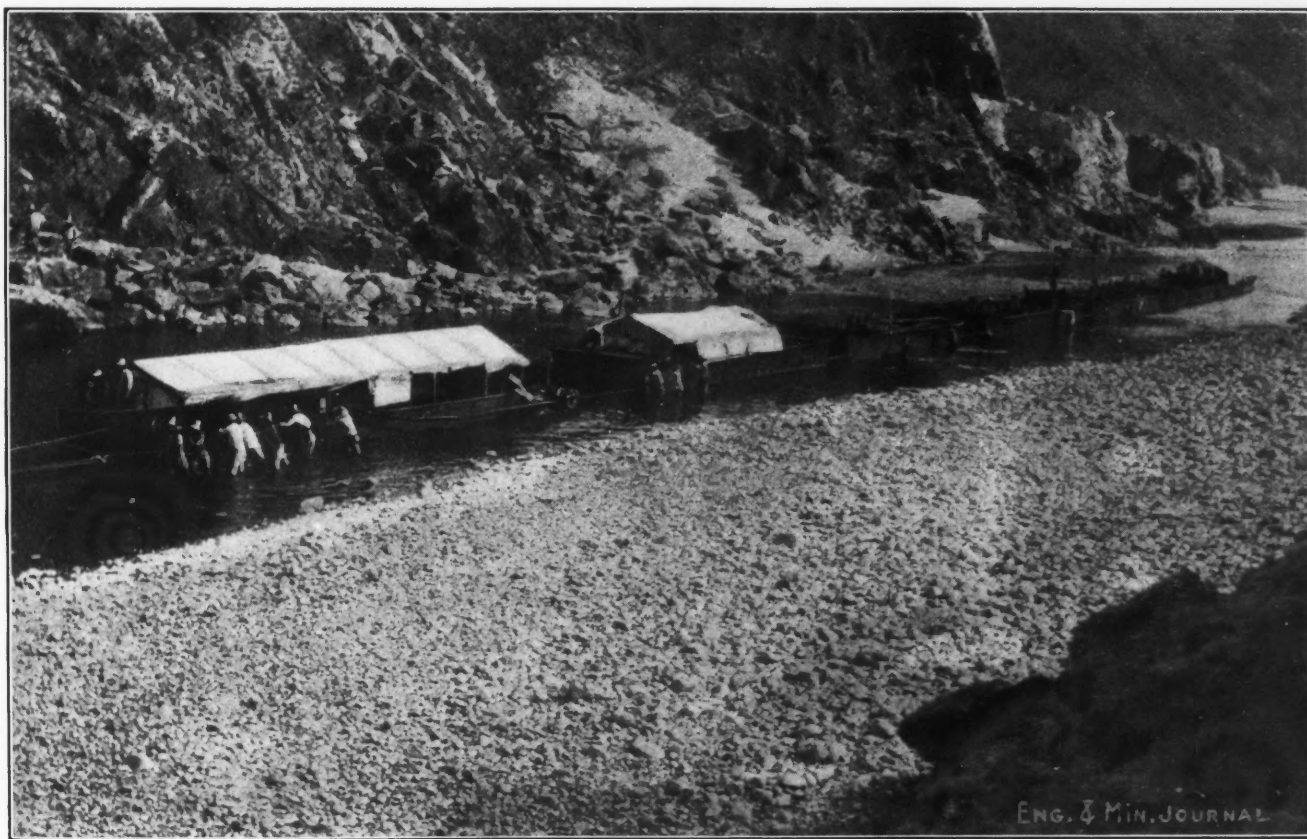
Transporting Heavy Machinery in Mexico

By H. R. CONKLIN*

The Lluvia de Oro mill, Lluvia de Oro, Chihuahua, Mex., was designed in 1906, and, although the transportation of heavy articles to the mill site is extremely difficult, machinery was purchased without sectionalizing. This required the construction of about 11 miles of exceedingly expensive wagon road from the mine, at an elevation of

on account of high water. During the rest of the year, except for the possibility of a dangerous rise in the winter months, the stream discharges from 200 second-feet up, and the rapids, with bottoms of boulders and gravel, have much too little water to float a boat of any size.

Several power boats were built on different plans, and while some of them arrived at the upper river terminus, using wooden barges for trailers to carry freight, none had proved successful in the transport of this equipment to its destination.



FLEET OF STEEL BOATS OF THE LLUVIA DE ORO GOLD MINING CO., ON FUERTE RIVER, TAKING IN HEAVY UNSECTIONALIZED MACHINERY

about 4200 ft., to the River Fuerte, at an elevation of about 900 ft.; an additional wagon road, much more easily built, of about 25 miles, from the town of Choix to the River Fuerte; and the design and construction of boats or barges to carry heavy freight up the river, from one wagon road to the other, a distance of about 25 miles.

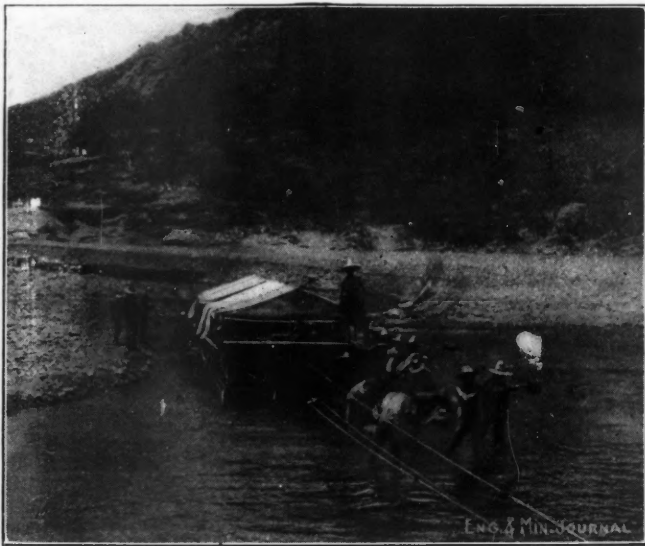
This stretch of river has many rapids. During the rainy season, from July to November, it is entirely unsafe

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In September, 1908, when I was appointed managing engineer, a large part of the machinery was still awaiting transportation at the lower river terminal. An entirely new scheme was adopted for river transportation, consisting of steel boats, each 40 ft. long, 10 ft. wide and 4 ft. deep. One boat was used as a power boat, and six as barges. A stern wheel was put on the power boat, for use in the quiet parts of the river, and a double-drum, pile-driver hoist placed in the middle of the boat. Power was furnished by two gasoline engines of 15 hp. each, placed

in the front end. Each engine drove a friction clutch on a countershaft placed across the boat between the engines and the hoist. This countershaft carried four friction clutches, one for each engine, one for the hoist and one for the stern wheel. Roller-chain drive was used throughout.

Half-inch "Hercules" steel rope was used, the rope from either or both drums of the hoist passing either forward or astern through bull's-eye castings in each end of the boat. This permitted the use of two ropes in front, which were carried ahead and fastened to rock or trees, to drag the boat up a rapid; 12-in. snatch blocks enabled the multiplication of the pull on the boat up to four or five laps in each rope. By alternately driving each drum with both engines an enormous pull could be developed, and several times when necessary the power boat, weighing about 18 tons, was dragged bodily up a steep bank 80 ft. high, to be safe during high water. Many rapids were so steep and rocky that the power boat must first be dragged up, anchored firmly, and then two or three barges at a time dragged up with tail ropes.



ANOTHER VIEW OF THE STEEL BOATS OF LLUVIA DE ORO GOLD MINING CO., LLUVIA DE ORO, CHIHUAHUA, MEX.

Boat bottoms were of $\frac{1}{4}$ -in. steel plate, the sides of $\frac{1}{8}$ -in. steel. All were flanged so that the riveting was inside the boats with no laps or seams outside to catch on sharp rocks. The bottom of the power boat was worn through in four months' work. The machinery, except the stern wheel, was moved into one of the barges, requiring less than two days' work, and the freight all successfully delivered at the upper river terminal. A view of this fleet is shown in the accompanying halftone.

SECTIONALIZED MACHINERY ADVISED

Transportation up such a river is possible, but certainly should not be undertaken unless absolutely necessary, and sectionalized machinery that could be packed on mule back would have been far preferable. Since the completion of construction, the occasional necessity of transporting heavy repair parts has arisen. This has been done with a single barge, using man power on a winch bolted to the barge bottom. Four or five tons can be moved in one trip. If a trip is necessary for trans-

porting from 1000 to 1500 lb., a small boat with sheet-iron bottom and plank sides can be pulled upstream by ropes and men without a winch.

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Notes on the Hardenberg Mill

BY LEWIS H. EDDY

The new 20-stamp mill of the Hardenberg mine, in Amador County, Calif., was put in commission on Feb. 2. The stamps weigh 1080 lb. each, dropping 104 times per minute, and have a rated duty of five tons per stamp in 24 hr. The mortar blocks are set on concrete foundations, with concentrator belting between the block and the concrete. All the foundation construction is of heavy concrete.

The pulp passes through 24-mesh screens over amalgamation plates to eight Frue vanners. The housing of the mill is constructed of wooden frame covered with galvanized-iron sides and roof. The south side is left open in preparation for 20 additional stamps which will probably be installed in the present year. The mill is driven by a 50-hp. electric motor, and the mine is equipped with electric power throughout. The ore bin has a capacity of 500 tons of ore, approximately equal to five days' run of the mill. This will be increased to 1000 tons when the 20 additional stamps are installed. There are also two surface excavations provided for the storage of reserve ore, one at the shaft, the other above the mill, having an aggregate capacity of about 5000 tons of ore. Six thousand tons of ore will feed 40 stamps for 30 days.

This provision for the storage of surplus or reserve ore will enable the management of the Hardenberg to proceed without interruption in the development of the known orebodies and to undertake the exploration of new ground that could not be accomplished with the available bin capacity restricted to a tonnage equal only to five days' run of the mill. During the period of construction of the mill, storage, and other surface equipment essential to milling, the ore was accumulated on the dump, and it was from this dump the bin was supplied in the initial run of the mill.

The mill is situated 400 ft. distant from the three-compartment vertical working shaft sunk to the 1100-ft. point. The ore comes from the 800- and 1000-ft. crosscut levels driven into the hanging-wall side of the main ledge which dips about 62° E. The plant is now fully equipped to proceed with mining and milling without interruption. The orebodies have been proved to a vertical depth of 1100 ft., and the ore has increased in value since the decision was made to install the mill. The old workings had reached 900 ft. inclined depth through a shaft on the footwall side and were abandoned because of trouble in holding the shaft in the soft gouge. The present method of mining obviates this trouble. The indications are favorable for making a permanent and profitable producer of the Hardenberg. H. Malloch, of San Francisco, is manager, and N. S. Kelsey, of Jackson, is superintendent.

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The Production of Metals in British Columbia, in 1912, according to preliminary estimates of Provincial Mineralogist William Fleet Robinson, was as follows: Placer gold \$500,000; lode gold, \$4,960,000; silver, 2,900,000 oz.; lead, 38,000,000 lb.; copper, 51,000,000 lb. and zinc, 8,500,000 lb., \$17,497,000 being the estimated value of the total production of metals.

Silver Cyanidation at Tonopah—III

BY HERBERT A. MEGRAW

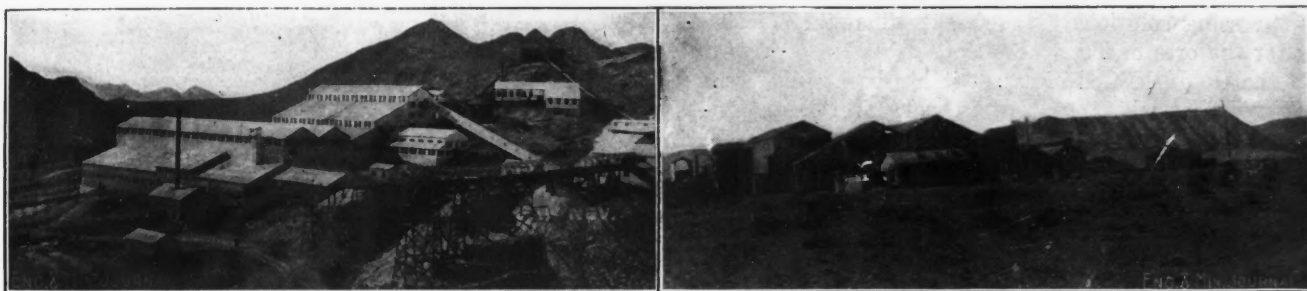
SYNOPSIS—Summary of comparisons and conclusions resulting from the study of the methods used at Tonopah. Ores are washed and sorted at two plants. Although cyanide solutions are used throughout the district for all mill work, some operators believe advantages would be gained by crushing in water. No experiments have been made as to the applicability of crushing machines other than stamps. Short tube mills of large diameter are used and there is a great difference of opinion in regard to the best lining. El Oro lining not used. Trent agitators are indorsed by some and criticized by others, while many types of agitation devices are in use. Concentration necessary at the mills treating higher grade ore. Concentrate not locally treated, but sent to smelters. Goldfield Consolidated mill uses a unique double treatment of concentrate. Consensus of opinion is in favor of heating solutions. Extraction calculations performed by method open to discussion.

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The ores of the Tonopah district have not as yet been subjected to thorough tests in order to determine the advisability of sorting the ore before milling it. Some of

heated by steam. The inside of the cylinder contains a spiral, or reverse screw arrangement, which obliges the ore to ascend through the cylinder until it is finally discharged at the higher, or discharge end. Near the discharge end there is a section of the cylinder perforated with small holes through which the washing water returns to the tank below. The coarse ore delivered to the sorting belt is in perfect condition for sorting, as the operator can see at a glance its character and can eliminate all absolute waste without hesitation. The mud and clay washed from the ore are collected in the washing tank and can be recovered at convenient intervals. It is usually of high grade and is sent to the mill along with the regular milling ore.

The practical utility of this system has been thoroughly tested and calculated at the West End plant and the conclusion is that there is a clear and definite saving by its use. A large portion of rock that will not pay its way through the mill is discarded, saving the milling cost of putting it through the process and enriching the portion of payable ore. In other words, the same amount of silver is concentrated into a smaller bulk for milling,



NEW MILL AT TONOPAH, NEV., AND OLD MILL AT MILLERS, OF THE TONOPAH-BELMONT DEVELOPMENT CO.

the plants have adopted sorting in a desultory way and two have taken some pains to accomplish a more or less thorough sorting. These latter are the West End Consolidated and the new Belmont. The first of these has installed a mechanical washing machine which screens and washes the ore in hot water and then delivers it upon a wide sorting belt running at slow speed. This belt is so arranged that the sorters work on one side of it, throwing the waste not off the belt, but to one side of it. At the end of this belt there is a splitter which divides the stream delivery, the milling ore going to its proper bin while the waste is delivered into a waste bin from which it can be readily discarded.

There are several advantages about this sorting system. The ore to be sorted is passed over a trommel with small holes and is given a thorough rasping which dislodges much of the sticking clay and mud and also gets rid of the fine portion of the ore which does not require sorting but which goes directly into the mill. The coarser ore thus is passed through into the washer proper, which is a large steel cylinder set on an incline with its lower, or receiving end, set into a tank of water which is

the economies being evident. The new Belmont mill has installed a similar machine for washing the ore.

Sorting in some form is practiced by several of the operating companies at Tonopah, but only at the above mentioned plants is it carried out in thorough form. It has been stated that a great many of the Tonopah dumps would pay well for sorting them over if it were possible to lift the material economically and get rid of the waste. If this statement is true, it seems likely that sorting while the ore was originally in motion might have repaid the trouble necessary to do it. It is a question which requires some study and it is impossible to make any statement which would certainly cover all cases.

TONOPAH ORES CRUSHED IN SOLUTION

All the operating mills at Tonopah use solution throughout the mill operations. At the same time there are certain of the operators who believe that better metallurgical results could be obtained if it were possible to do the crushing and grinding in water without incurring a loss of cyanide and dissolved metal. It is evident that in treating silver ores where solution of comparatively high cyanide content must be used, crushing in water is not usually practicable. The amount of water taken in

Note—This is the eleventh of a series of articles by Mr. Megraw on American cyanide practice. Previous articles appeared Nov. 2, Nov. 23, Dec. 14, Dec. 21, Dec. 28, 1912; Jan. 4, Feb. 8, Feb. 15, Feb. 22 and Mar. 1, 1913.

unavoidably from the grinding system to the cyanide plant would have to be discharged as moisture with the residues, and at that time would contain both cyanide and metal in solution, a combination that could not be thrown away. The only system by which it might be managed would be to filter the pulp from the grinding system, whereby it could be introduced into the cyanide plant with approximately the same quantity of water as the residues would contain in moisture. Whether the advantages obtainable would justify the additional expense is a question which would have to be solved in each particular case. The procedure is followed at the mill of the Smuggler-Union Mining Co., at Telluride, Colo., as has already been mentioned in these papers.

CRUSHING IN WATER AT GOLDFIELD

The advantage of crushing in water is believed to be a saving of cyanide by removing cyanicides from the ores, resulting also in an improved extraction. This matter has received much attention from the operators at the Goldfield Consolidated mill and experiments covering several months' work have convinced them that water crushing has decided advantages over crushing in solution. Naturally enough, the conditions at the Goldfield mill are decidedly different from those obtaining at Tonopah and the results of experiments cannot be transferred bodily. The former is treating a gold-bearing ore and using solutions much weaker than those necessary for the ores of Tonopah.

At the Goldfield Consolidated, it has been satisfactorily proved that when crushing in water is followed the consumption of cyanide is less and the extraction of metal better than when crushing in solution. It is shown, also, that when crushing in solution is practiced, there is likely to appear in the mill a light gelatinous product which refuses to settle and causes a great deal of trouble in mill operating. The substance appears much like an alumina product, which it may be, but that has not been proved. On the contrary, when water is used in the crushing system, this product does not appear.

It is extremely difficult to account for this difference and many theories have been invented in the attempt to do so. The theory has been advanced that no matter how alkaline a crushing solution may be, and all solutions containing cyanide must be kept alkaline, there will be a certain length of time, however short, when the acid liberated from the ore will overbalance any alkalinity immediately available at any one point, and that during this short time a chemical change might take place which would render soluble some elements which would not be put into solution with water and which would be removed by washing before reaching the cyanide department, were water used in crushing. This momentary acid condition might also introduce certain combinations prejudicial to high extractions. Of course, there has been no research which would prove that this condition does exist and is responsible for the results shown, but the results are plain. Commercial operators rarely have the opportunity to solve questions of this kind, but it is just such problems which most need solving in the cyanide field.

Whether or not similar conditions to those found at Goldfield would obtain at Tonopah is not certain, but with this example in mind there are many who would like to have the opportunity of trying it.

STAMP CRUSHING UNIVERSAL

The use of gravity stamps for crushing is universal at Tonopah and it seems that nothing else has been considered in the design of the plants. This seems unfortunate, for the ore does not appear to be too hard to give good results with rolls or Chilean mills, either of which might be applied with economy. It is true, however, that stamps have been considered the conservative crushing machine for a long time and the design and construction of plants at Tonopah has been eminently conservative. To install a machine which will surely do the work, even though at a cost somewhat higher than that of one which might be satisfactory, is a sound basis upon which to reason and designers can hardly be censured for following that system. At the same time the results obtained by the other machines, rolls and Chilean mills, both as to efficiency and cost, are no less definite and clearly proved, the obstacle to their use being simply that the results are not so well known. One cannot say with certainty that either of the machines above mentioned would satisfactorily take the place of stamps at Tonopah, but it is not too much to say that I believe either of them would introduce economies.

VARIED LINING FOR TUBE MILLS

The matter of tube mills at Tonopah introduces some interesting variations which are worthy of attention. First attention is called by the shortness of the mills generally used, especially in the later installations. This progression has apparently been along conservative lines and there is reason to believe that the theory is sound. Certainly it has resulted in a reduction of power for the same production.

The mills recently installed are generally 5 ft. diameter and 18 ft. long, in one case the length has been reduced to 16 ft. with satisfactory results. It will be interesting to watch this development and see what it brings forth. It is not impossible that the tube mills of the future may be more like drums of large diameter and short length than the long, narrow tubes first used.

The lining of the tube mills has given rise to much argument. The contrast here to Mexican practice is noteworthy. In all the Tonopah installations I have not seen a single instance of the use of the El Oro ribbed lining, but everywhere there is the use of the smooth cast lining and the siliceous blocks, both of which had been tried and discarded in Mexico before the El Oro lining came into use. The smooth cast lining would seem, theoretically, to be the most inefficient of all possible linings, as it would appear that the pebbles would be more than likely to slide over it and reduce the ore by rubbing it between the lining and the pebbles. The matter of the dropping or tumbling of pebbles would apparently be reduced to a minimum, and while it is clear that the power requirements would be reduced to the lowest possible point, apparently the efficiency would go down with it. That this is not the case is what several of the operators declare positively. They claim to get better results, both as to character of product, its quantity and cost of production. And it is also stated positively that the pebbles do not wear flat in the smooth-lined mills. It is a fact that if one is careful he can avoid seeing flat pebbles on the scrap heaps of these mills.

The silex lining has its advocates also, the installation at the new Belmont mill containing silex lining except in experimental cases. Silex has proved to be a good lining in many cases and except for the item of cost has done good work in Mexico. The objections there to its use are the cost and the time necessary to reline the mill when it wears out. This usually puts a tube out of commission for from five to seven days and where there is no reserve capacity it seriously interferes with the mill operation.

The Komata lining has had trials at Tonopah and in the case noted in the Tonopah Extension mill, is doing satisfactory work. Komata linings have also been installed at the Goldfield Consolidated with satisfactory results and are now used altogether. It is claimed that these linings increase the power consumption, which is undoubtedly true, but that the ultimate efficiency is increased. This is even more definitely shown when the revolutions of a mill into which they are placed are reduced considerably. For instance, a 5x18-ft. tube mill using smooth or silex lining and revolving at 26 or 27 r.p.m. can be reduced, when the Komata lining is used, to about 22 or 23 r.p.m., resulting in a lower power consumption and no great reduction of efficiency.

declare it has no merit in it, that it is a nuisance and not satisfactory in any way. The truth lies somewhere between these two extremes, no doubt, but at what exact point is impossible to state.

The Hendryx agitator has been previously mentioned in these columns, but it is a machine which has never become popular on account of its high power consumption. There is no doubt that it is a good agitator, but it will probably never become a serious factor in the agitation of slime for the reason of its high operating cost.

Pachuca tanks have been the subject of investigation for some time and many operators claim that they offer no advantages in economy nor in additional extraction obtained.

Referring back to the new Nipissing mill at Cobalt, in which the slime agitators are the old-style mechanically moved arms, the designers stated that they had been able to find no device which would assure them either better results or lower costs. In such event the Pachuca tank would be entirely out of the reckoning, for if it presents no such advantages, its high cost of installation and the additional cost of pumping in a mill, occasioned by the height of the tanks, would certainly preclude its installation. I am of the opinion that the



MILL AND SAND TAILING PILE OF THE DESERT POWER & MILL CO., MILLERS, NEV.

The height at which the load of pebbles is carried also varies a good deal. The variation is from somewhat below the center line of the mill to 6 or 8 in. above it, calculating with the mill not running, of course. In cases where the load is carried above the center line of the mill a grating has to be used in the discharge in order to prevent the issuing of pebbles. At the West End mill a difference of pebble load made an enormous difference in the efficiency of the tubes so that the whole mill was affected. This question of lining will probably be solved in the near future when there will be some agreement among the operators as to which type best suits their needs. At present there seems to be a great difference of opinion.

MANY TYPES OF AGITATORS

Opinions in regard to agitators seem to differ as widely as they do in tube-mill linings. There are examples of the Pachuca, Hendryx, Trent and other systems in use. The original mills of the district, the Desert and Belmont mills at Millers, used mechanical agitators for their slimes, the Hendryx type is in use at the Montana-Tonopah mill and several installations are using the Trent system, while the new Belmont mill at Tonopah is using the Pachuca system.

Particularly the Trent agitator seems to be a bone of contention. Some users say it is perfect and others

Pachuca tank is likely to be replaced by some other more satisfactory design.

CONCENTRATION PRACTICED IN SOME MILLS

It will be noticed that some of the Tonopah mills practice concentration while others do not. The two at Millers, the Montana-Tonopah, the West End and the New Belmont practice concentration, while the Tonopah Extension and the MacNamara mills do not. In those mills which do concentrate, the object has been to make as little concentrate as possible consistent with removing the objectionable elements from the ore. With low- or medium-grade ores concentration is not necessary but with the rise in silver content, attendant upon the increase in the proportion of sulphides, concentration must be resorted to. Many of the mills using the process have reduced the number of tables, the point being that it is more expensive to market concentrate than bullion; therefore as large a proportion as possible should be taken out in bullion form. This is sound reasoning, particularly where the concentrate has to be shipped to smelters where losses may be multiplied by many means.

There is no instance of local treatment of concentrate at Tonopah. In this connection it is interesting to review the situation at Goldfield, where the Consolidated treats all of its concentrate by an elaborate process. Experiments on concentrate treatment showed that by treat-

ing the concentrate raw a certain percentage could be saved; that by first roasting the concentrate and then cyaniding it, a better extraction would result, but that by treating it raw, then roasting it and retreating by cyanide, an extraction about equal to the sum of the results of the other two methods could be obtained. That system has been installed and is followed with success. After the cyanidation of the roasted concentrate, the residue is delivered into the tank which feeds the filter and is discharged with the filtered tailing. By this means the concentrate tailing is reduced to a value nearly equal to that of the regular mill tailing. The process is interesting and unusual.

HEATED SOLUTIONS USED

Operators universally agree that the extraction of silver from the Tonopah ores is increased by heating the solutions. The point to which this is carried is generally about 120°. There seems to be no difference of opinion on this point and all the mills are doing this with good results. The question naturally occurs as to whether the Mexican operators have been overlooking anything in the matter of heating solutions. I have seen the scheme tried several times and made experiments on it, but without any beneficial result. That this is not unusual will be shown in a later paper, when I will call attention to another silver mill which has made repeated experiments and found no increase of extraction through heating the solutions. Still, this is a point which ought to be worked out for each particular ore, no general rule governing it.

Heating solutions seems to have no effect whatever on the extraction of gold. This means, of course, solutions of normal temperature, as extraction of both metals falls off in abnormally cold solutions.

The use of lime and lead acetate at Tonopah does not vary widely from accepted practice at most other camps. The addition of these materials varies, and the practice is governed principally by convenience. The filters in use at Tonopah are all of the stationary vacuum type. The present condition of the filter problem makes it advisable for discussion to be postponed until there shall be more liberty to publish statements.

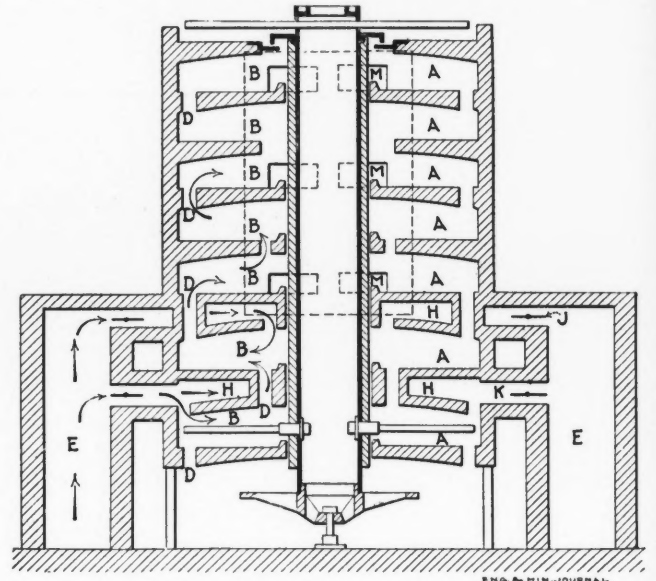
CALCULATION OF EXTRACTION

At Tonopah, as in most of the mills at the present time, the calculation of extraction is performed by using the content of bullion produced plus the content of tailing discharged as the value of head samples. Some of the older operators look with envy on the mill men of the present day and think of the monthly recurrence of attacks of heart disease that came with the attempt to reconcile production and tailing content with head samples taken at or before the batteries. Extractions of 120% were not unusual in those days, nor were drops to 60 and 70% unexpected, but the mill man was continuously in hot water about it, particularly if he differed with the general manager about the accuracy of the head samples. This later method is much simpler and tends to avoid worries. At the same time it is hard to agree with a method of solving a problem by means of which any answer is the right one. I am anxious to have this matter discussed and hope that there will be some one kind enough to take it up and extract opinions about it.

Wedge Roasting Furnace with External Fireboxes

A roasting furnace with external fireboxes and various other aids to heat control is patented by Utley Wedge (U. S. Pat. No. 1,040,071, assigned to the Furnace Patent Co., of Philadelphia, Penn.). In the accompanying illustration, the superposed hearths are represented by *A*, the superposed working chambers by *B*, while *C* is the roof of the furnace, which may be used for drying, and which may be furnished with any of the ordinary means for feeding the ore into the uppermost hearth. The furnace has the usual central rotating shaft, provided with projecting arms (shown in the figure in the lowest chamber only), which arms are provided with the usual rabbles for feeding the material over the successive hearths, and causing it to pass from hearth to hearth through the openings *D* which alternate between the inside and the outside.

In furnaces of this type, with external fireboxes, irregularity of working is sometimes induced by inequali-



WEDGE EXTERNALLY FIRED ROASTING FURNACE

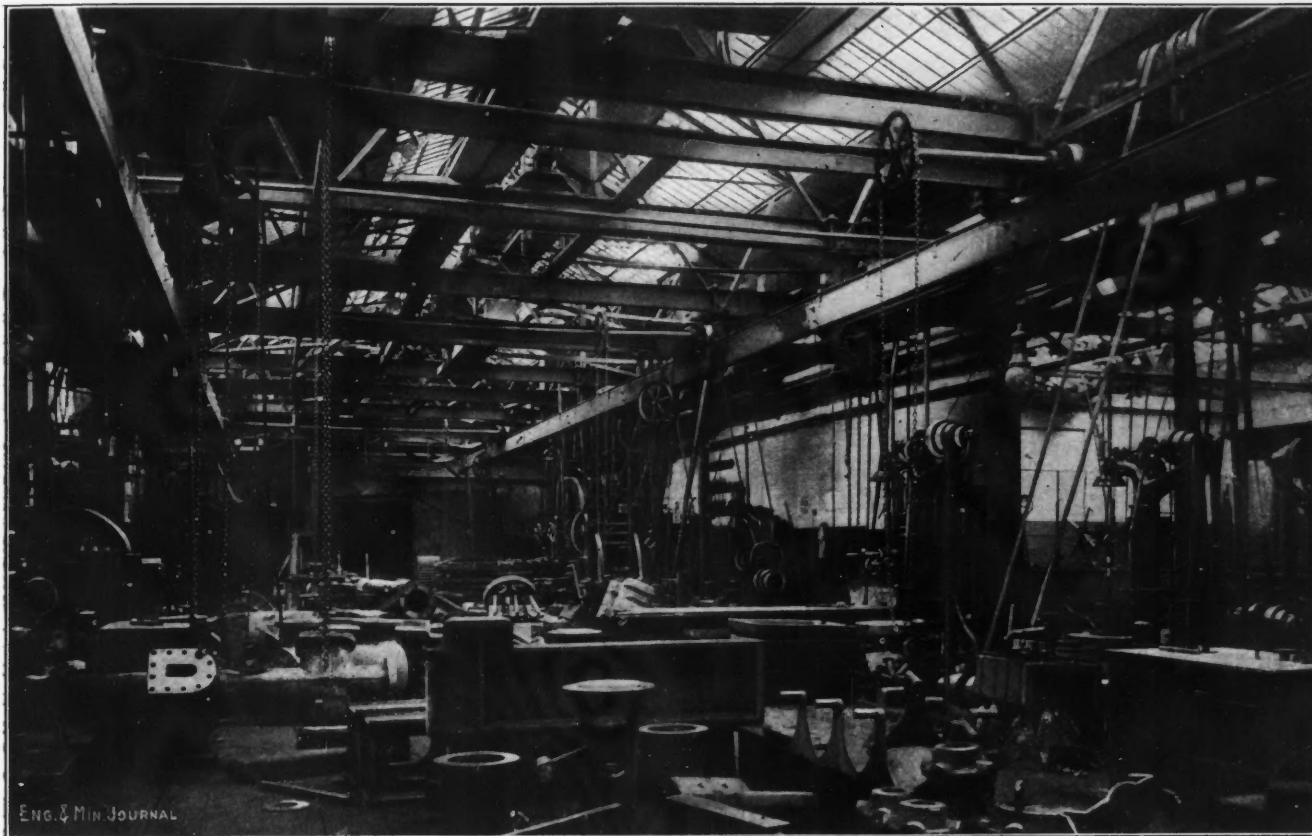
ties in the supply of heat. In order to correct this defect, heating chambers *H* are introduced between successive treatment hearths, and the combustion gases pass through these chambers as well as directly to the hearths themselves.

As shown in the illustration, there are two fireplaces *E*, one at each side of the furnace, these fireplaces communicating with the heating chambers *H* through upper and lower flues *J* and *K*, a portion of the products of combustion from the lower flue being deflected into the lowermost treating chamber and passing thence in succession through the treating chambers above it, and the products of combustion from the upper flue passing first through the upper heating chamber and thence into the treating chamber above the lowermost, from which they pass in succession through the treating chambers above. In order to regulate the heat in the upper treating chambers of the furnaces, communication is provided between the gas outlet flue and a number of the chambers; in the drawing, gas outlets *M* are shown from the first, third and fifth chambers.

The Anaconda Machine Shops

The engravings shown herewith, representing some of the shops and tools of the foundry department of the Anaconda Copper Mining Co., accompanied an article by F. A. Stanley in the *American Machinist*, Feb. 13, 1913. Fig. 1 gives a general view of the interiors of the shops

and suggests the variety as well as the number and the size of the jobs these mine shops are called upon to handle. The number of forges in Fig. 2 is suggestive of the scale of work. Fig. 3 shows some of the blast-furnace jackets and slag spouts.



MACHINE SHOP OF THE FOUNDRY DEPARTMENT OF THE ANACONDA COPPER MINING CO.



FIG. 2. BLACKSMITH SHOP

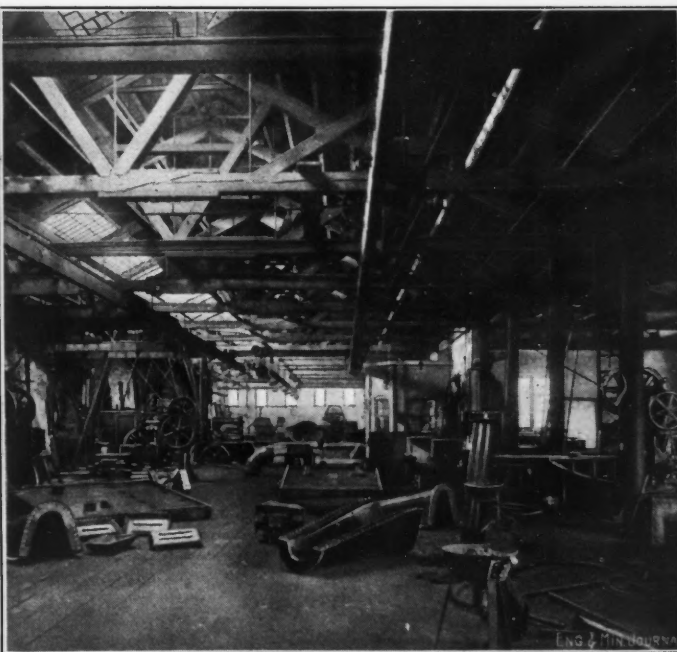


FIG. 3. BOILER AND SHEET-METAL SHOP

About Iron, Iron Mining, Etc.

H. V. Winchell lately sent us the following letter:

In looking over some correspondence I have run across a copy of a letter which I wrote in Germany last summer to the editor of "Harper's Weekly." It is perhaps not surprising that that grave and reverend journal did not care to publish this letter. It might perhaps be interesting to some of the readers of the "Engineering and Mining Journal."

We are of the opinion, with Mr. Winchell, that his communication is interesting. It is unnecessary for us to reproduce the article in *Harper's Weekly* that he criticizes, his own remarks being sufficiently illuminating. Mr. Winchell's letter is as follows:

Editor, "Harper's Weekly,"

Dear Sir—The pages of your journal bear frequent evidence of your appreciation of the fact that one of the important functions of the press is educational. In many of the fields of art and science there are at different times in your columns little tales of interesting facts or more elaborate articles conveying real information for your readers. From daily newspaper science we may well pray to be delivered, and indeed the well informed seldom waste time in reading scientific articles in the daily press; but when a sober and responsible weekly journal undertakes to present a statement of industrial or scientific facts and conditions we are inclined to read it carefully with credence and respect. Indeed the less we know about the subject the more are we likely to be misled by erroneous statements thus presented as we suppose *ex cathedra*. I beg, therefore, to call attention to an article which appeared on page 26 of your issue for Aug. 24, 1912, under the caption "The Scarcity of Iron Ore." Seldom are more mistakes and erroneous impressions contained in four hundred words.

The first paragraph sanctions the sensational and discredited report of the recent discovery in Pennsylvania of "one of the largest bodies of iron ore ever discovered in the world." Here may be found a good illustration of the truth of the proverb that "Error goes around the world while Truth is putting on his boots." The newspapers were full of this sensation for a few days and everybody, including the science editor of "Harper's Weekly," must have read the headlines, and no more; for a perusal of the text which followed was in itself a sufficient rebuttal of the glowing captions. The same newspapers later contained the news that the bubble had been pricked by special investigators of the United States Geological Survey. But the headlines were less conspicuous and must have escaped the notice of many, including your scientific commentator.

The next paragraph of your article presents the astonishing statement that "iron is the most abundant mineral in existence." As a mineral, iron does occur in nature; but is a great curiosity. As one of the components of many different minerals it is abundant, but it does not constitute nearly so large a proportion of the earth's crust as two or three other elements, notably silicon and aluminum. Furthermore the magnetic compass is not generally deflected by the attraction of the metal as it is found in most of its combinations. The majority of our iron ore is hematite, which means blood-stone and is so called because of the color which it imparts to water when powdered; and this mineral has no perceptible influence on a compass. Neither have limonite and siderite, both of them iron ores of commerce.

The third paragraph begins with an ambiguity, follows with a misstatement of facts, and closes with an error. Instead of there being "hundreds of varieties of iron" there is but one. The minerals which constitute desirable iron ores are not limited to two, although the bulk of our American iron is manufactured from the two ores mentioned, viz.: hematite and magnetite. The first iron made in America in historic times was probably from siderite or iron spar; and limonite with its several varieties, as well as siderite, are valuable ores in many parts of the world.

Paragraph four is radically inaccurate. "Ores which contain more than a minute proportion of phosphorus" are not only not worthless but in great demand. Millions of tons of such ores carrying from 1% to 3% of phosphorus are mined in Sweden and sold at good prices, in Belgium, Germany and England. In some cases a premium is paid for high-phosphorus content and the resultant rails and steel products are as good as any made in America. Again instead of a maximum of 2% of silica, few ores contain such a small proportion of it, and these ores are not only not "valueless," but command good prices. In fact ores containing as much as

40% of silica are mined in Michigan and shipped east for reduction, and the average silica content of Lake Superior ores is perhaps from 6% to 10%. Furthermore "ores containing more than 3% of sulphur" are not "impossible to use" and the presence of sulphur has no necessary connection with the sparking or flashing and the odor when the ore is struck with a pick. Even the barbarians know how to make a fire by rubbing steel on flint or other siliceous rocks; and many other substances besides sulphur yield a peculiar odor when burned.

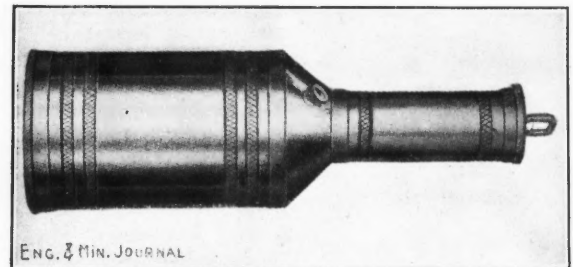
These are not all the flaws in your article on iron ores. The title itself is misleading as will be seen by an examination of the reports of the National Conservation Commission, or the monograph of the "Iron Ore Resources of the World" prepared for the International Congress of Geologists in Sweden two years ago, both of which estimate iron ore enough definitely known to exist today to supply the world for hundreds of years at the present high rate of consumption. And the fear of "scarcity" will be still further allayed by a perusal of a recent discussion of the subject by Professor Kemp, of Columbia University, now the president of the American Institute of Mining Engineers, or the recent descriptions by equally competent authorities of the discovery of iron-ore fields in Cuba and Brazil beside which the vast supplies of the Mesabi range pale into insignificance. There is no "scarcity of iron ore," and there is not likely to be one at any time.

If the foregoing seems to constitute a severe indictment of your little article I trust it will be received as simply an indication of my interest in the dissemination of useful information and the elimination of erroneous impressions from the minds of the people. If I tell you that the very next article on the same page is also inaccurate you may perhaps suspect that your scientific reviews need some editorial revision before presentation to the public.

Very respectfully,
HORACE V. WINCHELL

Niagara Searchlight for Mining Use

The Niagara Searchlight Co., of Niagara Falls, N. Y., has brought out a hand searchlight, shown in the accompanying illustration, which is recommended to mining engineers. It is an aluminum cylinder with a small electric



NIAGARA HAND SEARCHLIGHT

lamp and an excellent reflector, similar in design to that of an automobile headlight, but smaller. Inside of the cylinder are five small dry-cells. The current is put on by pressing a button. The whole apparatus weighs only 31 ounces.

This searchlight is not recommended for use all the time, but for such purposes as throwing the light up into a stope, down a shaft, or in emergencies. We have tried it and found it to be excellent for such purposes. The cost of the instrument is \$10. New batteries cost \$1 per set. We have not determined their life, but the manufacturer informs us that the cost is about 5c. per burning hour.

A Shipment of Amblygonite Ore was recently made by the Beecher Mining Co., of Custer, S. D., to the Parmelee Pharmaceutical Co., of New York. This shipment consisted of 76,000 lb. and the ore contained approximately 7.5% of lithium.

Shaft Sinking at the Indiana Mine

BY CLAUDE T. RICE

SYNOPSIS—At the Indiana mine in the Michigan copper country a concrete-lined caisson or drop shaft was sunk through 100 ft. of sandy overburden. Steel rings, the first reinforced for a cutting shoe, were bolted above and within the one below it, in succession, and between them and collapsible wooden forms, concrete was poured, its weight carrying the caisson gradually to bedrock. Then material within was excavated and the shaft sunk in the usual way.

Diamond drilling in the vicinity of the old Belt mine, resulted late in 1909, in finding the celebrated Lake ore-body in a new amygdaloid considerably to the south of the then productive mines of the Lake Superior copper country. Much excitement followed and much prospecting was done in an attempt to trace the lode farther north. In diamond-drill holes sunk in hope of finding the Lake amygdaloid, cores of rich copper ore were obtained, in which native copper occurred in a shattered matrix of felsite. Two holes, some distance apart, struck this felsite at a depth of about 1400 ft. from the surface, but other holes failed to reveal it. The cores were rich and the occurrence of native copper in felsite was quite new in the district. Theretofore native copper had always been found in basaltic flows of the Keweenaw series and in conglomerates. Consequently, it seemed preferable to sink a shaft to this ore than to try to trace it by diamond drilling. As a result of this prospecting, the Indiana Mining Co. was organized.

In prospecting native-copper deposits, it is usually necessary to do much actual mining in order to test the ground thoroughly, and as the ground in this instance was tight, it was decided to sink a large shaft, the dimensions finally selected being 15 ft. 10 in. by 6 ft. 10 in. in the clear. This is typical practice in the Lake Superior copper country; the magnitude of development operations approximate actual mining, and working shafts are sunk where a prospect hole would be considered sufficient in many other districts. As in the event of finding copper, a rock house will be required, the headframe is rectangular in plan, is built of structural steel, and, in some respects, is reminiscent of a typical headframe of the Joplin, Mo., zinc-lead mines.

SAND, CLAY AND QUICKSAND IN OVERBURDEN

The shaft, for opening the newly discovered lode, would have to be sunk through 100 ft. of overburden, in the upper 60 ft. of which there was sand and clay, followed for about 20 ft. by material in which quicksand and clay prevailed and in which were one or two seams of sand and gravel about 1 ft. thick. From 70 to 77 ft. from the surface, the material was hardpan succeeded by sand, clay, and quicksand, which extended to hard rock. This overburden was penetrated by a drop shaft. The drop-shaft casing was made of annular sections of steel plate, 8 ft. in diameter at the top, but each ring being of slightly smaller diameter, so that each section bolted inside the preceding one. The sections were overlapped 4 in. The two lowermost rings were of 1/2-in. plate; those above were 3/16 in. thick. A 5/8x6-in. angle was fastened to the bottom plate to stiffen the bottom and give a somewhat

stronger cutting edge. This angle-iron ring, furthermore, facilitated the concreting that was to follow.

STEEL AND CONCRETE DROP-SHAFT SUNK THROUGH OVERBURDEN

The first 50 ft. of the shaft was sunk in winter without any trouble being experienced as the ground froze and stood without support. The thickness of concrete was proportioned to give weight enough to overcome a frictional resistance of 400 lb. per sq.ft. No allowance, however, had been made for the fact that the 50 ft. of sand that stood without support would offer little resistance to the settling, and, as a result, the drop-shaft sank down

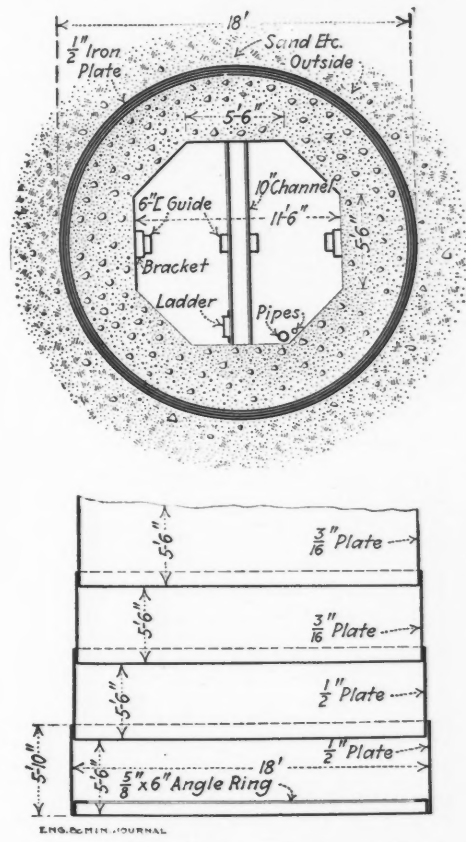


FIG. 1. DROP SHAFT THROUGH OVERBURDEN IN PLAN AND SECTION

through the overburden faster than the sand could be excavated, causing no difficulty other than that the cutting edge was bent up somewhat by forcing boulders out of its path. The concrete lining of the steel ring was put in from the bottom up, in the first 50 ft., collapsible wooden forms being used. The shaft opening within the lining was octagonal. The central rectangle, formed by joining the two shorter sides, was used for hoistways; ladders and pipes being carried down the corners, as shown in Fig. 1. In this illustration, 10-in. channels are shown in the center of the octagon. These were put in at 6-ft. centers, to carry the center guides, which in the concreted part of the shaft are 6-in. channels. The end guides are secured by brackets set in the concrete. These brackets were not put in until after the drop-shaft had

been seated upon solid rock. Instead, blocks of wood were put in the concrete at the places where the brackets were afterward to be set; this being necessary because the drop-shaft was continuously sinking and the hoisting and lowering of material was done by a boom derrick. As this bucket could not be used with guides, had the brackets been set in place at first, the buckets would have caught upon them.

After the concreting in the first 50-ft. section of the drop-shaft had been carried up to the surface, further steel plates were bolted to the completed portion; the collapsible wooden form was moved up, and a new section concreted, the operation being repeated as rapidly as the drop-shaft sank. Reinforcement was used only in the upper 10 or 12 ft. of the completed drop-shaft, consisting of a few wire ropes, in 1:3½:7 concrete; concrete for the lower part of the shaft being a 1:2½:5 mixture.

DROP-SHAFT SUNK TO ROCK BEFORE EXCAVATING MATERIAL

When solid rock was reached, the material within this steel-and-concrete caisson was excavated. A smooth shelf was then cut in the solid rock by a hammer and drill, and the joint was sealed with concrete. Work was started

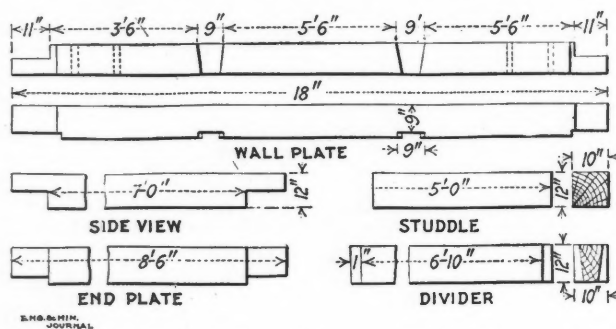


FIG. 2. SHAFT SETS USED IN HARD GROUND

about Jan. 1, 1911, and the drop-shaft was completed about Apr. 1. The total cost of the work was \$57.58 per ft. Provision had been made for an air-lock, had it been necessary to sink through a heavy flow of water, or very wet ground.

After reaching bedrock the shaft was sunk in rectangular section, a manway compartment being carried down at the south end; the manway proper being in the southeast corner, while the opposite corner was used for pipes. The excavation in solid rock was continued to a depth of about 15 ft. below the bottom of the drop-shaft, using hammer and drill and loading the hole very light; after that depth had been passed, machine drills were used. At a depth of 120 ft., a 30-ft. station was cut for a small pump, and in the floor of the station a good-sized sump was excavated to hold the water caught by the ring that was put around the shaft where a flat dipping clay seam was cut through. However, very little water was made, and the second clay seam was not cut until a depth of 530 ft. had been reached.

RECTANGULAR SHAFT SUNK THROUGH ROCK

Below the drop-shaft portion, the shaft has three compartments, and is of the shape shown in Fig. 4. The end plates are 12x12-in. timbers; 10x12-in. timbers being used for wall plates and dividers. The method of framing is shown in Fig. 2, no daps being cut for the studdles. Two hanger bolts are used in each wall plate, made of

1-in. iron upset at the ends, so as to take a 1¼-in. nut. Bearing sets were put in from 20 to 40 ft. apart, according to the ground, being seated in hitches from 6 to 20 in. deep. Ordinarily, it has been possible to work 20 or 30 ft. ahead of the timbering, but in some places where the walls were broken by many slips, the sets have been carried within 7 or 8 ft. of the bottom.

The wall plates are protected by a 10-in. blasting timber hewed flat on its top side, and which is bolted to the wall plate through the hanger-bolt hole, while the divider timbers and the end plates are protected by 2-in. hardwood planks spiked to the sides and bottom. Except in the middle compartment, through which the buckets travel, the miners are protected from falling material, by a flooring of 8-in. logs. The logs of this platform are securely spiked from above so that they cannot be thrown out of place by blasts, and this platform provides a handy place for placing the drills during blasting, and also protects the timbering higher up in the shaft when blasting is going on. Ventilation is obtained by using a casing of 1-in. plank between the hoisting compartments, one being cased higher than the other.

GUIDES CARRIED BY STEEL BRACKETS

Sollars are put in the manway compartment, which is 3 ft. 6 in. by 6 ft. 10 in. in the clear, at intervals of 30

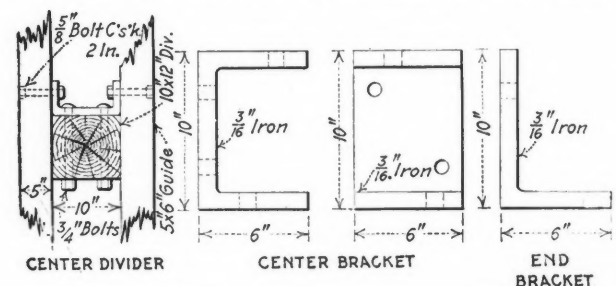


FIG. 3. DETAILS OF BRACKETS FOR GUIDES

ft.; ladders are broken at the sollar. The rungs of the ladders are of ¾ in. iron placed at 10-in. centers. The guides are 5x6-in. pieces of fir, 22 ft. long, and are butted together with flat ends, being put in with the 6-in. face against the timbers. The guides are bolted to iron brackets, which in turn are bolted to the timbers. These brackets, shown in Fig. 3, are made of ¾-in. iron, 5 in. wide. Those for the end plates and dividers next to the manway are strips of steel 16-in. long turned up 6 in. at one end, while those for the center divider are made from plates 22 in. long turned up 6 in. at each end. The guide timber is fastened to the bracket by a ⅝-in. bolt, the head being carried in a countersunk hole 2 in. deep, while two ¾-in. bolts are used to secure the bracket to the dividers and end plates. The guides are extended by false guides 10 ft. long that are replaced with regular guides.

The timbering is done by a crew of four or five men including the boss. It can put in and block three or four sets in a shift. The crew also lags the sets, fills in behind the lagging, carries up the ladders, and puts the sollars in the manways.

Hoisting of broken ground is done with a crosshead and bucket swinging on a bail and having a capacity of 30 cu.ft., or about 1½ tons. A 1-in. rope is used, and a 12x20-in. Nordberg duplex, second-motion hoist having a 5-ft. drum that will carry 800 ft. of rope before it becomes necessary to wind it back on itself. In dumping

the bucket an apron is swung over the shaft, and the ore is dumped into a 1½-ton car at the bottom of the chute. Water is also hoisted from the bottom of the shaft in the bucket, and is dumped into a trough that swings in under the bucket and over the shaft.

ONLY TWO DRILLS USED

Drilling is done only on day shift; two No. 9 Leyner drills are used on a 9-ft. bar, and two men work on a drill. To a depth of 470 ft. reddish felsite prevailed that was hard to drill, but which broke quite well; 30% Red Cross dynamite was used. Below that depth bluish felsite somewhat harder to drill, which does not break as well has come in, and 40% dynamite is used. At a depth of about 600 ft. the trap will come in, and below that is the red felsite, in which the copper was found.

Ground is broken about 20 ft. long and 10 ft. wide. Sinking is done by taking a cut toward one end of the shaft, a bench about 6 ft. wide being left along one end from which the drilling is done. This cut is alternated from one end to the other, because of the tightness of the ground, which, under average conditions, will not allow

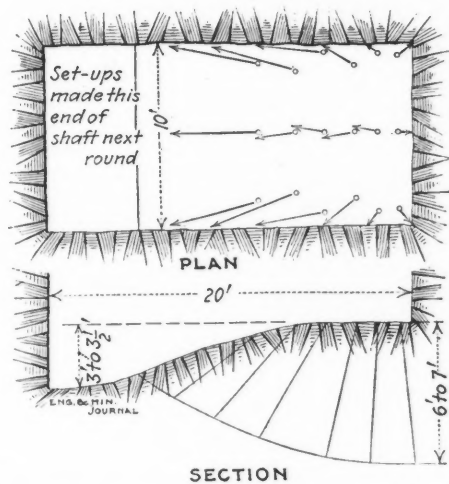


FIG. 4. BENCH ROUND AS USED IN INDIANA SHAFT

much more than 2½ ft. of burden to be put on the toe of a hole. From 12 to 18 holes are required to a round. The machines each put in from 30 to 50 ft. of hole in a shift, and average about 40 ft. It takes two shifts to drill the round illustrated in Fig. 4. Generally the back holes are drilled from 6 and 7 ft. deep. About 17 lb. of dynamite is used per foot of shaft sunk.

The longest drill is 9 ft. long. The starters are 2 ft. 9 in. long, and each following drill is 12 in. longer. The gage on the starter is 2⅝ in., and changes ⅜ in. for every gain of 1 ft. in the length of the drill. Generally a drill is used only once, and can be run ahead only 12 in., because of the hardness of the ground. The water for the Leyner drills is held in two 50-gal. barrels on a stage in the manway 80 to 100 ft. from the bottom of the shaft. The barrels are filled from the sump in the station by a ½-in. pipe. The barrels last the two machines through a shift.

The cost of sinking this three-compartment shaft, 6 ft. 10 in. by 15 ft. 10 in. inside timber, including superintendence, and every cost except the general office expenses at Houghton, was about \$36 per foot.

Topaz and Stream Tin in Mason County, Texas

BY H. CONRAD MEYER*

During the spring of 1912, I had occasion to visit the interesting Llano region of central Texas. This entire region, which is centralized in Llano and Mason Counties, is characterized by its reddish soil, due to the detrital matter derived from the coarse red granite, typical of the region. The district has claimed considerable attention in the past, owing to the discovery of a commercial deposit of rare yttrium minerals at Baringer Hill. In a government report on this deposit, by Frank L. Hess, the area is described in part as follows:

In general the Llano region in the heart of which Baringer Hill is situated, is an island of pre-Cambrian rocks intruded by plutonics and surrounded by an irregular zone of Cambrian and other Paleozoics, including some that are possibly Devonian and some Carboniferous rocks. The inner portion includes part of Burnet, Llano and Mason Counties, and is situated at almost the geographic center of Texas. The history of this island has been considerably discussed, and views differ as to whether it was an island during the deposition of the Cretaceous, by which the area is almost entirely surrounded, or whether it has been exposed by denudation of the latter rocks. The coal measures extend to the north from the region, giving some evidence of an area of highland previous to the deposition of the Cretaceous. Personally the writer is inclined to agree with the view that the region has been denuded, although his investigations have been but superficial. The plutonics are granitoid rocks of many textures and differ considerably in composition. Large areas are composed of the rather coarse red granite, the principal outcrops of which occur near Marble Falls from which the state capitol of Texas was built.¹

The foregoing extract briefly generalizes the geologic features of the area. The two commercial deposits of gem topaz are both situated in Mason County, near the little settlements of Streeter and Katemey, respectively. The Streeter locality is best reached by stage from Llano, the terminus of the Texas & Houston R.R., over the post road to Mason, the county seat of Mason County. Streeter lies due west of Mason about eight miles. The total distance from Llano is about 42 miles, and it requires the better part of two days to make the journey by the mail hack. Katemey by post road is approximately 12 miles north of Mason.

TOPAZ ACCIDENTALLY DISCOVERED IN 1904

In 1904, R. L. Parker, of Streeter, now deceased, picked up in the bed of a dry creek, a crystal of what he supposed to be quartz. The heaviness of the material, however, aroused his suspicions, and a sample was submitted to a mineralogist for identification, who at once pronounced it topaz. Through a careful search, the source of the mineral was found to be a pegmatite dike cutting the coarse red granite of the district. At first only the alluvial deposits were washed, a comparatively large number of crystals being secured by "dry washing," most of which were badly waterworn, presenting a frosty appearance on the exterior, but on breaking disclosed a perfectly limpid interior.

It was not until about 1908 that any attempt was made to work the pegmatite dike for the mineral in place. A dozen or more prospect holes were opened on the Parker property, and approximately 200 lb. of good crystals obtained. A large proportion of these were marketed as gem material. At the Streeter deposits the topaz occurs

*Foote Mineral Co., Philadelphia, Penn.
¹Bull. 340, U. S. Geol. Survey.

in vugs partly filled with clay and associated with microcline feldspar, biotite, tourmaline, smoky quartz and albite.

The microcline is of the flesh-colored variety and occurs in large crystals. Smoky quartz and biotite are the most abundant, the former often being intergrown with the crystals of topaz, the latter occurring in large, lustrous cleavage plates. The albite is of unusual habit, being found in fan-shaped laminated aggregates, easily separable. It is the variety known as cleavelandite. Minute black needles of tourmaline occur sparingly. At the Katemcy deposit, conditions are somewhat different. The feldspar here is the greenish-blue gem variety of microcline, known as Amazon stone. This is said to occur in large cleavage masses of excellent color. In addition to the above minerals, a freely cleavable transparent sea-green fluorite was noted. The topaz is intimately associated with the quartz and feldspar, and the interstices are filled with a reddish felsitic rock, forming a mass which, in hand specimens, has the appearance of a coarse breccia. The topaz composes about 80% of the mass and exists as distorted crystals, thus indicating that it is of secondary deposition. Topaz-bearing rocks of this nature have been noted at Schneckenstein, Saxony, and are locally known as "topazfels." From a mineralogical standpoint, the topaz found at both of the above localities is of great interest. Owing to the nature of the occurrence of Katemcy, very little of the material produced there could be used for gem purposes.

The Streeter deposits, however, have afforded, besides a quantity of clear colorless crystals, a small number of beautiful light-blue crystals, which rival those from the historic locality in the Adunchilon Mountains, Merchinsk district, Siberia. It is interesting to note that none of these blue crystals have ever been found in the Katemcy locality. The largest crystal found measured about three inches in diameter and was of a faint greenish blue. Crystallographically, the material presents nothing new in the way of rare or undescribed planes. The brachydome y is the dominant face and exhibits peculiar vicinal prominences. Several cleavage plates were examined under a high-power microscope, but failed to show the presence of liquid inclusions, which have been observed in this mineral from other localities.

No important work has been done at either of these deposits during the last two years, owing to the slight demand for topaz in the gem trade. During the work on the placer deposits of topaz a small quantity of a heavy black mineral in roughly rounded grains was secured. The nature of the material was unknown to the workers, and there seems to be no record of the exact locality from which it was obtained.

A pound or more was shown to me, and I recognized it as stream tin or cassiterite. Mingled with the grains were numerous small honey-colored cubes of fluorite, broken prisms of black tourmaline and quartz sand. The crystals of fluorite were but slightly worn by attrition with the much harder grains of cassiterite and quartz, thus indicating that the stream tin had not been transported far from the lode. The cassiterite was unusually pure, most of it occurring in broken crystals and angular translucent grains of a resin-yellow to brownish-black color. It is possible that systematic prospecting of the many "dry creeks" of this region, tributaries of the Llano River, would result in some interesting developments.

HYPOTHESIS CONCERNING FORMATION OF TIN DEPOSITS

The finding of this ore at once suggests the possibility that the topaz deposits have a deeper significance than is apparent on casual consideration. In the tin deposits of Mt. Bischoff, Tasmania, topaz occurs in large quantities close to the ore body. A similar condition exists in the tin lodes at Durango, Mexico. The workable deposits of stanniferous sands near Durango, and also those of Nino province, Japan, yield quantities of topaz crystals.

It is believed that tin deposits of the ordinary type owe their origin to pneumatolytic action, in which fluorine has been the active agent. The almost invariable presence of fluorine compounds such as fluorite and topaz in tin lodes, and the various successful laboratory experiments in the synthesis of cassiterite make such a theory highly probable. The only important tin deposits of the state occur in the Franklin Mountains, near El Paso. According to Weed², these deposits resemble in many respects those of Cornwall, England. The El Paso deposits, however, have not yet proved to be as extensive as was hoped for, when first exploited. The American tin market depends almost entirely on imports and the steady advance in price of the metal, its oxide, and various tin salts, represents a deplorable inactivity in the development of our natural resources.

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Electrolytic Process of Gold Leaf Manufacture

In a process for the manufacture of gold leaf introduced by a London firm, described in *Daily Consular and Trade Reports*, Feb. 1, 1913, a highly polished aluminum ring, about 5 ft. in diameter and 5½ in. wide, is covered with an adhesive substance, such as a solution of gum, and is allowed to dry. The adhesive surface is dusted with metallic powder, so that it is covered with a very thin layer of base metal. This layer is polished and the ring is rotated slowly with its lower surface in contact with a solution of a nickel salt, the ring being connected with one pole of a battery, while the other pole is immersed in the nickel solution. An electrodeposit of nickel is thus produced on the polished layer of base metal. The nickel deposit is washed and the ring is rotated with its surface in contact with a solution of gold, the electrical connections being as before, so that the latter metal is electroplated on the nickel. There are thus four layers on the periphery of the ring, namely, gum, base metal, nickel and gold, but each layer of metal is so thin that the combination is said to be even thinner than the best gold leaf.

To remove the leaf from the aluminum ring a transverse cut is made in the continuous film, and, starting from this cut, the ring is rotated slowly with its lower part immersed in a liquid which dissolves the adhesive substance, when the film falls from it and is received upon a band of paper traveling at the same speed as the periphery of the ring. The film and paper are then cut up and made into books.

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In Grinding Copper on a carborundum wheel, the copper is apt to clog, says "American Machinist." By rubbing on tallow this is avoided, and the cutting action of the wheel is not impeded.

²Bull., U. S. Geological Survey, No. 178.

Notes on Mine Sampling

SYNOPSIS—Many small samples a safeguard. High assays require varying treatment. Short sections offer many advantages. Samples in large orebodies require interpretation. Loose leaves used for notes and for permanent record. Sampling department of a mine should be in charge of a competent technical man, since important estimates are based on the records of this department.



In sampling a mine, a large number of small samples are better than a few big ones. While the ultimate average value of an ore is determined by the mill or smelter returns, there is as much opportunity for error in basing the estimate on a mill run of a few tons as on a few small samples, inasmuch as the inclusion of a rich portion would salt the large sample to almost as great an extent as it would the small one. The sample taken over too large an area also tends to obscure the mistakes which may occur. In a multiplicity of samples lies the engineer's safeguard and if these are properly taken and the assays intelligently interpreted and calculated, the results should, within reasonable limits, represent the average value to be obtained from the ores.

In the examination of a prospect, the available data are usually meager and the engineer must take into consideration many other things besides the actual assay values of the ore exposed. In the method of taking the samples, a certain latitude is allowable because, with so little on which to base his conclusions, the personal equation of the engineer must necessarily be the deciding factor. In the examination of developed or partially developed mines, however, while his personal equation must play an important part in arriving at the ultimate conclusions, it should not be allowed to enter into the sampling operations. That in itself should be as nearly mechanical as possible and any attempt to change the actual results should not be made until all the data are at hand.

HIGH ASSAYS SELDOM ENTIRELY REJECTED

The greatest difficulties are encountered where the ore is erratic. The inclination to avoid sampling the richer portions should not be yielded to, no deviation from the method laid down should be admitted and any adjustments necessary can be better made in the light of the knowledge gained from all the data. Several courses of dealing with high assays are open. The sections in which they occur should always be resampled. If the resulting assay is extremely low, it is safer to use it, but where the two results are approximately the same, it is safe to take the average. This applies to those mines where the general average is low, but where the orebody, as a whole, is rendered profitable by the occurrence of a number of these rich, erratic sections. In cases of this sort, it is usually advisable to figure the results at their full value.

Where these rich sections are of infrequent occurrence, if a resampling bears out the original result, it is wise to sample midway between the sections on each side, and if there is a more or less gradual falling in value, the average of the three sections may be taken. Another method is to take the average of several of the neighbor-

ing sections showing the highest results, which without reduction can be used in calculating, and substituting this average for the high assays.

From a survey of all the results, what may be termed a maximum high level can be struck and all the highest assays reduced to this. As a final step, they may be omitted altogether. This is, however, open to many objections because their occurrence indicates that the metal is there and while, of course, they cannot be expected to represent the average assay of the block of ground whose height is the distance between levels and whose length is the distance between sample sections, they carry some weight and exert a certain influence upon the value of the block and are therefore entitled to careful consideration. The method of handling high assays must, however, depend upon the conditions at the individual properties and no method of discounting them should be permitted until sufficient information is obtained to throw a clear light on their occurrence.

CERTAIN ROUTINE MUST BE ADHERED TO

System is necessary in sampling. The samplers should work in pairs, one to cut and the other to catch the cut-

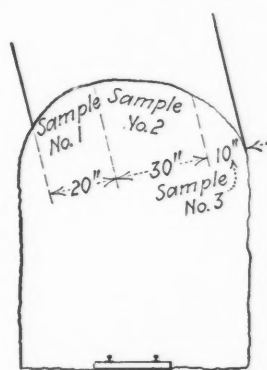


FIG. 1. SAMPLING DRIFT BACK IN SECTIONS

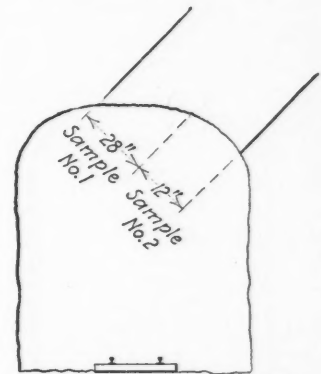


FIG. 2. METHOD OF MEASURING SAMPLE WIDTH IN INCLINED VEIN

ings. The work can be divided between them, preferably by allowing them to cut alternate samples. It is advisable to have one of each pair a technically trained man, while the other may be an intelligent miner. Young college graduates are usually available and when properly educated, make excellent samplers, as they bring a trained mind to the work and are more apt to appreciate the necessity for extreme care, as well as taking more interest.

The sample sections should, wherever possible, be measured from survey stations, so that any particular one can always be relocated. The intervals between samples should be rigidly adhered to and no deviation allowed on account of the section coming at some spot which appears to be either rich or poor. The adjustments necessary for these factors can be better undertaken when the work is completed and all results are before the engineer.

HAMMER AND MOIL CANNOT BE SURPASSED

The ordinary precautions are so well known that it is not necessary to consider them in a paper of this sort. It may be stated, however, that the usual tools, a moil

Note—Abstract of a paper presented by G. C. Bateman at the Ottawa meeting of the Canadian Mining Institute.

and 4-lb. hammer, cannot be improved upon. It will be found advantageous to have some of the moils with a chisel bit and some with the regular point and they should not be too long, generally not more than 10 in. In certain classes of ores, a small pneumatic chipping hammer can be used advantageously, but in all cases where the ore varies in hardness, or where there is enrichment along softer portions or fractures, more accurate sampling and better results can be obtained by the use of themoil and hammer. An ordinary prospector's pick should be avoided, except in the examination of small prospects, where it can sometimes be used to advantage.

LARGE BREAD-PAN EXCELLENT SAMPLE CATCHER

For catching the samples, it is inadvisable to use canvas, better results being obtained with a gold pan or box. A useful substitute is an ordinary baker's bread-pan about 14 by 20 in., and 3 in. deep. It is light, easily handled, quickly cleaned and without sharp, square corners in which the fines may stick. Where the ore is brittle and flies readily under cutting and so escapes the pan, it is sometimes advisable to make a wire ring, about 14 in. in diameter, with a handle and form a receptacle by sewing around it a portion of a canvas bag, about 10 in. deep. This can be manipulated to catch all the sample and can readily be turned inside out for cleaning, but must be dumped into a pan before putting into the sack, or some of the ore will be lost in transferring. However, when the man who is holding the pan or box holds his gloved hand in front of the cutting edge of themoil, the flying pieces readily drop into the pan. Small acetylene lamps give a very satisfactory light to work by. One of these, with a candle hung on the edge of the box or pan, is amply sufficient for a pair of men.

SAMPLE CHANNEL SHOULD BE DELIMITED

When the sampling faces have been located and cleaned, it is well to mark the limits of the sample trench. This can be done with chalk or by passing the flame of the acetylene lamp along two parallel lines. This latter leaves a clearly defined, black line, more readily distinguished than the chalk mark. The distance from the starting point should also be marked on the wall opposite each section.

The size of the channel varies with the ideas of each engineer. One, 4 in. wide and about $\frac{3}{4}$ in. deep, gives a good sample and as accurate results as would be obtained from a larger quantity. It is not the quantity of material which is taken that makes for an accurate sample, but the care and intelligence with which it is cut.

SHORT SECTIONS OFFER MANY ADVANTAGES

Short sections are preferable to long ones, particularly where the values are not evenly distributed. A vein eight feet wide should be split into three or more sections. This increases the number of assays, but the slight extra cost counts for little. The same weight of material should be cut from each portion of the sample trench. With short sections, the danger of a mistake in this respect is localized and there is less liability of salting a large section through the inclusion of a small rich stringer. The distribution of the metal is also accurately determined; and the most economical stoping width can

readily be found. With careful notes, valuable information regarding the possibilities of sorting can also be obtained.

This method also does away with the difficulty experienced in sampling the back of drifts, illustrated in Fig. 1, where the face of the ore is very irregular, as the sample sections can be broken at the desired points. As the different kinds of rock are sampled separately, a geological map of the mine is obtained at the same time; so that the engineer at once gets the average assay value of the ore, its distribution, the location and average assay of a possible pay streak, the maximum economical stoping width, information as to the possibilities for sorting, and the geological characteristics of the orebody.

The samples should differentiate the characteristics of the ore. For example, if in a vein a well mineralized section lies next to barren-looking material, these should be sampled separately. Alternating bands in a vein should also be sampled separately and in such cases, it is well to take in an inch or so of the apparently barren ore on each side of the more valuable portion. Thus if there is any enrichment along the contact it will be included in the class of material to which it rightly belongs.

It is seldom advisable to have sections over three feet in length and where the ore is inclined to be concentrated or erratic, a maximum of about two feet is better. When narrow, rich streaks are encountered, the sample may be only a few inches in length, as it is advisable to sample these separately unless they occur close together.

In sampling a vein narrower than the stoping width, the vein only should be sampled, care being taken that the measurements for width are at right angles to the dip, as shown in Fig. 2. The actual width sampled may be greater than this, but as long as the proper measurements of the vein width are taken, the result will be correct.

OREBODIES OF IRREGULAR SHAPE REQUIRE SPECIAL METHODS

Where the vein is wider than the drift and the full width is exposed only by crosscuts, the method of procedure is the same, but a point to be carefully considered is whether or not the drift is run in the richer portion of the ore, and whether its value decreases as the limits of the orebody are reached. The samples from the crosscuts must be carefully considered in such a case. In orebodies of this sort, particularly with replacement deposits where the walls are defined by the economic limits of working, good judgment is required to see that the different factors governing the estimate of ore value are given their proper weight.

Where the orebody is very large and is opened by parallel drifts and crosscuts, there are several methods that can be used. If the pitch of the oreshoots is fairly flat, vertical sections can be taken along the walls. Where the shoots have a steep pitch, however, an excellent method is to cut a channel about breast high along the walls of the drifts and crosscuts for their entire length. If the ore is irregularly distributed, it may be advisable to sample both walls. A much greater amount of work can be done by the samplers when this method is followed, as the men have a firm footing and the heart-breaking, overhead striking is avoided. On such work in

fairly hard ground, two good men can cut 40 ft. of sample trench in a day.

NOTES SHOULD BE SYSTEMATICALLY KEPT

Extremely important is the method of keeping the notes. These should be clear and self-explanatory and in such form as to be readily available for future reference. Fig. 3 is a specimen page of a form which can be used to advantage for every type of deposit. This has been filled out with the notes of an actual sampling record. The sheets are kept in a loose-leaf ring-binder of convenient size for underground work and when the notes are transferred to the permanent record, the sheets can be filed. It is most inadvisable to write descriptions on the sam-

notes may be underground and a large number of assay sheets are inconvenient to handle, while single sheets are easily misplaced.

PERMANENT RECORDS SHOULD BE OF CONVENIENT FORM

The permanent record (Fig. 4) contains the same information as the notebook and in addition, the extensions for dollar-inches. The use of dollar-inches or dollar-feet is optional with the engineer. There is, of course, no excuse for using the arithmetical average in calculating except where the sample sections are all the same length.

When calculating the assays of a vein, the average width of which is less than the minimum economical stoping width of, say 30 in., as against a stoping width

MINE.....		LEVEL 100'			
WORKING PLACE... N ^o 1 Drift West					
LOCATION DISTANCE FROM S. Wall..	SECTION FORMATION	WIDTHS	NUMBER OF SAMPLE	WIDTH OF SAMPLE	ASSAY VALUE
2'-1"	Schist		5350	25"	○
4'-7"	Schist		1	30"	
5'-10"	Schist	3"	2	15"	
	Quartz	11"			
	Schist	1"			
1'-3"	Schist	1"	3	15"	
	Quartz	14"			
2'-9"	Schist		4	18"	
2'-6"	Quartz		5	30"	○
3'-5"	Basalt		6	11"	
4'-2"	Schist		7	9"	
4'-9"	Quartz	7"	8	9"	
	Schist	2"			
1'-2"	Schist	3"	9	14"	
	Quartz	11"			
3'-4"	Schist		5360	26"	○
	Quartz				
4'-3"	Schist	1"	1	11"	
	Quartz	9"			
	Schist	1"			

DATE... Sept. 23/12	
SAMPLER... G. C. B.	
REMARKS	
○	Sample sections 10' apart measured west from 0112 #5351 heavily mineralized banded structure little mineral
	20' Well mineralized
	Few stringers of Quartz
○	30' little mineral
	" " heavily silicified
	heavy " Quartz stringers
	" " banded structure
	40'
	little mineral
○	banded mixture well mineralised
	banded - well mineralised

FIG. 3. FORM OF LOOSE-LEAF NOTEBOOK FOR MINE SAMPLING

ple tags. The assayer should see only the number so as not to be influenced by outside considerations. The number tags may be sheets of stout paper about 3x5 in., conveniently in the form of a pad. The numbers should be in series and each number should appear on the tag in duplicate, so that in the assay office it can be torn in two, one-half being put with the reject and the duplicate with the assayer's pulp. The numbers may be printed with a duplicate numbering machine before going underground. The returns from the assay office are best entered in an ordinary level or transit book, only the numbers and the corresponding assays being put in. This provides a convenient and easy record, as the book containing the

assumed to be 42 in., there will probably be some sections more than 42 in. in width, and when this is the case, the assay value must be multiplied by 42 in. and not by the actual measured width. Otherwise, when the average assay over a width of 30 in. is reduced to correspond to an assumed stoping width of 42 in., these long sections will have their values increased instead of decreased.

In some cases, it may be necessary to multiply the dollar-inches or dollar-feet by the specific gravity of the ore, as for a mine containing lead ore, some of which may occur as calcite with galena disseminated through it and other parts be solid sulphide. The specific gravity of

these two kinds of ore will show a great difference, and this factor should be taken into account.

The record of each working place should be kept on a separate sheet so that it may be added to as work progresses. Thus, all the information is readily available and by carrying the progressive totals, the average assay for any particular working can be obtained in a moment. In addition, the average value of any particular shoot can be readily obtained.

SAMPLING DEPARTMENT OF GREAT IMPORTANCE

The form shown was designed primarily for working mines, where it constitutes the permanent records on which all estimates are based. It is, of course, used in conjunction with good assay maps, which should al-

New Method for Production of Minium

Minium (Pb_3O_4) is usually produced by roasting the oxide of lead or carbonate of lead, but the reaction is so slow that even though the finest scales of lead oxide are used, the roasting must continue 24 or 28 hr. to obtain a utilizable product, says *Metaux et Alliages*, January, 1913. For a long time attempts have been made to find a means of obtaining the desired results in a shorter time, by the aid of catalyzing agents, but the trials have had no results. To accelerate the reaction by elevating the temperature has also proved impossible. It is possible, however, to accelerate matters considerably by an elevation of the pressure of oxygen in the reacting air.

SAMPLING RECORD													
SHAFT <u>1</u>													
LEVEL <u>100</u>													
WORKING PLACE <u>No. 1 Drift West</u>													
DATE	DISTANCE FROM <u>South Wall</u>	FORMATION	SECTION	WIDTH (INS.)	ASSAY VALUE (DOLLARS)	DOLLAR INCHES	PROGRESSIVE TOTALS			NOTE BOOK		REMARKS	
							DOLLAR-INCHES	WIDTH INCHES	NUMBER	NO.	PAGE		
Sept 13	2	Schist		25	2 40	60 00				5350	2	57	All sections started from South Wall. Sections every 10' along drift from 012 West.
	4	"		30	7 20	216 00				1			
	5	"	3										
		Quartz Schist	11	15	15 60	234	510 00	70		2			
	1	Schist	12										
		Quartz	14	15	13 60	204 00				3			
	2	Schist	2	15	8 80	158 40	872 40	103		4			
	2	Quartz		30	80	24 00				5			
	3	Basalt		11	1 20	13 20				6			
	4	Schist		9	11 20	111 80				7			
	4	Quartz Schist	7	9	30 40	273 60	1295 00	172		8			
	1	Schist	3										
		Quartz	11	14	2 40	33 60				9			
	3	Schist											
		Quartz		26	10 60	276 60				5360			Mixture
	4	Schist	1										
		Quartz	9										
		Schist	1	4	24 80	352 80	1958 00	223		1			
							Average Width = $\frac{223}{4} = 56'$						
							Average Assay = $\frac{1958.00}{223} = \$8.78$						

FIG. 4. LOOSE-LEAF FORM FOR PERMANENT SAMPLING RECORD OF OPERATING MINE

ways be kept up to date. The organization of a mine-sampling department is worthy of the most serious attention, and should be separate from the mining department and under the control of a fully qualified technical man. In operating mines, it is often considered too great an expense to maintain a permanent sampling crew, but if the mine is of any size, the information from this source is of such great benefit that it should be considered one of the most important departments in the organization. Each sample, intelligently taken, constitutes a new light on those underground treasure houses, through which the engineer is so often groping in the dark.

To realize this, the ordinary oxide of lead used under pressure in iron containers, at a pressure of 12 atmospheres, gave in an hour a product carrying 60% of Pb_3O_4 , whereas under normal pressure it would have been necessary to heat for at least 15 hr. to obtain the same effect. With pure oxygen under a pressure of 12 atmospheres, one obtains the same end in only a few minutes.



The 1912 Production of Portland Cement in the United States is estimated at 81,941,998 bbl. by Ernest F. Burchard of the U. S. Geological Survey. This represents an increase of 3,413,361 bbl. over 1911. The production from the principal districts in 1912 is given as follows: Lehigh district of Eastern Pennsylvania and New Jersey, 24,449,523 bbl.; Iowa and Missouri, 7,557,090 bbl.; California and Washington, 7,258,542 bbl.; Ohio and Western Pennsylvania, 7,239,775 bbl. and New York, 4,490,180 barrels.

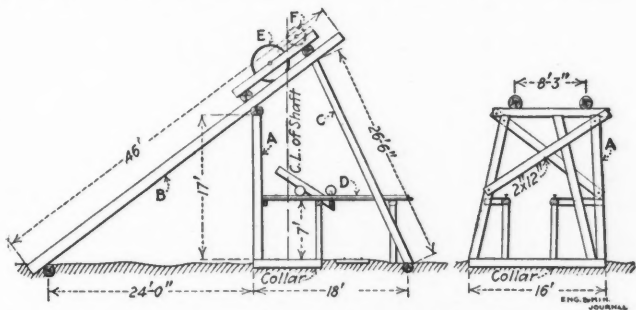
DETAILS OF PRACTICAL MINING

Reversible Temporary Timber Headframe

BY P. V. BURGETT*

The accompanying drawings show a round-timber headframe suitable for shaft sinking and development work. It is very simple in construction, and can be quickly and cheaply erected. As first designed, it consisted of only the middle bent *A*, the "rakers" *B*, the dumping platform *D*, and a 4-ft. sheave wheel *E*. The permanent hoisting engine, on the same side of the shaft as the "rakers," was to be used for hoisting. Later it was found that the hoisting plant could not be built in time. So the back braces *C* and a 2-ft. sheave wheel *F* were added to the headframe, and a temporary hoisting engine and small upright boiler were erected on the opposite side of the shaft from the permanent engine.

The details of the middle bent *A* are shown in the drawing. The back braces and "rakers" have no cross-



PROSPECTING HEADFRAME FOR HOIST ON EITHER SIDE

pieces for braces except those used to support the sheave wheel. The shaft has three compartments; two 5-ft. skipways and a 3-ft. ladderway. During shaft sinking the middle compartment is used for hoisting.

Keeping Tunnel Grade

The Rawley adit, at Bonanza, Colo., was driven at an average grade of $\frac{1}{2}$ of 1%, the machines being mounted on a horizontal bar. In order to keep the grade as closely as possible between the times when it was checked up by the surveyor, there was used the following device described by Messrs. Simonds and Burns before the February meeting of the American Institute of Mining Engineers. The hangers used at the survey stations to give the center line for setting up the bar, were made with a stirrup-shaped bottom to carry a candle and their length was so calculated and adjusted by means of a wire at the top that, when suspended, the line of the candle flames prolonged, not only gave the correct center of the face, but the proper height to set the bar to preserve the grade. Any inaccuracies in breaking

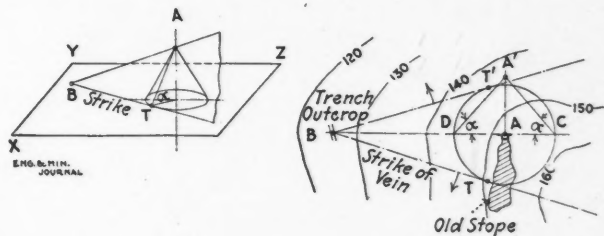
*Oliver Iron Mining Co., Mesaba, Minn.

the rock thus tended to compensate instead of proving cumulative, and the usually difficult problem of preserving a uniform grade was neatly solved. The elevations, of course, were checked whenever new survey stations were placed, and the proper length for the hangers was recalculated.

Determining Strike of Magnetic Deposit

BY M. G. F. SOEHNLEIN*

In the process of investigating a vein with a view to laying out development work, certain conditions made it difficult to determine the strike and some ingenuity was necessary to solve the problem. The vein was opened at the top of a hill where there was an entrance to an old mine. Lower on the side of the hill at *B*, the outcrop of the same vein had been found in a trench. There was no doubt about its identity, as its mineralization and



GRAPHIC METHOD OF DETERMINING STRIKE OF MAGNETIC VEIN WITH TWO POINTS LOCATED AND DIP KNOWN

width distinguished it very clearly from other veins on the same property. Since the working was accessible for about 60 ft. from the surface, it was easy to get accurate measurement of the dip of the vein with a suspended clinometer. But both the vein and the country rock were highly magnetic, so there was no possibility of taking its bearing with a compass, although, of course, this would have also determined its strike, being at right angles to the dip. A line could have been run from *B* with a transit, but the slope was very low and the entrance too difficult for setting up an instrument there.

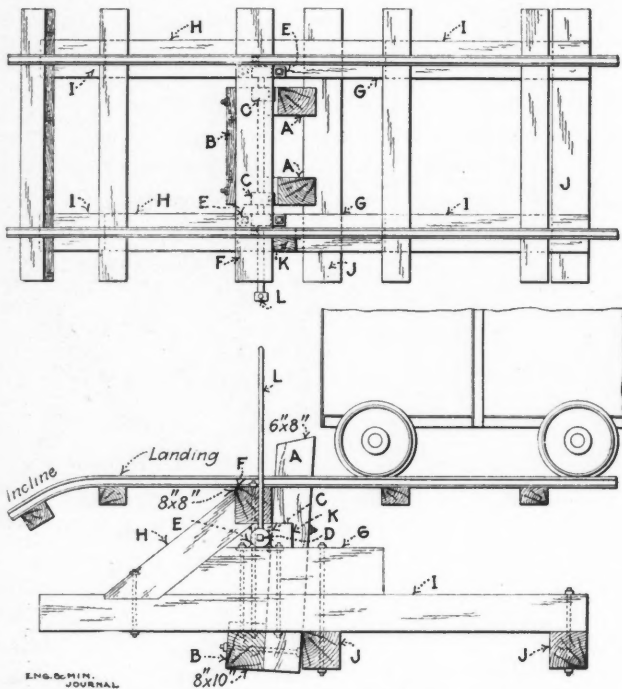
A graphic method was employed to determine this strike. The plane of the vein, *ABTA*, as shown in the ideal view, Fig. 1, must be tangent to a cone with its apex in *A* and with an angle α at its base equal to the dip of the vein, and the intersection *BT*, of this plane with the horizontal plane *XYZ* through *B*, will be the strike required. Therefore on a plan of the known data, Fig. 2, a line *AA'* is drawn at random, equal to the difference in height between *A* and *B* and the angles *DA'A* and *CA'A* constructed equal to the complement of α . Then the vertical projection of the cone is

*Machacamarca, Bolivia.

the triangle $DA'C$, and the horizontal projection is the circle $DT'CTD$, centered at A , with AD as radius. The tangent BT , drawn from B to this circle, is the required strike of the vein. The other tangent BT' , which can be drawn from B , also fulfills the conditions, but it is evident that it cannot be the strike, because the dip is in the other direction.

Safety Block for Inclines

To prevent the accidental return of a car or skip that has been hoisted to the top of an incline and detached, the device shown in the accompanying drawing is recommended by William W. Jones, State mine inspector, Albany, N. Y. It consists of two almost upright timbers A , fastened to the square shaft D by the straps C . The shaft is turned in two places to fit the boxes E . The bottoms of the timbers A are bolted to a transverse piece B . The hoisted car hits the timbers A , which revolve with the shaft, permitting the car to pass. The weight of B then brings them to the upright position



AUTOMATIC SAFETY STOP FOR TOP OF INCLINE

and the cross piece F prevents their swinging in the other direction. To release the car, the lever, which is attached to a square portion of the shaft, is used to force

BILL OF MATERIALS FOR SAFETY BLOCK; TRACK 3-FT. GAGE

Timber		Iron	
A	2 pieces 6x8 in. x 4 ft. 4 in.	4 bolts	1/2 x 20 in.
B	1 piece 8x10 in. x 2 ft. 2 in.	2 bolts	1/2 x 14 in.
F	1 piece 8x8 in. x 5 ft.	2 bolts	1/2 x 17 in.
G	2 pieces 8x10 in. x 4 ft.	2 bolts	1/2 x 28 in.
H	2 pieces 8x8 in. x 3 ft. 2 in.	2 bolts	1/2 x 34 in.
I	2 pieces 8x8 in. x 10 ft.	4 bolts	1/2 x 10 in.
J	2 pieces 8x8 in. x 5 ft.	2 bolts	1/2 x 18 in.
K	1 piece 5x6 in. x 1 ft. 1 in.	1 shaft	1 1/2 x 1 1/2 in. x 4 ft. 4 in.
		1 piece	1 x 1 1/2 in. x 5 ft.
		2 clamps	for shaft
		2 boxes	2 1/2 x 8 x 2 in. bore.

the timbers down below the level of the axles. The bill of material for installing the device on an incline with a track of 3-ft. gage is given in the table.

The Panama Canal Equipment includes 101 steam shovels; 307 locomotives; 4572 cars of various classes; 553 drills, both piston and churn; 20 dredges; 124 boats of other kinds; besides a great quantity of unclassified equipment.

Metal Drift Set

The use of steel sets instead of timber is rare in metal mines, but in the ability to take up pressure the Nellen system, with which experiments are being made in Belgium, may contain suggestions.

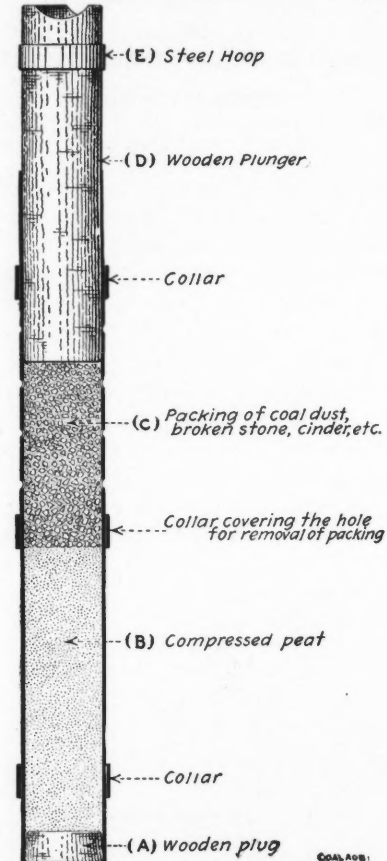


FIG. 1. SECTION OF TELESCOPIC POST

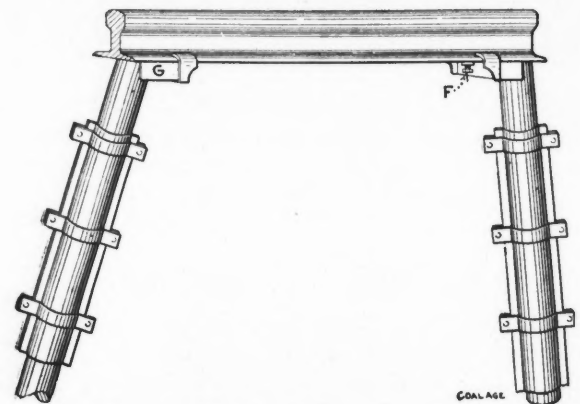


FIG. 2. METAL POSTS AND CAPS

As shown in Figs. 1 and 2, from *Coal Age*, the lower part of the set consists of a 4.8-in. split sleeve, held together by split and bolted collars. It is packed with material and plugged at the bottom. The upper portion of wood, about 28 in. high, telescopes into the sleeve. Through the holes shown at C , Fig. 1, packing material can be removed and the wooden cylinder allowed to settle, if the weight of the roof becomes excessive. The cap, which consists of a T-rail, Fig. 2, rests on compressed peat blocks G , and is held in place by the iron shoes F . As affording a means of combating swelling and bad ground, the telescoping action might be useful in metal mines.

Working Four Shafts with One Hoist

By V. G. HILLS*

An interesting method of using one hoisting engine for conducting the work in four separate shafts was employed in Halifax County, Nova Scotia, where numerous tungsten-bearing quartz veins in a series of folded quartzites were under development. The hoist was installed in the little house in the center of the illustration, which covers one of the shafts. The locations of the other three shafts are shown by the headframes. With a sheave for each shaft and two extra sheaves placed in inclined positions on a bracket built against the end of the shaft house, the cable was transferred from one shaft to another and the hoisting done in one while the drilling was progressing in another. As a matter of fact, hoisting was never done from more than three of the shafts during any period of 24 hours, and usually from only two; but it was found quite possible to carry on hoisting during the same day from sinking operations in two shafts and drifting operations in a third, the latter being carried on by one shift only. Two of the shafts were about 100 ft. distant from the hoist.



ONE HOIST SERVING FOUR SHAFTS

In further explanation of the picture it may be noted that there was not room to put the boiler in the shaft house, and that the low headframes represent the common Nova Scotia practice when working on a small scale. The miner of that country has a penchant for dumping both ore and waste on a level with the collar of the shaft, apparently for the pleasure of shoveling it up again into a car or wheelbarrow.

❖

Setting Out a Crosscut

The following method is one pursued by surveyors in Cornwall for starting a connection. Suppose it is desired to run a crosscut from a drift to a point, let us say station No. 1, in another drift. The two drifts are surveyed in, and the bearing and distance from the nearest point, called station No. 4, in the first drift, to station No. 1, is computed. The point 4 is not located in the mine. The use of a compass is objectionable as being subject to local attraction. Therefore, a wire is pulled taut between the survey stations, Nos. 2 and 3, adjacent to 4 on each side, the distance to 4 from 2 or 3 meas-

*Mining engineer, 318 McPhee Bldg., Denver, Colo.

ured off and a plumb bob hung from the wire. The transit can be set up under this plumb bob, which will be station No. 4, and the proper angle turned from 2 or 3, to give the direction of the new working.

❖

Hexagonal Stope Sets

There are three plane figures, the parallelogram, the triangle and the hexagon, which will completely fill a plane surface without leaving interstices. The rectangular parallelogram developed as a rectangular parallelepiped has been the standard shape for stope sets. It possesses certain weaknesses which are overcome by diagonal bracing. As a logical development of diagonal bracing, triangular sets have been proposed, and Robert Schloesser, in *Proc. Aust. Inst. of Min. Engrs.*, March, 1912, discusses the availability of hexagonal sets. A model of such a set is shown in Fig. 1. These sets could be placed horizontally, in which case, Fig. 2 would be a plan of a stope, or could be placed vertically, in which case Fig. 2 becomes a vertical section.

Used horizontally, the set represented in Fig. 1 has six horizontal members and twelve diagonals between adjacent floors. These diagonals take the place of posts

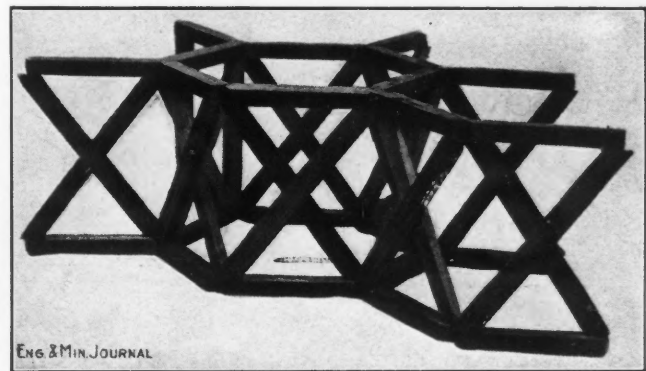


FIG. 1. MODEL OF HEXAGONAL SETS

and it can be seen that each meeting point of three horizontal members is supported by a tripod of three diagonals. Supposing the horizontal members to be 8x10 in. by 6 ft., the diagonals would be 5x10 in., and would pass midway, with or without being let into each other. Floors would probably be eight feet apart. The joints between the horizontal members would be secured by simply cutting to 120° as shown. The joint with the diagonals would be dapped in for one inch or more. Each diagonal would project under the next horizontal member and butt against the diagonal under that member, as shown in plan in Fig. 3, in which *A*, *B* and *C* represent the rising diagonals under the horizontal members. Set horizontally, hexagonal sets would be convenient for division into floors, but would not easily allow of rectangular drifts. Drifts in any one direction could be secured by substituting vertical posts for the diagonals, but laterals would have to be at an angle of 60° from these.

Placing the sets vertically like the cells of a honeycomb, shown in Fig. 2 as a vertical section, the question of drifts and crosscuts would be simplified. They could be arranged with extra long members, as shown in Fig. 4, for the sill floors, or with vertical posts as shown in Fig. 5. The division of a stope into floors would not be

quite so simple. Crosscuts at right-angles could be arranged by the removal of the diagonals. The question of raises and chutes could be solved in the same way. The greatest degree of strength would be secured by using the sets vertically, as well as the greatest degree of stiffness or resistance to "swinging" of the stope.

The caps of a square set can be considered to form a composite stull from hanging wall to foot wall, and stresses in any one cap are not distributed. The same is true of the posts, which transmit the load of the back, along one line to the sill below. With hexagonal sets, such stresses are divided and subdivided indefinitely with a consequent gain in strength for the system as a whole. Comparing hexagonal sets of the dimensions described,

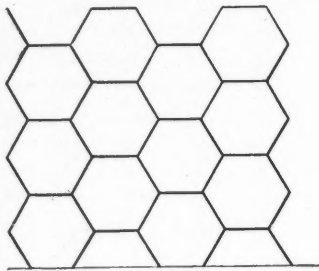


FIG. 2

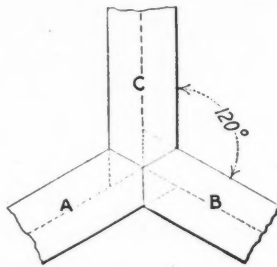


FIG. 3

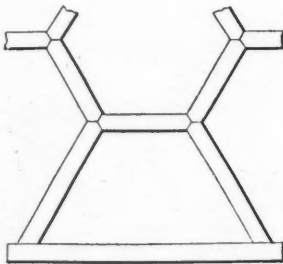


FIG. 4

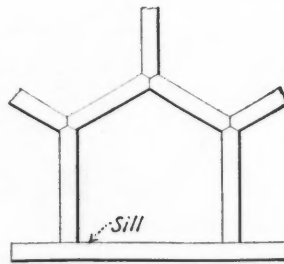


FIG. 5

SETTING AND FRAMING HEXAGONAL STOPE SETS

with a square-set system consisting of 6-ft. caps and girts, and 8-ft. posts, the former will show a saving of 37% in the timber used for any given space. Apparently this system shows a possible method of gaining strength and stiffness, but at some sacrifice of convenience.

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Selection of Suitable Explosives

It may be said in general that it is desirable in mining to break the ore without making a fine product. In the case of narrow veins carrying tellurides, the waste is more easily sorted out when in large lumps. Thus in the Cripple Creek district, according to information furnished by the E. I. du Pont de Nemours Powder Co., the rather slow-acting Repauno gelatin and Monobel No. 1 are used. In the Michigan copper mines a slow, heaving powder is desirable as the native copper will not shatter. Giant Extra and Red Cross Extra dynamites are used there. In the mining of sulphide ores which require concentration, fines are most undesirable and the slower explosives are more suitable. In the soft hematite ores of the Lake Superior ranges, economy is especially necessary and as a quick explosive would waste a large part of its energy in pulverizing the ore immediately around the drill hole, the slow powders with their heav-

ing action are used there also; and inasmuch as freezing is likely to take place underground, Red Cross Low Freezing Extra dynamite of from 20 to 40% is generally adopted. However, in cases where hard and soft bands alternate, the faster powder must be used, as a slow explosive would merely blow out in the soft portions.

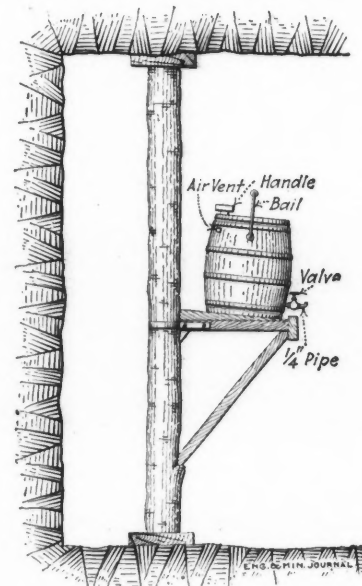
For general work underground, the "extra" grades of dynamite will be found most suitable. It is of the greatest importance to use strong caps and fuses. Nothing weaker than a No. 6 detonator is recommended and many companies use No. 8 blasting caps and electric fuses, which are twice as strong as the No. 6 detonators. Tamping is also most advisable. Experiments indicate an addition of 30% to the available force of even the quickest dynamite by the use of proper tamping. Tamping also results in a material reduction of the bad fumes.

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Sanitary Fountain Made from Cask

By E. C. CARTER*

The accompanying illustration shows the water casks used in the mines of the Gold Hill & Iowa Mines Co., at Quartzburg, Idaho. Small wine casks are used for



SANITARY UNDERGROUND DRINKING CASK

this purpose, and furnish a sanitary and inexpensive method of supplying water to the different parts of the mine.

The carmen generally send these kegs to the surface with the first car out on each shift, thus keeping the water fresh and cool. By giving the keg a slight slant toward the front sufficient force is obtained to drive the water from the small 1/4-in. pipe until the keg is practically empty.

[If it were found that the arrangement as presented offered a temptation to suck out the water when it was low, a head could be obtained at all times by dropping the opening below the bottom of the barrel, using three cells instead of one. If this were done, merely opening the stopcock would always insure an immediate flow of water.—EDITOR.]

*Manager, Gold Hill & Iowa Mines Co., Quartzburg, Idaho.

DETAILS OF METALLURGICAL PRACTICE

Surface Bins Excavated in Rock

For the new Hardenberg mill in Amador County, Calif., a novel system of ore storage is employed. The collar of the shaft is 62 ft. above the top of the mill ore bin. The ore supply is trammed to the mill by hand. From the surface track leading to the mill a tunnel has been driven into the hill through the bedrock to a point about 20 ft. back of the shaft to connect with a storage excavation. The connection is made by an upraise from the bottom of the tunnel and alongside the shaft. The tunnel is eight feet high. The bottom of the excavation is on a plane with the top of the tunnel. This gives 54 ft. of depth available for the storage of ore between the collar of the shaft and the tunnel. This excavation is cut into the solid greenstone and has a capacity of 1250 tons of ore, which may be increased by widening the cut. A larger storage compartment consists of a glory hole in the slope of the hill above the mill, which has a capacity of 3000 tons of ore. This will be made available when desired by driving another tunnel into the hill from the top of the glory hole to a point at the main or regular storage compartment, where the ore can be drawn off and trammed to the glory hole when there is an excess of ore.



Hints for Graphite Crucible Users

Some valuable information as to the proper handling of graphite crucibles is given by the Joseph Dixon Crucible Co., Jersey City, N. J., in its new catalog.

Avoid wedging material tightly in crucibles.

Scalping of crucibles comes when one portion of the crucible is heated to a temperature much higher than that of the adjoining portions. The expansion of the more highly heated portion is sufficient to rend it apart from the unexpanded cooler part.

Crucibles may easily absorb 5% of water from the air, and the presence of water in any part of the crucible prevents that part from getting heated above 212°, so that it is important that the crucible should be both warm and dry before being sharply heated up. A small fire inside of the pot during the night before using, is a simple makeshift for those not having a better arrangement.

In the use of oil fuel, perfect combustion is the end to be achieved. Too little oil or too much steam (or air) brings about an oxidizing condition that extracts the carbon from the crucible wall.

A large excess of air at low red heat is bad, as the carbon of the crucible is then consumed. This tends to make the pot porous, develops "alligatoring," and rapid wasting away.

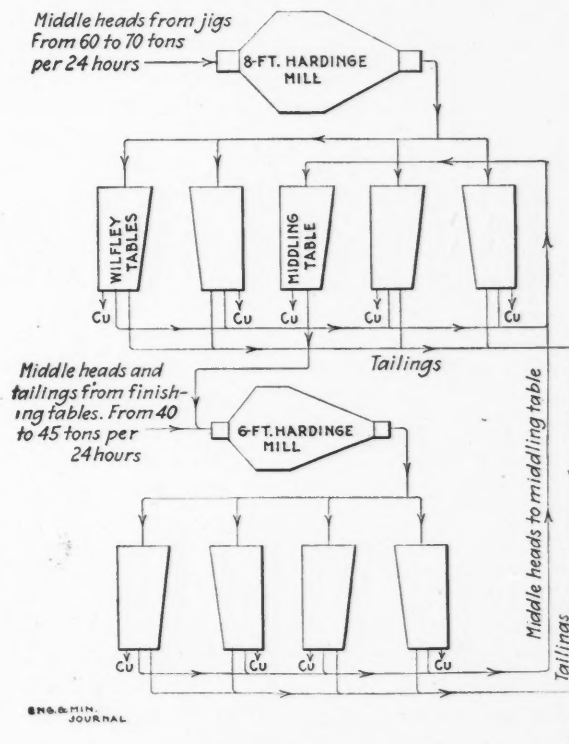
Do not heat up a new crucible too rapidly.

If the crucibles show excessive cutting or fluxing at one point, it indicates a higher temperature at that point, and that the furnace is not in proper order.

Baltic Regrinding Plant, Redridge, Michigan

By A. H. SAWYER*

One of the greatest problems in ore concentration is the treatment of middling products from jigs and tables. It is here that the greatest losses occur and where the most improvement is possible. In order to effect greater savings from this product an efficient and economical grinding machine is necessary. In the Lake Superior district various types of grinding machines, including Chilean and Huntington mills, have been tried, but because of their low capacity and high maintenance cost



ENG. & MIN. JOURNAL

FLWSHEET OF BALTIC REGRINDING PLANT

they have not been successful in solving the problem. With the advent of the low-pressure turbine, producing power at less cost, and the use of tube mills mechanically more perfect, the treatment of middlings promises to be much more successful than in the past.

The old section of the Baltic mill at Redridge, Mich., which contains four Nordberg simple steam stamps, is being equipped with a regrinding plant divided into four units, one for each head. The plant is being built in the basement, previously not used, so that no alteration in the mill proper was necessary.

Each unit consists of one 8-ft. by 30-in. and one 6-ft. by 22-in. Hardinge mill and nine Wilfley concentrating tables. Feed launders connect adjacent units so that if

*Mining engineer, Redridge, Mich.

THE COST OF DOING THINGS

Unit Drilling Costs, Rawley Tunnel

In driving the Rawley adit, described by Will C. Russell in the *JOURNAL* of Feb. 1, there was compiled each month, from the records of drilling, powder consumption and footage, a table of totals and unit costs. Some of these, together with a summary for the entire operation, covering 18 months, were included in a paper presented by Messrs. Simonds and Burns before the February meeting of the American Institute of Mining Engineers. The summary is given in the accompanying table. The variations in speed and efficiency are to be ascribed to the greatly varying conditions un-

to December, 1911, inclusive, the rock was very hard, containing pyrite and jasper. In February, three days were lost by an accident. From Mar. 29 to early in May, there was very little work done on account of a large flow of water encountered. During September and October, 1912, much timbering was necessary. The most economical results were obtained, using two shifts and short rounds.

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Electric Power Costs at El Tigre

When the Tigre Mining Co. decided to enlarge the treatment plant at its mine in northern Sonora, a large increase in power capacity was also found necessary, particularly as the local wood-fuel supply was becoming exhausted. It was calculated, said James W. Malcolmson in a paper presented before the October meeting of the American Institute of Mining Engineers, that 750 hp. would be required for the mine and mills. To furnish this, four alternatives were considered: (1) To continue with local wood-fuel, cheapening transportation with tramways and generating by gas producers and gas engines; (2) to build a plant at Yzabal, the nearest railroad point, burning oil for steam generation and transmitting electric power 30 miles; (3) to dam the Bavispe River at a point 10 miles away and generate electric power by water; (4) to install a steam plant at Douglas and transmit electric power 65 miles.

The timber available for fuel consisted of about 80% white pine and 20% scrub oak. The cost of fuel for the producer plant was calculated as shown in the accompanying table.

A steam plant at Yzabal would consume 1.5 lb. of Texas oil per horsepower delivered to the motors. The oil cost \$1.70 per bbl. of 311 lb., giving a total fuel cost for a year of \$52,480. The first cost of the producer plant using European machinery, which was cheaper, would be \$150,000, including one spare engine to permit periodical cleaning. The first cost of the steam installation would be \$133,000 for the generating plant, \$17,000 for economizers, which were not important, \$30,000 for the transmission line, \$14,000 for transformers at each end, and \$19,400 as a 10% safety margin on the estimate, giving \$213,400 as a total.

But the fuel saving on the gas plant would be wiped out by a rise of \$0.50 per cord for wood (double this rise actually took place later) and it was considered that the gas plant would be at more expense for labor, repairs and supplies; that it would be less reliable and more troublesome; and that the pine would eventually be needed in large part for underground and construction work. Therefore the gas-plant scheme was definitely abandoned.

As regards the hydro-electric plant it was found that the river flow was so exceedingly variable as to make its utilization impossible except at great expense in construction or in connection with an auxiliary steam plant.

MONTHLY TOTALS AND UNIT COSTS

Month	Number of Shifts	Number of Feet Drilled	Actual Hours of Drilling	Pounds of Powder Used	Feet of Advance
1911					
May.....	..	..	..	..	111
June.....	33	5,901	185	2,867	218
July.....	59	11,323	397	5,785	414
Aug.....	62	11,059	427	6,935	403
Sept.....	48	7,850	345	4,183	280
Oct.....	61	8,703	476	6,043	352
Nov.....	60	9,676	444	6,155	394
Dec.....	46	5,037	280	2,408	282
1912					
Jan.....	62	9,673	396	5,186	462
Feb.....	53	9,176	330	4,559	403
Mar.....	56	10,539	365	5,656	472
Apr.....	..	1,210	51	327	40
May.....	62	6,069	310	3,011	205
June.....	83	11,888	442	6,768	488
July.....	80	10,480	439	5,448	555
Aug.....	69	8,049	312	3,202	421
Sept.....	68	7,296	299	3,163	390
Oct.....	37	3,302	125	894	185
Total..	939	137,231	5623	72,594	5963

	Feet Drilled per Minute	Pounds of Powder per Foot of Hole	Feet of Hole per Foot Advanced	Pounds of Powder per Foot Advanced	Minutes for Drilling one Foot	Feet of Advance per Shift
1911						
May.....	..	..	..	..	..	..
June.....	0.532	0.486	27.0	13.1	1.89	6.6
July.....	0.476	0.511	27.4	14.0	2.10	7.0
Aug.....	0.431	0.627	27.2	17.2	2.32	6.5
Sept.....	0.379	0.533	28.0	14.9	2.64	5.8
Oct.....	0.305	0.694	21.9	17.2	3.28	5.8
Nov.....	0.363	0.636	24.3	15.4	2.76	6.6
Dec.....	0.299	0.478	17.9	8.6	3.33	6.1
1912						
Jan.....	0.407	0.536	20.9	11.2	2.45	7.4
Feb.....	0.464	0.497	22.8	11.3	2.15	7.6
Mar.....	0.484	0.537	22.4	12.0	2.08	8.4
Apr.....	..	..	..	..	..	..
May.....	0.326	0.496	29.6	14.7	3.06	3.3
June.....	0.448	0.569	24.4	13.9	2.23	5.9
July.....	0.398	0.520	18.9	9.8	2.51	6.9
Aug.....	0.431	0.398	19.1	7.6	2.32	6.1
Sept.....	0.407	0.434	18.7	8.1	2.45	5.7
Oct.....	0.439	0.271	17.8	4.8	2.28	5.0
Average..	0.407	0.520	22.9	12.2	2.46	6.4

(a) No record was kept for May. The advance of 111 ft. is not included in the total as given.
 (b) During June 380 ft. was driven but no record was kept covering the first 162 feet.
 (c) In April 62 ft. of additional crosscut was driven. The entire length of the adit was 6235.5 feet.

derground. Thus, up to Dec. 22, 1911, the work was conducted in two 8-hr. shifts, each shift putting in one full round to break eight feet if possible. After that date, each shift was required to drill and break two rounds of from 4.5 to 5.5. ft. each, and the men were paid for overtime. But toward the end of March it was discovered that the method was illegal, in that overtime work is prohibited in Colorado law, and consequently it had to be changed to one using three 8-hr. shifts, a large part of this time being wasted. From September

There remained for consideration the Douglas plant, and this was finally built. By making arrangements with the Copper Queen Consolidated Mining Co., it was estimated that power would cost somewhat over \$70 per horsepower-year delivered, or an annual total of between \$54,000 and \$57,000 as against \$105 from the Yzabal plant or a total of \$79,000 annually; this in spite of the more than double length of transmission.

The Douglas proposal was therefore adopted and power first delivered to the mine in June, 1911. The plant, which is at the works of the Copper Queen Company, consists of two 750-kw. exhaust-turbine generators working at a 50% overload or underload without serious loss of efficiency. The current is delivered to the busbars at

FUEL COST OF PRODUCER GAS GENERATED FROM WOOD

	Horsepower-hours per Year	Pounds of Wood per Horse-power-hr.	Total Pounds of Wood per Year	Pounds of Wood per Cord	Total Cords per Year
White oak, dry.....	1,600,000	3.3	5,280,000	2020	2,600
Fine, dry.....	4,800,000	3.0	14,400,000	1326	10,900
Total.....	6,400,000		19,680,000		13,500

Estimating these 13,500 cords at \$3.25 per cord equals a total of \$43,875 per year. Adding coke used in the bottom of the producers, 14% of the weight of the wood consumed, equals 150 tons per year, and at \$20 per ton, equals \$3000 per year, giving a total fuel cost of \$46,875.

2200 volts, stepped up to 44,000 volts by three General Electric transformers and stepped down to 440 volts at the mine for local distribution. The 60-cycle, three-phase current is carried on a single line of wood poles, in three wires of No. 4, Brown & Sharpe gage, medium-hard-drawn copper, telephone wires being carried below. The poles are spaced 200 ft. apart with a span of 1600 ft. over the Bavispe. The line including the transformer stations was built by Sanderson & Porter, of New York.

The cost of the line and transformers was \$161,121. The cost of the line alone was about \$2000 per mile. The generating plant cost \$71,894. The cost of installa-

Mining operation charges consisted of exploration, 4.61c.; development, 3.87c.; stoping, 39.13c.; tramming, 15.76c.; hoisting, 3.44c.; timbering, 3.57c.; and mine expense, 13.07c. per ton. Milling operations include crushing, 4.55c. per ton; milling, 62.16; and water supply, 0.52c. per ton. Miscellaneous account was made up of hospital and claims, 0.09c. per ton; insurance and taxes, 2.29c.; ore sampling, 0.83c.; concentrates and ore freights, 21.26c.; legal expense, 1.42c.; and sundry charges, 1.23c. per ton. The gold credits amounted to 11.47c. per ton and silver 5.6c. per ton.

The ore treated averaged 1.142% Cu or a total head contents of 9,727,235 lb. of copper and the net smelter returns showed 5,527,810 lb. of copper, indicating a net recovery of about 56.8% of the copper contents. The mill recovery was 59.09% concentrating at the ratio of 12.51:1. Concentrates averaged 8.438% Cu, 1.38 oz. Ag, 0.0708 oz. Au and 28.86% Fe per ton. The development work consisted of 4451 ft. of drifting, 614 ft. of raising and 17 ft. of sinking, a total of 5082 ft. The cost per pound of copper was 17.17c. Credits for gold, silver and miscellaneous earning make a net cost of 15.5c. per lb. of copper.

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Data on Tramming

The following notes and table were compiled from data in articles recently published in the "Cost of Doing Things." The table is made up from data furnished by officials of the mining companies given. The notes were extracted from the latest annual reports or obtained from other reliable sources but are necessarily limited owing to the lack of tramming costs published in the reports. At the Elkton Consolidated Mining & Milling

DATA ON TRAMMING

Mine	State	Shoveling from Rock Bottom				Shoveling from Plat				Loading from Chute			
		Size Car Used	No. of Men	Length of Tram Ft.	Amount Trammed per Man-Hr.	Size Car Used	No. of Men	Length of Tram Ft.	Amount Trammed per Man-Hr.	Size Car Used	No. of Men	Length of Tram Ft.	Amount Trammed per Man-Hr.
Erie Consolidated.....	Calif.	1½ ton	2	1000	1.17 ton	1 ton	1	100	1.75 ton	1.25 ton	1	1500	3.12 tons
Pittsburgh-Silver Peak	Nev.	1½ ton	1	1000	1.6 ton	1.1 ton	1	1000	1.575 ton	1.1 ton	1	700	6.19 tons
Cananea Consolidated.....	Mex.	16.8 cu.ft.	1	300	35.8 cu.ft.	16.8 cu.ft.	1	300	42.0 cu.ft.	1.68 cu.ft.	1	300	84.2 cu.ft.
Ohio Copper.....	Utah					20 cu.ft.	1	100	41 cu.ft.	20 cu.ft.	1	150	206 cu.ft.
Mother Lode.....	B. C.									2.15 ton	1	450	8.4 tons

Tramming with horses and locomotives

tion was paid for by the Tigre Mining Co. and the power bought on a sliding scale varying with the amount taken and the cost of fuel oil at Douglas. This cost is about 0.95c. per kilowatt-hour at Douglas.

An average of about 616 hp. is distributed at the El Tigre switchboard at a total cost of \$86 per horsepower-year. This power consumption takes care of 6000 tons of ore concentrated and 7500 tons cyanided, beside the requirements of the mine.

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South Utah Mines

The annual report of the South Utah Mines & Smelters, Newhouse, Utah, for period Sept. 1, 1910, to June 30, 1912, states that 426,002 tons of ore were milled and 701.48 tons shipped at a cost of \$2.2255 per ton. This cost was made up as follows: Mining, 83.45c. per ton; milling, 67.23c.; miscellaneous accounts, 24.96c.; and smelting, freight and refining, 46.91c. per ton. From this cost a credit for gold, silver and other earnings amounting to 21.60c. per ton was deducted, leaving a net cost of \$2.0095 per ton.

Co., Cripple Creek, Colo., the 1911 cost of tramming was 14.6c. per car of approximately 0.7-ton capacity. The South Utah Mines & Smelters, Newhouse, Utah, reports its tramming cost for the year ended June 30, 1912, at 15.76c. per ton of ore, which evidently includes the cost of handling the waste removed. In Goldfield, Nev., tramming has averaged about 18c. per ton of ore produced from stopes and has ranged from about 14 to 25c. These figures are for actual tons trammed and do not include any shoveling in stopes. At the North Star mine, Grass Valley, Calif., observations show that a man pushes an 18-cu.ft. car about 150 ft. per min. and shovels about three tons per hour from a plat into car against two tons when shoveling off a rock bottom. According to this a shoveler's efficiency is increased about 50% by using a plat. The Wolverine Copper Co., Houghton, Mich., reports tramming costs at 17.4c. per ton of ore, and the Wetlaufer-Lorrain, Cobalt, Ont., 21c. per ton of ore.

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About 65 Tons per Drill-shift are broken at the Dome mine in Ontario, and about 6.5 at the North Star in California. This difference in two well managed mines shows the futility of comparing costs without considering local conditions.

History of the Copper Queen Mines

SYNOPSIS—An interesting and authoritative history of the Copper Queen mines, presented by Doctor Douglas, before the Institution of Mining and Metallurgy. The early vicissitudes of this successful enterprise illustrate the turns of chance determining the life of a mine or district. The circumstances permitting the entrance of the Calumet & Arizona into Bisbee are published, probably for the first time. A generous tribute is paid to the influence of that rival but friendly company in the progress of the district. Remarks on the relations between Phelps-Dodge and the El Paso & Southwestern; on the necessity of square setting in the stopes; and on the increased precious-metal content in Bisbee ores.

❖

A large mine of the baser metals cannot be opened without cheap transportation. Before the annexation of the Southwest, it is true, some copper was extracted from the Ajo mines, which are within easy distance of the Gulf of California, and some native copper from the Santa Rita Mountains in New Mexico. After annexation, the first copper mined was from the Planet mines, at the mouth of Bill Williams Fork, on the banks of the Colorado River. This ore went by water all the way to England. The next mine opened, about 1870, before the advent of the railroad, was the Longfellow, at Clifton, Ariz. The first attempt to smelt its very rich ores was made in reverberatory furnaces, with firebrick costing a dollar apiece. That proving unprofitable, the old-fashioned Mexican adobe furnace, with charcoal as fuel, was adopted. By an interesting series of expedients, commencing with a metal plate sprayed with water, the owners, the Lezinsky brothers, developed a furnace built up of copper troughs cast from the crude copper they were producing. Though 700 miles from the nearest railway station, they made copper profitably, simply because, they being merchants in that section of the country, the teams which came west with their merchandise, returned loaded with their copper bars.

DEVELOPMENT FOLLOWED THE RAILROAD

It was not until the Southern Pacific traversed the territories of Arizona and New Mexico that active copper operations were undertaken on deposits, all of which had been discovered prior to the building of the road. As soon, however, as economical access to the world's markets was afforded, active mining and smelting were commenced. But it was only when the railroad systems of the territory expanded and the copper districts were brought into close contact with one another, that ores could be cheaply exchanged and the full benefit of railroad transportation experienced by the mines and smelters, to the mutual advantage of both the carriers and their clients. One is therefore faced by the paradox that without cheap transportation few mines can be made to pay and conservative methods adopted; and yet, until these mines are developed, often at a loss to the shareholders, and with inevitable waste, and thus freight as-

sured to the railroad capitalist, money to build the railroad is not forthcoming.

BISBEE ORES RICH AND SELF-FLUXING

Cheap local transportation was not indispensable to the Warren district as it was to the Globe and Clifton districts, inasmuch as the Bisbee ores were of high uniform richness, and were self-fluxing. Moreover, in the early days, it was assumed that Arizona had the advantage over Butte of possessing in abundance oxidized ores that could be converted by a single fusion into black copper. Before long, however, when the converter was adopted in copper smelting, it came to be recognized that the intermediate production of matte was essential to clean and economical work. Bisbee alone, almost from the first opening of its mines, possessed sulphides of copper in such quantities as to interfere with the quality of its bars made in a single smelting operation, and, in fact, in such quantity that until today the mines of the district yield naturally oxidized as well as sulphide ores in such proportions as to yield a suitable furnace mixture without roasting.

Globe, after more than 30 years of active mining, exchanges its oxidized siliceous ores for basic sulphides from Bisbee. Until this was done copper smelting at Globe, notwithstanding the richness of its siliceous ore, was unprofitable. And at least one of the Clifton companies has still to look abroad for pyrites.

OUTCROPS WERE INCONSPICUOUS

But, notwithstanding its subsequent prominence, the Warren district had not attracted as much notice as some other districts before its active development. One reason was that the copper-bearing limestones which dip south from the core of the Mule Pass Mountains exhibit very few exposures of ore. It is now known that the whole series of limestone, extending from the Cambrian to the Upper Carboniferous, all carry some copper, but the beds which contained, so far as exposed, the largest masses of pyrites under conditions favorable for decay; and during which copper was concentrated as oxides and secondary sulphide ores, are found in Carboniferous, and to a lesser extent in the Upper Devonian limestones. As these are overlaid by hundreds of feet of comparatively barren rock, and as the beds which contain the orebodies dip more steeply to the south than the inclination of the surface, the surface orebodies in these productive limestones were exposed only near the outcrop of their beds, and the deeper orebodies of the chain had to be sought for at steadily greater depths.

The one notable orebody which made the district famous cropped out in the Copper Queen claim, on the northern exposure of what was subsequently known as the Copper Queen Hill. It was an almost circular body of oxidized copper, iron and manganese, approximately 60 ft. in diameter, inclosed in unaltered limestone. The ore was so basic that for a short time foreign silica had to be added to the furnace charge; but it was so rich that for months the furnace yield was 23% of copper.

The furnace plant consisted of one water jacket of 36 in. diameter, supplemented afterward by a second. They were erected immediately beneath the open-cut from

Note—An abstract of a paper, "The Copper Queen Mines and Works, Arizona, U. S. A.," by James Douglas, with subsidiary papers: "Geology of the Bisbee Ore Deposits," by Arthur Notman; "The Power Plant at Bisbee, Arizona," by Charles Legrand; "The Power Plant at Douglas, Arizona," by Charles Legrand; and "Reduction Works at Douglas, Arizona," by George B. Lee; "Bull." 101, I. M. M.

which the ore was shot down, through a breaker shed, on its way to the furnace.

OTHER CLAIMS WERE ACQUIRED

There was at the time only one other company extracting a small quantity of surface ore from the Neptune group of claims, to the south of the Queen Hill. The profitable deposits lay so far below their surface that even the most enthusiastic miner would have lost courage in looking for them. The property of this company, consisting of seven claims, was ultimately sold by the sheriff, and passed into the possession of the Copper Queen Mining Co. These orebodies, reached by underground development on the dip of the limestones, are still providing the Copper Queen Co. with a fair share of its ore supply.

In the beginning of 1881, though active mining was being prosecuted only on the Copper Queen and Neptune claims, the district for a long distance around had been located. Immediately above the Copper Queen, on the hillside, a parallel claim, the Atlanta, had been relocated over an older claim, the Satisfaction. The Queen orebody was dipping toward it, and maintaining its full size, though not its original percentage of copper, when the claim was bought, on my advice, by Mr. James and Mr. Dodge, the senior members of the firm of Phelps, Dodge & Co. I could not conceive of such an extraordinarily large and rich mass of ore, as was exposed in the Copper Queen, constituting either the only deposit, or terminating abruptly within the arbitrary bounds of a single claim. I was right, and yet I was wrong. The limestones enveloped it on its dip as completely as they confined it at its outcrop, and this wonderful cylindrical body of copper ore and ledge matter disappeared before it reached the Atlanta side line. This untoward disappointment happened, after four years of profitable work, at the 400-ft. level of the incline from the outcrop; but not until the original owners and the shareholders of the company they had organized, had extracted 34,536,000 lb. of copper, and distributed in dividends \$1,350,000.

During this first period of the Queen's progress, the Atlanta Mining Co. had been driving tunnels, and following irregular, tortuous streaks of copper from the surface downward in the hope of discovering another orebody, but all in vain. Meanwhile, however, the Prince Copper Co. had obtained a claim to the west of the Copper Queen and on the same limestone horizon, and was extracting rich ore from an outcrop and contesting the rights of the Queen to follow their ore on its dip, in conformity with the law of apex, into the Queen ground. It won its suit and prospered for a time.

A NEW OREBODY WAS DISCOVERED

In the summer of 1884 the Copper Queen company had almost exhausted its ore resources, and was drifting aimlessly in pursuit of others. The shareholders of the Atlanta Mining Co. had contributed their last assessment before abandoning their search, when almost simultaneously the shaft which the Atlanta company was sinking, and the drift that the Copper Queen company was running to the east, entered another orebody with apparently a reverse dip to the rich shoot which had made the previous life of the Copper Queen so prosperous.

The inevitable legal question as to the rights of the Copper Queen company, under the Eureka-Richmond rul-

ing, to claim ownership of all bodies on the dip of the limestones within the endline of their claims along the outcrop, became acute, and a decision had to be reached whether litigation or mining would be the principal industry of the Warren district. Instead of fighting it was decided to combine, and the original Copper Queen company, which owned only the Copper Queen, the Czar, Copper Jack, Iron Mountain and the Rucker claims, threw in its exhausted claims, in August, 1885, with the Atlanta Mining Co., owning the Atlanta, Belle Isle and Ellie. The new company simply added the word "Consolidated" to its old title. The capitalization of the company, considering the rather dubious outlook, was lowered from \$2,000,000 to \$1,400,000. Then for three years there was a cessation of dividends. But something better than earning dividends occupied the company during this gap in its money-making career. Other orebodies, one of them the most productive of any as yet extracted, were discovered on the Atlanta, and the prospects became so encouraging that money was borrowed to erect larger and more economically designed works.

When the bottom of the original Queen orebody terminated in limestone, a small streak of ore was detected crossing from the Queen into the Atlanta on the old 400-ft. level. Till the new orebody was struck, this veinlet was the only clue to follow, and to reach it the shaft was being sunk on the Atlanta with the fateful \$15,000, the last contribution to the exploration fund, which was to decide the fate of the old Atlanta Mining Co., and probably of the district. This so called "joker," when the ground was explored by the Consolidated company, led into a large orebody which constituted the chief ore reserves for a number of years.

FURTHER INCREASE OF HOLDINGS

The discovery of these new orebodies and explorations in depth along the dip of the limestones to the south, began to throw light upon the character of the ore deposits, their possible relation to one another, and some faint suspicion as to the bearing of the felspathic rock and the faults upon the genesis of the ores. The effect was to excite some faith in the permanence of the region as a mineral producer and encourage the purchase of adjacent property. The Holbrook & Cave Co., owned by a neighboring company, was in the market and was secured by interests favorable to the Copper Queen. The large area owned by the Neptune Co. was sold by the sheriff and bought in by the same interests; and other groups of contiguous mining claims were secured, extending the property of the Copper Queen far beyond the limits of any actual discovery, and over an area beyond all anticipation of the extension of oxidized ores in depth. Mining property was still cheap, and, had the faith and hope of the Copper Queen administration been as strong as they should have been, the whole of the limestone area within sight could have been secured for a trifle. But the welfare and development of the district at large would not have progressed as rapidly under single, as they have under multiple, ownership.

GEOLOGICAL RELATIONSHIP HARD TO ASCERTAIN

In the early days the geological features were hardly recognized, and in searching for ore the miner followed such clues as in his experience he accepted as indications. The petrologist's skill in distinguishing minute

mineral differences, and the ingenuity of the geologist in accounting for natural phenomena and deducing nature's ways of bringing them about, is marvelous; but the instinctive and mysterious assurance with which an old and experienced miner interprets with almost occult sense the near presence of ore, and anticipates what he cannot see, stands him, though very indifferently, as a substitute for the more accurate diagnosis and often correct prognosis of the scientist.

The earliest reconnaissance of the geological structure of the region was made by Doctor Ricketts, but the first actual survey was made by Mr. Ransome, of the U. S. Geological Survey, whose monograph and maps have become the guides which we and our neighbors have since followed with advantage in search of ore. Our present geological staff, under the general direction of J. M. Boutwell, and with Arthur Notman as local head, has generally corroborated the observations and deductions of Ransome, and its advice has given a degree

GROWTH OF THE COPPER QUEEN

Year	Claims Acquired	Holdings Acres	Lb. Copper Produced	Dividends Paid	Remarks
1881	2	26.08			
1882	34,536,000	\$1,350,000	Under Martin & Ballard and original Copper Queen Mining Co.
1883	..	..	
1884	1	0.473			Under Copper Queen Consolidated Mining Co. Developing and rebuilding.
1885	3	37.99	6,721,535	.....
1886	3,797,360	Enlarged smelting works and better prices paid for copper by M. Secretan during 1888 and 1889.
1887	16	188.734	5,945,550	.....
1888	5	59.107	9,379,949	140,000	
1889	1	10.77	9,408,000	105,000	
1890	1	11.56	9,031,680	210,000	
1891	3	23.19	10,203,683	420,000	
1892	28	234.353	9,806,764	385,000	
1893	6	55.685	13,795,618	300,000	
1894	..	..	12,688,372	200,000
1895	..	..	15,741,731	250,000
1896	23,298,150	400,000	Large accessions of property by acquiring the Holbrook & Cave Co.'s mine, the Neptune Co., and other claims. Bisbee smeltery enlarged to an extent limited by site.
1897	..	..	23,999,873	700,000
1898	2	0.708	33,749,390	1,000,000	
1899	2	0.872	36,901,684	2,000,000	
1900	6	54.722	34,382,309	2,800,000	
1901	35	430.485	39,781,333	3,150,000	
1902	10	196.21	35,831,755	800,000	
1903	7	120.168	36,939,800	800,000	
1904	..	..	61,225,522	800,000
1905	..	..	76,791,981	2,300,000
1906	79,807,461	6,500,000	The production of the Douglas smeltery
1907	..	..	52,502,961	3,800,000
1908	..	..	81,986,236	3,000,000
1909	..	..	75,869,405	4,025,000
1910	..	..	71,928,357	6,300,000
1911	45	727.494	75,203,813	5,200,000	

of uniformity and reasonableness to our exploratory work which it did not possess before. But at best our development work is costly and still more or less empirical, for while faults may be accepted as the channels by which ore currents ascend or descend, or into which lateral secretions may filter to form orebodies, all faults are not the parents of orebodies, and even productive faults are barren in places; and, therefore, when searching for ore in our limestones, we must burrow erratically, often following delusive trails which science or false precedence may have traced for us.

Our strictly exploratory work represents one-fourth of the cost of our total mining operations, and therefore any aid which geology can give us toward exploring systematically instead of empirically, is of immense pecuniary advantage to us. During the year 1910, for instance, there were 59,806 ft. of exploratory and development work driven, and the cost of doing that was 21.9% of the total mining operations. In 1911 the number of feet driven was 62,444, and the cost was 23.5% of the total.

CHANGES MADE IN REDUCTION PROCESSES

Till 1893, copper was made in the cupola from oxidized ores, by a single fusion, into bars of the Chile standard.

But as early as 1886 a film of matte floated on our bars, and the quality of our copper declined until we were forced to abandon the direct method, make matte, and reduce it to metal in a converter. In 1893 the first converter was blown in. The result was economical from the start. The recovery of copper, through saving in slags alone, over the direct method, was indicated by a furnace yield of 8.39% as against 7.56% with the old.

Moreover, almost simultaneously with the substitution of the rapid pneumatic process for the old, slow method of concentrating matte, refining by electrolysis was introduced, by which a purer copper was obtained than by the old furnace method, and the associated gold and silver were recovered at a small extra cost. When converting was first adopted, the converters were fed from a remelting furnace, but this wasteful operation was soon abandoned, and each of the three trough converters, 8 ft. in length by 5 ft. 8 in. in diameter, was fed from a cupola, 10x3 ft. 6 in., provided with a tilting-well placed between the cupola and its converter on a lower level. But though the capacity of each furnace was adjusted as accurately as possible to the capacity of its own converter, the furnace had occasionally to wait for a converter and the converter for the furnace, more especially as the matte could not be poured until the well was nearly full, lest the slag in any quantity accompany it into the converter.

ARGENTIFEROUS COPPER KEPT SEPARATE

The coupling of a single furnace and converter enabled us to make, without any serious complication, a rich argentiferous bar for electrolytic refining at a time when the cost of electrolytic treatment was still high, by selecting our more argentiferous ore for concentration in a single cupola, and thus separating the copper for the older and cheaper refinery furnace treatment from that which could be economically electrolyzed.

As the statistics of our copper output show, the change of method was speedily followed by an increase of production, which made the introduction of the crane a necessity. And at the same time the reduction in the electrolytic charges soon brought all our Bisbee copper within economical range of electrolysis, though the quantity of the precious metals was small. The ores of the Bisbee district contained at that time, and for a long period, only between \$0.60 and \$0.70 value per ton in silver, and a trace of gold, which, when concentrated in 99% bars, represented from \$8 to \$10 per ton of copper. Though the precious metals are not evenly distributed, the higher value of electrolytic over casting copper permits of the recovery of even such small values in precious metals as the ores of the Warren district carry.

INCREASED PRECIOUS METAL CONTENT

There has been an increase of late years in the gold and silver contents of the ore, due in part to the exposure of some rich argentiferous copper-lead ore. From 1904 to 1911 the silver increased from 7.9 oz. to 23.4 oz. per ton of copper and the gold from \$2.37 to \$7.43 per ton of metal. But the uneven distribution of the precious metals is exhibited in the latest report (1911) of the Calumet & Arizona Mining Co., which gives the gold and silver contents of their copper bars as \$28.07 per ton of copper, while the Superior & Pittsburg Copper Co. (a subsidiary company of the Calumet & Arizona Co.), work-

ing adjoining claims, gives the gold and silver value of their copper bars as \$21.20 per ton of copper. During the same period the bullion from the ores of the Copper Queen mine contained \$20.05 per ton in gold and silver values.

The production of the Copper Queen mine in 1912 was 692,995 short tons of ore, containing 81,597,115 lb. of copper, 13,863 oz. of gold, and 674,086 oz. of silver. In addition to the copper ore, the mine yielded 10,626 tons of lead ore, containing 2,953,685 lb. of lead, 3889 oz. of gold, and 325,931 oz. of silver.

From our experience as to the gold and silver values in the bullion, which determines the method of refining to be selected, the Copper Queen bars, containing gold and silver of a value of \$20 a ton, or even half that value, are economically refined by electrolysis, whereas our Detroit bars, with \$4 to \$5 in gold and silver values to the ton, are preferably made into merchantable, refined ingots by the furnace method. The bars of both brands are, however, of exceptional purity as turned over to the refinery, and therefore treated on very favorable terms.

The production of the Copper Queen company, roughly speaking, increased as the area it controlled increased, though not exactly in proportion, for the reason that the unstable condition of the large masses of arenaceous ledge matte in which the rich bodies of ore occur have made it undesirable and expensive to open up much ground in advance of its extraction. The partitions of limestone between the large masses of so called ledge matter are not strong enough to prevent such lateral and vertical movements as render it impossible to maintain the verticality of the shafts or an operating grade for any length of time on our levels.

RAILROAD CONNECTION OBTAINED

An essential element to the progress of the mine was the facility of transportation. Up to the date of the French syndicate, which was formed shortly after the opening of our second works, the increase of our production up to approximately 1,000,000 lb. per month involved a transportation in fuel and bullion of about 100 tons per day, and the transportation by 18-mule teams became embarrassing. Before embarking in railroad building we tried a Fowler traction engine. It did its work efficiently on the hard roads and steep grades of the Mule Pass Mountains, but ploughed laboriously through the sands of the level mesa, and was hopelessly bogged in wet weather.

The company, therefore, built 37 miles of standard gage road from Bisbee to Fairbank, as the Arizona & Southwestern R.R. Our transportation charges had been \$7 per ton by team for that distance. Estimated by the ton-mile rate, the railroad transportation was high, namely, 3c. per ton-mile, but the total charge per ton was only a little over \$1, as against \$7 by mule team.

The railroad then built served our purpose until 1900, when the necessity became imperative of selecting a new site for works, which would afford room for expansion. Up to that date the mining company had owned and operated the railroad. As, however, legislation was enacted which forbade any industrial enterprise controlling its own transportation facilities, if those facilities were organized as a public railroad company, the copper company was obliged to sell the Arizona & Southwestern R.R. to the El Paso & Southwestern R.R. Co. The latter com-

pany built first to the junction point of the Nacozari railroad, which point was christened Douglas; and subsequently extended its track into El Paso, a further distance of 217 miles, in order to reach a competitive railroad point. Douglas lies in the Sulphur Spring Valley where, though water never flows continuously on the surface, there is an unfailing underground supply.

RAILROADS DEPENDENT ON MINES

At a still later date the railroad was extended to the Dawson coal fields in northern New Mexico, as well as the El Paso & Northeastern R.R. Co. and the Dawson R.R., in order to reach the coal. The railroad company, though an absolutely disassociated enterprise, recognized that, as it depends so largely upon the prosperity of the mining industries along its lines, it must afford them, especially in the matter of fuel transportation, satisfactory and prompt service. Statements of freight traffic on the eastern and western divisions of the El Paso & Southwestern R.R. Co. exhibit the mutual reliance of the mining and transportation interests on each other in this particular section of the Southwest. The products of mines form from 56% to 61% of the total traffic.

The accompanying table marks the different stages of growth in the enterprise as indicated by the rapid increase in production, each step upward of which was due to some radical improvement in method, enlargement of plant, or expansion of mining territory. Previous to 1887, the company was known as the Copper Queen Mining Co., after that time its title was Copper Queen Consolidated Mining Co.

ENTRANCE OF THE CALUMET & ARIZONA

It was about this period, when we were contemplating the erection of new and larger works, that an event occurred which has had a very notable influence upon the development of the district. After the failure of the early competitive companies the Copper Queen company had been the only operating company and the dominating power in the Warren district. But in the year 1899 a group of courageous miners secured an option on the Irish Mag claim, whose history was illustrative of a phase of Western life which is fast disappearing. On one of my early trips to Bisbee, a man named Daly was introduced to me, who told me that there was a plot against my life, that he had been taken into the conspiracy and offered a certain sum to kill me. I recognized at once that the man was insane. Shortly afterward the same man came to me and offered me all his claims, including the Irish Mag, the Senator group and a claim on the Sacramento Mountain, for \$10,000, as he said he was anxious to leave the camp. I would have been glad to buy them, simply for the purpose of securing his extradition, but our superintendent, whose life he had threatened, said that if I bought them he would resign. Shortly after that Daly shot a deputy sheriff as he was entering his gate to serve a warrant for his arrest. Daly was seen running up Sacramento Mountain behind his house, and that was the last authentic knowledge as to his whereabouts, though he signed a deed of his property in Pueblo, Colo., to a certain Andy Mehan.

Another claimant of his property was a Mexican wife with whom he lived, and who claimed that she advanced Daly the money with which to do his title work. Protracted litigation followed. The title was ultimately vested

by the Supreme Court of the United States in the Mexican wife. Long before the decision was made we knew the Irish Mag to be of value, but, Daly being a fugitive from justice, we hesitated to negotiate for his claims. And so the Irish Mag slipped out of our hands and into that of our friends, the Calumet & Arizona Mining Co., the successor to the Lake Superior & Western Development Co. The Calumet & Arizona company has developed, by purchase and consolidation, into a powerful company, owning more than 100 claims, and making a production at present of over 50,000,000 lb. of copper per year. It built a smeltery at Douglas, not far from that of the Copper Queen, and is now rebuilding it with a view to increased economy in operation and a larger output.

ESTABLISHMENT OF VERTICAL BOUNDARIES

We might have claimed so much of the territory owned by that company as was covered by the apex of the Naco and Escabrosa limestones on Copper Queen ground, under the famous decision of Judge Field, in the Enreka and Richmond case. Had the question been submitted to litigation as to who owned the orebodies on the dip of that particular group of limestone beds, the decision would probably have been in favor of the Copper Queen; but the question could only have been settled after bitter litigation, enormous expense and repeated injunctions and interruptions of work.

The Copper Queen company, therefore, decided that it would make an arrangement with its neighbors, waiving the law of the apex, and adopting the common law rule, by which the side and end line carried down vertically define the ownership of the minerals in depth. The agreements between the companies involved the right to free access to each other's mines. Therefore, any discovery made by one company has been open to the inspection of his neighbor. And of this privilege the companies affected have taken liberal advantage. Consequently the Warren district in the last few years has made perhaps greater progress than any other in the West.

POSSIBLE ORE HORIZON EXTENDED

In addition to the two large companies, the Shattuck & Arizona Company has been organized to work a group of claims owned by L. F. Shattuck, adjacent to the ground of the Copper Queen company, where of old we would not have looked for ore. Many other companies have risked considerable capital without as yet receiving any return. But it would be premature to suppose that we know the limit, either in superficial area or in depth, of the copper ores of the Warren district. Heretofore, as already explained, the operations have been confined by ourselves and all our friends almost exclusively to the ore deposits in the Lower Carboniferous rocks. There is no probability of the limestones of older or lesser age carrying copper in anything like the abundance of the Naco and Escabrosa beds, but it is equally certain that the porphyries, which geologists assume to have been the source or the carrying media of the copper in the limestone, contain disseminated secondary ores of sufficient value to be worked, and that orebodies of notable size and of very good grade, have been discovered in limestones of Devonian and Cambrian age, which may give longer life to the district than is at present assigned to it.

SQUARE SETTING MOST SUITABLE

The method of mining adopted from the very first was by square setting. Considering the irregular size of the ore masses in the Warren district, and that they are embedded in so unstable a medium as the ferruginous clays, and considering that the whole mass of the Copper Queen Mountain and much of the adjacent territory has been since mining was vigorously conducted in a condition of continuous movement, extracting the ore by square sets was probably the best method that could have been adopted, looking to the safety of the miner and the conservation of the ore. In some of the larger and less decayed orebodies, slicing and other recent methods are being tried; but the old practice still holds its ground, though timbers of less size than the old 12x12 in. are now generally used, and the filling of empty stopes is more systematically practiced. Until a comparatively recent date the difficulty of maintaining steady grades favored hand tramping, but, by selecting certain levels where the limestones were undisturbed and on these levels installing double-track roads for electric haulage; by sinking a central shaft quite outside of the limestone area, and concentrating at this one point the ore which had previously been hoisted through four shafts, it has been found possible to replace hand tramping in great measure by electrical traction.

IMPROVEMENTS MADE IN PLANTS

The ore raised to surface by skips at this one central point is thence conveyed by belts and distributed by a tripper into a train of 50-ton cars. A preliminary mixture is thus obtained of the oxidized and sulphuretted ores, and of those with a siliceous or a basic gangue, preparatory to a more perfect furnace mixture, secured at the Douglas smeltery by a bedding system.

The old shafts are still used for lowering timber and mine supplies, but are all operated by compressed air. The machinery for compressing the air for that purpose and for hand drilling, as well as that for generating electricity, which is used for many purposes, is all concentrated in one power house, where steam is generated by California fuel oil.

The smelting works have been twice torn down and new ones erected. The value of the old works stood on the books of the company at \$1,100,000, but a plant which has become unfit for the proper application of modern labor-saving methods, especially if in an unsuitable location, should be relegated to the scrap heap rather than kept in commission; and not a single piece of the old machinery was introduced into the new.

The new plant at Douglas was designed for a production of 10,000,000 lb. of copper per month. It has been enlarged to a capacity of 12,000,000 lb., which will be further augmented to about 14,000,000 lb. when the new reverberatory furnaces are lighted. This output is made principally from the company's own ores of the Copper Queen and Nacozari mines, but a variable quantity of customs ore comes from Mexico and the southwestern part of the United States.

The company does not refine its own copper, but entrusts it to the Nichols Copper Co., whose operations are conducted at their works at Laurel Hill, within the New York Harbor limits. The terms upon which American copper refiners do custom work is to return the actual

copper contents of the bars delivered to them, in either refined cathodes, or bars and cakes, of the shape and size designated by the customer; returns to be made in 45 to 60 days after date of delivery. A somewhat longer latitude is generally allowed for the return of the gold and silver contents. Silver is either returned in bullion or in cash at the market value of silver on the date of the return. Gold is usually paid for at the same date at \$20 per oz. The charge for refining has gradually declined from 1½c. per lb. of refined copper in 1895, to an average of about ¾c. per lb.; an allowance of 15c. per 100 lb. used to be made for cathodes, but the difference is now much less. Phelps, Dodge & Co. sell their own copper through their own officers in the United States, and abroad through agents in London and Frankfurt a-M, Germany.

The control of the Copper Queen Consolidated Mining Co. stock was held by the same holders who were the sole owners of the Detroit Copper Mining Co., of Arizona, with mines at Morenci, Ariz.; and of the stock of the Moctezuma Copper Co., with mines located at Nacozari, Sonora, Mex.; and also of the stock of the Dawson Coal Mines, in New Mexico, since combined with the mines of the Stag Cañon Fuel Co.—whose name the Dawson company has adopted. For various reasons it was decided to consolidate the control of all these properties in a single company, Phelps, Dodge & Co., Inc., whose capital stock of \$50,000,000 is divided into 500,000 shares of \$100 each.

For the purchase of the stock of the various subsidiary companies the following stock was issued: Copper Queen Consolidated Mining Co., \$27,000,000; Moctezuma Copper Co., \$8,000,000; Detroit Copper Mining Co. of Arizona, \$6,000,000; Stag Cañon Fuel Co., \$4,000,000; and \$5,000,000 to be held for further issue.

Since its incorporation the company has acquired in the Burro Mountains, in New Mexico, the property of the Burro Mountain Copper Co. and the Chemung Copper Mining Co., and additional mining property in Mexico; and has bought from the mining companies their stores and mercantile business. These stores are now the property of the Phelps-Dodge Mercantile Co., and are operated by it.

The motive of the company is to confine its operations to a limit—the geographical area—and not scatter its capital and energies. The new mines which it acquires are regarded as a reserve rather than as a source of immediately increased production, and no secret is made of the fact that the securities of the railroad on which the company depends for the prompt supply of fuel and the local handling of its ores and copper, are owned by interests friendly to the copper company, though Phelps, Dodge & Co. do not directly or indirectly own a share or bond in any of the roads of the El Paso & Southwestern system.

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Stephen R. Dow Convicted

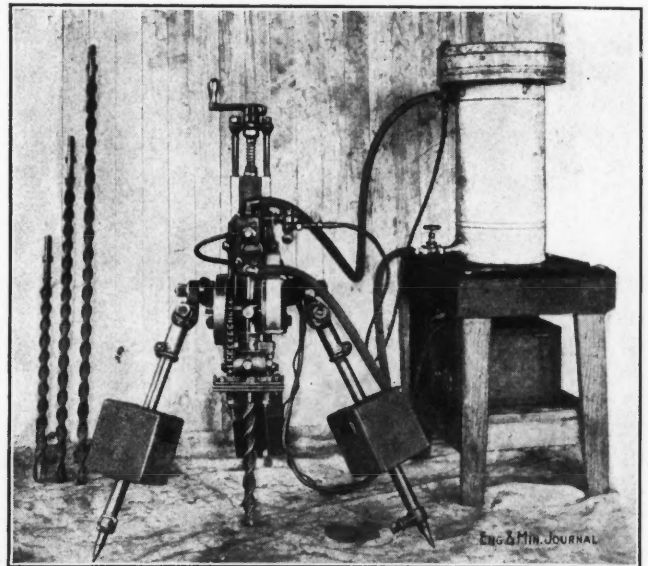
Stephen R. Dow, head of the brokerage firm of S. R. Dow & Co., was found guilty at Boston, on Feb. 26, on 24 of 92 counts of an indictment charging the conversion of funds of Michigan mining companies in which he was interested. His bail of \$25,000 was continued pending sentence and appeal to the Supreme Court. Dow was the president of four companies, the Algo-

mah, Indiana, Franklin, and North Lake, and funds of these companies amounting to \$300,000 were involved in the indictment. His finances became involved in 1911, but the firm was saved through a committee of the Stock Exchange. The final break came in October, 1912, when the firm of Stephen R. Dow & Co. went into bankruptcy and Dow was arrested, charged with the conversion of the funds of the mining companies.

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Scott Gasoline Rock Drill

The internal-combustion principle is made use of in the rock drill shown in the accompanying illustration. The machine is essentially a two-cycle gasoline engine, drilling on the hammer principle. The return of the piston is effected by energy stored in a flywheel and it is picked up for the forward stroke by a cushion of air. It is said that a speed of 3000 r.p.m. can be attained. The drills are held in the chuck by two small lugs on the shank, and while they do not reciprocate, they are automatically rotated. This rotation is effected by a chain

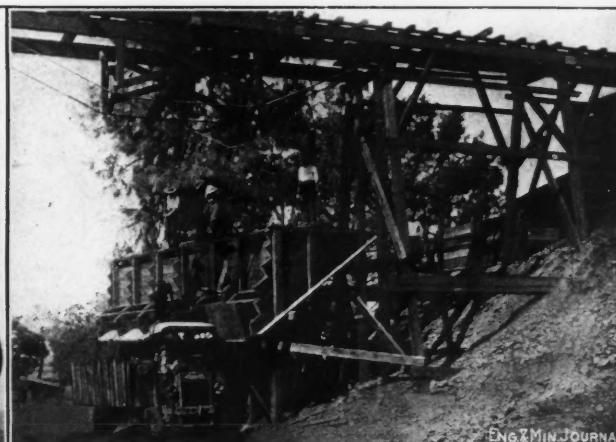


SCOTT GASOLINE ROCK DRILL

and sprockets, which communicate motion from the flywheel shaft to a worm over the chuck, geared into a wormwheel on the chuck. The drill steel shown in the picture is solid, with a helical conveyor to remove the cuttings, on the principle of the wood auger, but hollow steel can also be used, water being forced through it under pressure from the explosion chamber.

The cylinder is water cooled and automatically lubricated by mixing one pint of lubricating oil with each five gallons of gasoline. It is claimed that the engine will run for 10 hr. on two gallons of gasoline. Roller bearings are provided, packed with grease. The machine, it is maintained, will not break a front or back head. For use underground, the exhaust can be turned into water or piped to some place where it will be harmless. Four sizes are made, the smallest being unmounted and weighing 35 lb., while the largest weighs 265 lb. L. L. Scott, of 1613 Chestnut St., St. Louis, Mo., developed the drill and is putting it on the market. The point is urged that the machine is as suitable for underground use as is a gasoline locomotive.

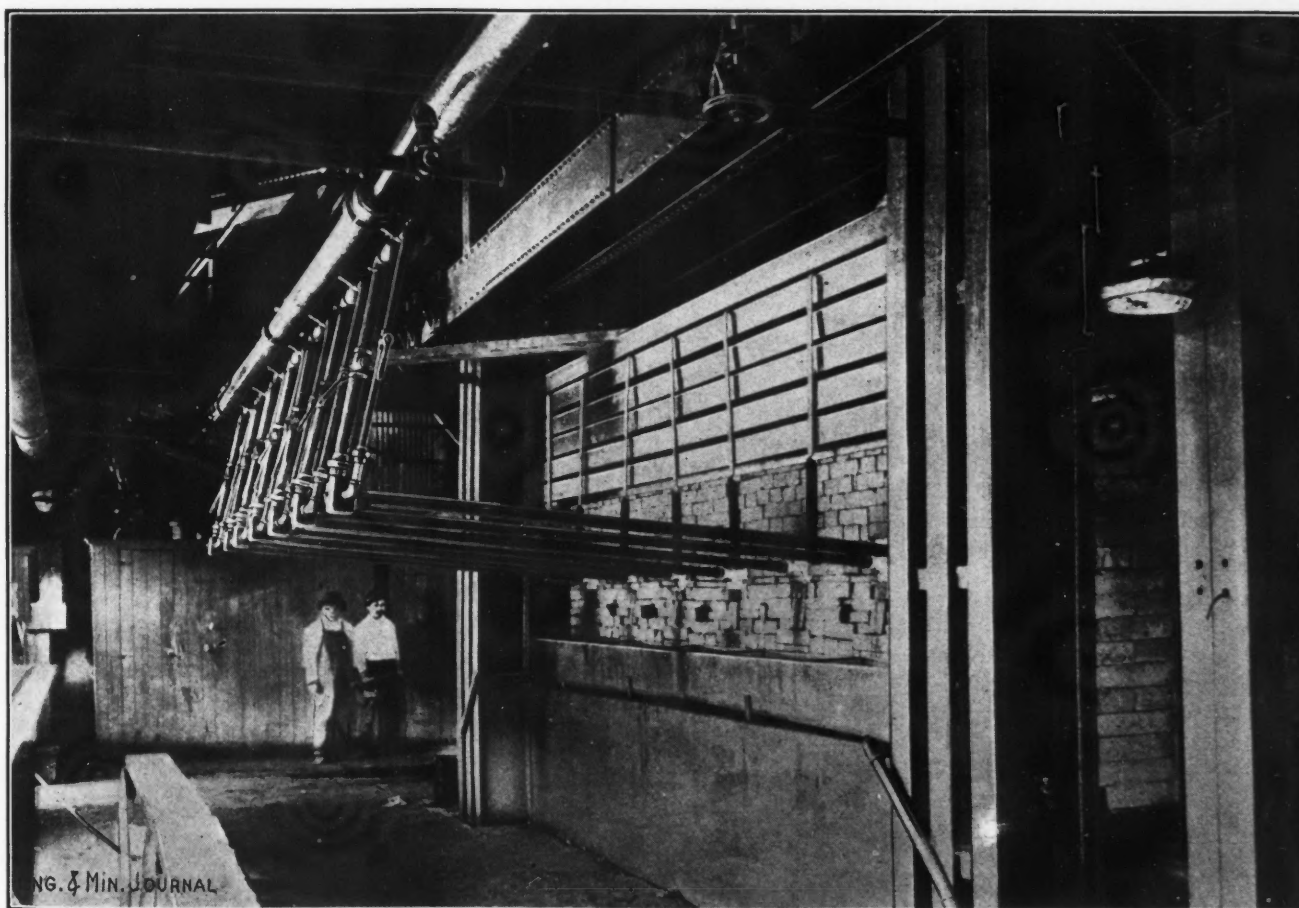
PHOTOGRAPHS FROM THE FIELD



A CONTRAST IN TRANSPORTATION IN CALIFORNIA

The Concord type of stage, in common use in the Mother Lode district in the early days, is now being superseded by automobiles, although a few old timers are still to be seen.

A 6-ton auto truck used in hauling copper ore from Copperopolis, Calaveras County, Calif., to Milton. This method of transportation is gaining in favor in the Mother Lode region.



FIRING END OF ONE OF OIL-BURNING REVERBERATORY FURNACES AT THE STEPTOE WORKS, MCGILL, NEV.

February Mining Dividends

Dividends paid in February, 1913, by 27 United States mining companies, totaled \$2,787,470, as compared with payments by 15 companies of \$1,951,556 reported for February, 1912. Industrial companies allied to mining paid \$10,215,663, as compared with \$8,962,120 in February, 1912, and Canadian and Mexican companies paid \$1,126,220, as compared with \$713,440 reported a year ago.

United States Mining Companies	Situation	Per Share	Total
Alaska Treadwell, g.	Alas.	1.00	200,000
Alaska Mexican, g.	Alas.	0.20	36,000
Alaska United, g.	Alas.	0.70	126,140
Arizona Cop., com., c.	Ariz.	0.48	738,653
Bunker Hill and Sullivan, l.s.	Ida.	0.20	65,400
Bunker Hill Con., g.	Calif.	0.50	10,000
Chief, g.s.l.	Utah	0.10	87,645
Elkton, g.	Colo.	0.02	50,000
Eagle and Blue Bell, s.l.	Utah	0.05	50,000
Fremont, g.	Calif.	0.02	4,500
Frontier, z.l.	Wis.	2.00	2,500
Gold Chain, g.	Utah	0.03	30,000
Golden Cycle, g.	Colo.	0.02	30,000
Homestake, g.	S.D.	0.65	141,960
Hecla, l.s.	Ida.	0.02	20,000
May Day, g.s.l.	Utah	0.03	24,000
Miami, c.	Ariz.	0.50	332,497
Mohawk, c.	Mich.	3.00	300,000
Moscow M. & M., g. s. c. z.	Utah	0.01	8,000
Nevada-Douglas, c.	Nev.	0.02½	102,500
Parrot, c.	Mont.	0.15	34,477
Tom Reed, g.	Ariz.	0.07	63,699
Tuolumne, c.	Mont.	0.10	80,000
United, c.	Wash.	0.01	10,000
United Verde, c.	Ariz.	0.75	225,000
Wasp No. 2, g.	S.D.	0.01	5,000
Yankee, l.s.g.	Utah	0.01	10,000

Iron, Industrial and Holding Companies	Situation	Per Share	Total
Amalgamated, c.	Mont.	\$1.50	2,308,319
Cambria Steel	Penn.	0.62½	562,500
General Chem.	U.S.	5.00*	407,565
International Nickel, pfd.	N. J.	1.50	133,689
National Carbon, pfd.	U.S.	1.75	78,785
U. S. Steel, pfd.	U.S.	1.75	6,304,919
Va.-Car. Chem., com.	U.S.	1.50	419,886

Canadian, Mexican and Central American Companies	Situation	Per Share	Total
Alacran, g.s.	Mex.	2.00	19,200
Amparo, g.s.	Mex.	0.04	80,000
Buffalo, s.	Ont.	0.03	30,000
Cobalt Townsite, s.	Ont.	0.60	120,000
Crown Reserve, s.	Ont.	0.05	88,441
Encino y Anexas, g.s.	Mex.	1.00	3,000
Greene Con., c.	Mex.	0.45	450,000
Hollinger, g.	Ont.	0.15	82,500
Norias de Bajan, s.	Mex.	0.50	1,000
Rio Plata, s.	Mex.	0.05	18,690
Seneca-Superior, s.	Ont.	0.10	45,000
Standard Silver-Lead, s.l.	B. C.	0.02½	50,000
Steel Co. of Canada pfd.	Can.	1.75	113,750
Temiskaming & Hudson Bay, s.	Ont.	1.75	23,383
Victoria, l.s.g.	Ont.	0.50	1,250

Increases in rates were made by Alaska United, Arizona Copper, May Day and Mohawk, among the American companies, and by Amparo, Cobalt Townsite and Greene Consolidated among the foreign. Cobalt Townsite is now paying at the rate of 50% per annum. New dividend payers are Chief and May Day, both of Utah, and Isle Royale, of Michigan. Yankee Con., of Utah, paid a dividend after 5½ years of non-dividend-yielding operations. Six Mexican companies are still paying in spite of disturbed conditions in that country. The increased dividend disbursements shown by the tables are gratifying.

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Lead Smelting in Bond

WASHINGTON CORRESPONDENCE

The Treasury Department has completed investigations as to works of the American Smelting & Refining Co., at Perth Amboy, N. J., and finds that there was a loss in the operation equal to 20% to be accounted for as wasted. In lead bullion it was found from the records that there was a loss in refining operations equal to 3.7% to be accounted for as wasted. Previous regulations were modi-

fied in conformity to these findings. As a result of recent experience it is now stated that the Department will fix wastage allowances each year. Notification has been sent to the companies that they will have to prepare to make detailed statements of the facts, showing the losses on the metals worked during the fiscal year ending June 30, in each year. An allowance of 19.9% in the smelting of imported lead-bearing ores has been granted in the case of El Paso Smelting & Refining Works at El Paso, Texas.

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Chronology of Mining for February, 1913

Feb. 1—The Oliver Iron Mining Co. advanced wages at its Minnesota mines; independent companies following its example.—About 6500 miners at the Lackawanna company's mines, at Scranton, Penn., and 600 at the Delaware & Hudson company's mines, went out on strike, refusing to work with nonunion men.—Chambers-Ferland mines, at Cobalt, Ont., were purchased by an English syndicate.

Feb. 3—The concentrating plant operated by the Manufacturers Corundum Co., at Craigmont, Ont., was destroyed by fire.

Feb. 4—Announcement of organization of the Colorado Mines, Railways & Utilities Co. to acquire control of the El Paso, Golden Cycle and other mines and railroads in the Cripple Creek district (Colorado).

Feb. 6—The jury hearing the case of Archie L. Wisner and John J. Meyers charged with using the mails to defraud in Nevada and California mine and oil exploitation schemes, disagreed and was censured by the trial judge for failure to bring in a verdict on the testimony offered.—An explosion of gas in a colliery near Fukuoka, Japan, killed about 150 miners.

Feb. 8—Felix Diaz led a revolt that ended the Madero administration in Mexico, and placed Gen. Huerta in control of the government, pending the elections.—Suit instituted by minority stockholders of the Federal Mining & Smelting Co. against the American Smelting & Refining Co., to have the smelting contract abrogated.

Feb. 10—Fighting between striking coal miners and armed guards in the West Virginia bituminous coal fields, again resulted in the declaration of martial law.

Feb. 11—Shipment of the largest single consignment of silver from Cobalt, consisting of 263 bars, weighing 308,997 oz., the consignment going to England.

Feb. 14—The school of mines building of the University of Minnesota was destroyed by fire.

Feb. 16—The concentrator of the Butte Central Copper Co., at the Ophir mine, in the Butte district, Mont., was started.

Feb. 19—A gas explosion in the Siwash Creek coal mines, at Yale, B. C., killed about 70 men.—Employees of the Britannia Mining & Smelting Co., Ltd., in British Columbia, went out on strike because of the company's refusal to recognize the Western Federation of Miners.

Feb. 26—Stephen R. Dow was found guilty of conversion of funds of the Algolah, Indiana, Franklin and North Lake mining companies, which operate copper mines in the Lake Superior copper country.

Feb. 27—The Lewisohns relinquished control of the Tennessee Copper Co. to James Phillips, Jr., and associates.

EDITORIALS

Activity in Colombian Placers

Columbian placers are coming in for increased attention, and on a more sensible basis than some of the earlier attempts at placer mining in that country. A number of extensive tracts running into thousands of acres are under option for investigation by drilling, and a modern 9-cu.ft. dredge on the Pato mine is about to give the final proving of the drilled portion of this company's 25,000-acre holdings. The ill-starred dredging enterprises of earlier years have little comparison with operations at present in view. Those small dredges, many of them not well adapted for the purpose and often poorly manned, were largely responsible for the early failures and their operations are not to be regarded as criteria of the possibilities of modern dredges handled under competent direction.

However, it is not all smooth sailing. There are tropical conditions to be overcome; fever and floods are prevalent in some sections, and these must be met and mastered before the ordinary operating difficulties can claim attention. Health conditions will, in most places, be taken care of when the operations approach a sufficiently large scale to warrant systematic attention to sanitation. Floods have ended the career of a number of small dredges that would doubtless have been saved if the operation had been in the hands of a stronger company.

For a number of years there have been numerous abortive attempts to work the placers of Colombia. Many of these efforts have failed owing to the shortsightedness of their promoters; enterprises were started with inadequate capital or with insufficient technical direction, or without consideration of climatic conditions either as regards floods or as affecting the health and efficiency of the operators. Failure for most of these was foredoomed. Attempts were made by another class of operators who tried to follow the natives and handle ground that had already been worked by the latter, perhaps several times, either in modern or earlier days. Naturally, the foreigner had no advantage in such ground and the efforts to find rich pockets or unworked playas have met with indifferent success; when a strike was made its prize was usually lost in subsequent fruitless work.

The gravels which offer the best opportunities today in Colombia are, as a rule, those where water conditions were too arduous for the natives to overcome. In the main, these are of two classes: (1) Gravel suitable for dredging, where the water was near the surface and too great in quantity to be handled by wing dams or the crude pumping apparatus of the natives; (2) Gravel banks, suitable for hydraulicking, that did not receive attention of natives or Spaniards in the slave days, and now involve too great an outlay for the latter-day natives to provide adequate water.

At present, attention in Antioquia is being chiefly directed to placers along the Cauca, the Nechi and the

Porce rivers and their tributaries. The most important operation today, that on which are centered the eyes of all who are interested in Colombian placers, is the Pato mine, controlled by the Oroville Dredging Co. interests. The property is west from the present bank of the Nechi river and nearly opposite Zaragosa. About 300 acres of its ground have been thoroughly drilled, indicating a good gold content and excellent gravel for dredging. A hydro-electric plant and a modern 9-cu. ft. Yuba Construction Co. dredge have been completed and placed in operation. The proof of the pudding is now awaited.

Below the Pato ground and on the opposite side of the Nechi is the Pochet property, which has been operated for several years. On it a 3-cu. ft. dredge has more than paid its way and at times brought a handsome return to its French owners. Negotiations are in progress to raise capital to develop two other large tracts in this vicinity. A drilling party was sent down this year to prospect extensive placer holdings to the west on the Cauca River and its tributaries. In the last few seasons hydraulic elevators have been profitably operated on gravels that proved too wet for the natives on the Porce and other rivers. Some straight hydraulicking has also been done.

In the Atrato Valley in the western part of the republic, where platinum occurs as well as gold, there is activity in exploration and a large tract in this valley is being considered in New York at present. The Certigue company operated last year a 5-cu. ft. Empire dredge on the Certigue River until December when the boat sank. To the south on the San Juan River, Goldfields American Development Co., Ltd., has been doing some prospecting. There are also other operations of smaller character in various parts of the Atrato watershed.

Reliable information regarding the Colombian gravels is meagre, or confined to those who have made direct investigations. However, the small dredges, even though handicapped by inherent difficulties of design and by inability to cope with floods, have shown that some of the gravels of this country contain gold in attractive quantities. With systematic testing of the ground and modern equipment under competent direction, interesting results may be anticipated from some of the large tracts now under investigation.

From the point of view of stable political conditions, Colombia is one of the best of the South American republics, and with its liberal laws should soon attract capital for the development of its natural resources, both mineral and agricultural. Its two great watersheds, the Magdalena in the center and the Atrato on the west, are just now receiving much attention, the Magdalena and its tributaries for placer gold, and the Atrato for both gold and platinum. A little attention has been given to the mining of other metals, but on account of difficulties of transport away from the natural water highways, lode mining in general must await its pioneer sister, placer mining. When the latter shall have drawn experienced

operators into the country and the gravels are beginning to be worked out, attention will doubtless be directed to the copper, silver and gold lodes, of which reports are occasionally received. For the present, however, attention will be directed mainly to the placers, and if these efforts are successful, it is likely that the next decade will be principally occupied with this form of mining, leaving the lode deposits for later attention.

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Crushing and Grinding at Tonopah

In this issue Mr. Megraw concludes his analysis of cyanide methods in the Tonopah district. It will be noted that stamps are used in all mills of the district and apparently are employed so that they are performing their proper function, i. e., coarse crushing. Coarse crushing followed by tube milling is the prevailing system on the Rand, adopted because of the increased stamp duty obtained and the fact that the battery discharge makes an excellent feed for tube mills. Some of the mills of the Tonopah district are taking pains to produce a proper feed for the tube mills by using battery screens of two different meshes. This should furnish a nice means of control and the results obtained apparently justify such procedure.

In the new mills of the district, the tendency is toward heavier stamps, but the maximum so far installed, 1400 lb., has not exceeded the bounds of conservatism, especially when compared with some of the installations on the Rand.

The use of shorter tube mills is an interesting development, especially since the 16-ft. mill used at the MacNamara mill is stated to produce as fine a pulp as the 22-ft. mill, with smaller consumption of power, lining and pebbles. This reduction in length would be considered a radical departure were it not for the fact that the overall length of the Hardinge mill is not more than 10 ft. Is it possible that metallurgists, after adopting a device from the cement industry, have failed to make the most of it by not adapting it to their needs? If the results obtained at the MacNamara mill prove of general application, it would seem that a simple expedient was overlooked, whereby the efficiency of the tube mill might be increased.

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The Changing Character of Mining Labor

A certain change is in progress in the character of American mining labor. The "old-time" miner, so-called, American or English born, is being supplanted by the foreign-born laborer. The change is slow, is more evident in some districts than others, and probably was completed several years ago in many regions; but it can reasonably be expected as an inevitable future development practically everywhere, and this will only duplicate past American experience in many other lines of industry. Mining at best is a gruelling, life-shortening work; and the average native American will trade even a \$4 mining job for something less remunerative, but more to his taste.

In a way, this change is a pity. The itinerant, self-reliant miner, jack of all trades and master of several, was an interesting type. He had potentialities quite non-existent in his foreign-born brother. The line of succession from mucker to manager was open and often

followed. Cases of a hammersman to-day and a millionaire owner tomorrow were not unknown. It was a democratic and thoroughly American system. But changing economic conditions force new methods and today in many camps it is hard to find enough single-jackers for even a sampling crew.

The new type of miner is not so intelligent, but is more obedient and more industrious. He works generally for less than the scale established at such camps as Butte and Goldfield. By himself, he is far less efficient, but as part of a system employing a multiplicity of bosses, he probably delivers a lower labor cost per ton. To many companies he is a more desirable employee than a skilled miner, even when the latter will work for the same wages.

From the point of view of safety, his habits of obedience and submission to discipline should help to reduce the death and accident rates. As a matter of fact, they do nothing of the sort. Because he knows no better and because he thinks he must, he submits without a murmur to exposure to danger as well as to outrageous living conditions, such as would make the old miner quit on sight. The company, because of his ignorance and docility, can introduce cheap but dangerous methods, offset his lack of skill by plenty of expert supervision and effect a material saving on the cost sheet. Compensations for death and accident, as matters are now, seldom form a charge against operations. Not being usually a good union man, the foreign-born miner can make no effective protest against his treatment. Since he has come to stay, public opinion and legislation must be invoked as the only means of procuring safe conditions in American mines, and of lowering our death rate, still far too high.

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Although no official notice was taken of the anniversary, the year 1912 was the centenary of the free mining of gold in Russia. Up to 1812 mining of gold in the Urals—the region then known as auriferous—was prohibited, all rights being reserved by the Imperial Government. In that year the placers were opened to individual miners under government grants, and the production, which had previously been insignificant, began to increase. From about \$10,000 yearly before 1812, it rose to \$200,000 by 1820 and to \$1,500,000 in 1824, when exploration began to be extended to the placers of western Siberia. In Russian mining history, therefore, 1812 was rather a notable date.

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The Transvaal has begun the year 1913 well, the January gold production running up to 789,390 oz., which was 12,984 oz. more than in December, and an increase of 52,330 oz., or 7.1%, over January, 1912. This is, perhaps more encouraging than a larger sensational gain might be. A moderate advance may well be expected to continue, and the Transvaal seems to be still some way from the turning point, which will come some day—but not yet. There were over 10,000 stamps dropping in January, and an army of 200,000 negroes at work, besides the white men employed.

❖

With the rallies in the prices for copper and spelter and a rather firmer tone in lead, a more cheerful feeling pervades the metal markets. After all, it ought to be recognized that 15c. for copper and 6c. for spelter are fine prices.

BY THE WAY

"Well informed insiders" gave out the tip a long while ago that a \$1 dividend would be declared at the February meeting of the directors of the Chino Copper Co., and considerable stock was bought in anticipation of the initiation of a \$4 annual rate. The meeting came and went, and all the outsider has now is the right to sell his stock a few dollars lower and wait until the "well informed" again prophesy dividends. It may also be of interest to note that the Wetlaufer-Lorrain directors passed its next dividend. Goldfield Consolidated, however, has "come back" and will pay in April.

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Dr. Edward Goodrich Acheson, widely known for his inventions in the manufacture of artificial graphite and its industrial applications, was recently decorated by the Czar with the insignia and the sash of the Order of St. Anne. The presentation was made at a recent dinner at the American embassy, St. Petersburg. The Order of St. Anne was created by Charles Frederick, Duke of Schleswig-Holstein Gottorp, in 1735, in memory of the Empress Anne and was adopted as a Russian order by Paul I about sixty years later. Doctor Acheson was in Russia primarily to address the Russian Imperial Technological Institute on the nature and use of artificial lubricants.

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That we shall all have to learn our chemistry again *ab initio* seems to be presaged by the statements of Sir William Ramsay, Prof. Herman Collie and Professor Patterson. These three scientists working separately, claim each to have found that in vacuum tubes containing only hydrogen, subjected to an electric discharge, neon and helium appear. The observers claim to have obviated the possibility of neon and helium being present originally. This narrows the question down to these possibilities: Transmutation of the aluminum cathode or of one of the elements present in glass into neon and helium; or the conversion of hydrogen into these gases; or that electricity itself, as electrons, builds up the atoms of these gases.

❖

Gold mining is again to the fore in Connecticut—in the minds of the promoters. From Newtown, Wilton and other Connecticut towns, come the perennial dispatches to the effect that gold has been discovered and the residents are excited. Most of the older citizens, however, are as familiar with these announcements as they are with spring tonics, and go through them without a quiver of excitement, though occasionally a neophyte is inducted through the mysteries by a promoter. At Newtown, the matter has been taken seriously enough to cause the incorporation of the Metals Reduction Co. The dispatch regarding this occurrence goes on to say that "traces of gold have been found in this locality, and it is believed by the promoters of the enterprise that sufficient quantities of the metal can be located to make its extraction profitable by modern methods. A smelting plant of a daily capacity of 100 tons, ore bins, engines, and machinery, have been received here and are being installed at the mine, where mining operations are already in progress." One of the backers of the enterprise has leased

for a term of years 200 acres of land, and is enthusiastic over the prospects—more so, indeed, than our Newtown people to whom this is not the first opportunity to get excited over gold finds in this vicinity." The man who tried to sell gold sovereigns in the streets of London would probably be safe in offering them in Newtown.

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There have been anxious days and nights in many Mexican camps during the last two years. An American engineer, writing recently from one of the camps in Jalisco, says: "We have had no trouble so far from the *revoltosos*, though on Jan. 20 the town had a scare. Explosions were distinctly heard in the camp and everyone thought that a town down the valley was being attacked; men were hastily gotten together to repel the enemy, who never came. On the night succeeding, a fine volcanic dust of a light gray color fell everywhere. I measured the fall of dust and found it to be equivalent to about 35 tons per square mile. The fineness of the dust had our tube mills beaten to a frazzle. A few days afterward it was learned that the source was the volcano at Colima. I have a very bad sore throat; in fact, everyone here has, and it is attributed to the volcanic dust."

❖

The romantic side of smelting is often missed in the meticulous detail of technical description. One of our metallurgical friends has sent us a cutting from the *African World*, Dec. 28, 1912, to show that the poetry of the blast furnace may still be written. That paper's Elisabethville correspondent contributes an account of "How Congo Copper Is Produced." Metallurgists will deduce some interesting facts about the smelting at Lubombashi, and any reader will be able to appreciate the description of the "water jacket" in operation. "It is a most interesting thing to watch the working. . . . The water jacket itself is a huge iron monster with many valves, pipes, and doors, and except for the constant stream of liquid fire—the scurrie—that is pouring out from its side and immediately washed away by the water of the Lubombashi River, you think it is quite dead; but the fire is raging in its bosom, and this is most anxiously watched. At certain intervals, regulated by indications judged by the boss smelter, you hear a shout, a door is opened, and out pours the liquid copper, which is caught in flat square iron dishes of about a foot and a half by two and a half. In these the material cools down and is ready for transport to the European market in blocks weighing about 170 lb., i.e., if the smelting has been good; at a bad cast more or less worthless scurrie adheres to the copper, but is easily beaten off when cold." Our metallurgical friend regards this description as worthy of a Carnegie medal. The operation of tapping at a shout from the boss smelter, "into flat square iron dishes" he is able to picture but inquires: "What, Oh what is 'scurrie'? Is it a first cousin to 'chats' and others of that ilk, or does it attempt to be descriptive of the movement of the material. We speak of rats 'scurrying' to their holes, but the term could hardly apply to a zinky slag when the lime gets high, as material of the consistency of chewing gum could not be said to 'scurry.' I await enlightenment *re* 'scurrie.' Our dictionaries fail us. Still, a skillful etymologist starting with scoria might improvise an explanation.

California Oil in January

SAN FRANCISCO CORRESPONDENCE

The net production of petroleum in all California fields in January was 7,139,716 bbl., a decrease from December of 61,780 bbl. The January shipments were 6,994,840 bbl., an increase over December of 214,397 bbl. The losses in January were 89,108 bbl., making the total output 7,083,948 and leaving a surplus of 55,768 bbl., a decrease from the December surplus of 206,634 bbl. Comparisons of January with December daily averages show a decline of 1993 bbl. in daily production, a reduction of 2243 bbl. in daily losses, a decrease of 6665 bbl. in

CALIFORNIA OIL PRODUCTION FOR JANUARY BY FIELDS	
Districts	Bbl.
Fresno County	
Coalinga.....	1,455,820
Kern County	
Midway.....	2,251,296
Kern River.....	825,389
McKittrick-Belridge.....	548,897
Maricopa.....	430,447
Lost Hills.....	159,022
Total Kern County.....	4,215,051
Santa Barbara County	
Santa Maria, Lompoc, Cat Cañon.....	378,200
Summerland.....	4,350
Total Santa Barbara County.....	382,550
Southern Fields	
Olinda-Brea-Puente.....	532,304
Coyote-La Habra.....	193,997
Salt Lake-Sherman.....	190,181
Ventura.....	68,294
Whittier.....	60,324
Los Angeles.....	31,842
Newhall.....	9,353
Total Southern Fields.....	1,086,295
Total all Fields.....	7,139,716

daily surplus. Gains in production were made in Midway, Maricopa, Lost Hills, Salt Lake-Sherman, Olinda-Brea-Puente, Coyote-La Habra. The January surplus added to December stocks makes a total of 47,608,160 bbl. on hand at the end of January. The field record of operation and development shows 427,073 bbl. consumed as fuel, 37 new rigs, 60 completed wells, 5845 producing wells active, 949 wells capable of producing but idle, 361 wells actively drilling, 361 wells on which drilling was suspended, 13 wells abandoned. The accompanying table gives the detailed production by fields.

Promoters' vs. Lawyers' Fees

It is interesting to contrast the profits of promoters and the consequences thereof, with the profits of lawyers, where there appear to be no consequences, says the *Boston News Bureau*. President Smith, in defending Lawyer Brandeis, says his contract with the Old Dominion Co. stipulated that he was to be paid "not more than 10%" of any sums recovered from Mr. Bigelow, which 10%, if fully paid, will probably foot up to \$220,000. But this is not all. Among the first clauses in the indenture, which set aside this Old Dominion lawsuit, was the placing of \$90,000 in a trust fund, a substantial portion of which has been paid to Brandeis on current legal account. Mr. Brandeis' partner, D. Blakely Hoar, and President Smith, are each to receive \$50,000 for looking after the assets in the "trust."

It is interesting in this connection to recall that A. S. Bigelow was associated with the late Leonard Lewisohn in the promotion of the Old Dominion Co. They purchased the Old Dominion copper mine for \$1,000,000 cash. They sold the stock first to their friends, beginning

at \$12.50 per share, thereby getting their capital back and \$500,000 of cash for the treasury of the company. Later, the public purchased the stock from a syndicate at higher prices.

Of the total 150,000 shares, it was claimed that 50,000 shares were issued illegally, and also that full par value of \$25 per share was not paid in. Suit was brought, and Mr. Lewisohn was able to go to the United States Supreme Court and get a verdict in his favor. Mr. Bigelow was unable to get through the Massachusetts courts on the main issue, and was held to make good on the par value of the shares, etc., to the extent of more than \$2,000,000. He surrendered all of his assets, including family and personal notes, and every dollar in his possession. [The company is still endeavoring to recover from the executors of the Lewisohn estate in a suit now before the United States Supreme Court.]

It may be said in this connection that it is on record that Mr. Bigelow made, by the promotion of his company, \$160,000. It is interesting to compare his profits in promotion with the lawyer's division at the finish:

Profits of A. S. Bigelow.....	\$160,000
Personal fortune surrendered.....	2,200,000
Possible division among lawyers, etc.:	
To Mr. Brandeis.....	220,000
To Mr. Brandeis' partner and President Smith.....	100,000
To Mr. Brandeis for legal expenses.....	90,000
Total.....	410,000

It may be further interesting to record that when Mr. Brandeis proposed a reorganization of the New Jersey company and the issue of 50,000 shares as a bonus to bond subscribers, he was asked: "Why should we sue Bigelow for issuing 50,000 shares without due consideration, and then issue to ourselves 50,000 shares as a bonus?" Mr. Brandeis saw the point, and his organization plan was abandoned, and instead there was issued to Phelps, Dodge & Co. for property that was not highly reported upon, and \$300,000 cash, 138,000 shares in a new company, so that today the Old Dominion Co. of Maine has almost 300,000 shares outstanding. Thus do promotion, litigation and capital expansion go hand in hand, with some lawyers securing the last and best pickings.

Amalgamated Sued by United Copper

An echo of ancient strife is a suit for \$30,000,000 filed by the United Copper Securities Co. and Arthur P. Heinze against the Amalgamated Copper Co. and its subsidiaries, including the Anaconda Copper Co., together with Adolph and Albert Lewisohn and Philip S. Henry, as executors of the estate of Leonard Lewisohn; William Rockefeller, H. H. Rogers, Jr., who with the Farmers' Loan & Trust Co., is involved as executor of the H. H. Rogers estate; John D. Ryan and James Stillman. The suit was filed by F. E. M. Bullowa, attorney for A. P. Heinze. The complaint alleges that agents of the Amalgamated burned the plant of the Montana Ore Purchasing Co. and also asserts that the Amalgamated company is a monopoly in restraint of trade. Two claims of \$5,000,000 each are urged and treble damages asked under the provisions of the Sherman law.

The Massena Plant of the Aluminum Co. of America is to be enlarged materially during the next two years, according to announcement. It is said that an order for 386 tons of steel shapes has been placed with the Lackawanna Bridge Co.

PERSONALS

F. F. Sharpless has gone to the Joplin district, Missouri. James Fitch has returned to Tacoma, Wash., from New York.

S. N. Graham has been appointed manager of the Peterson Lake property at Cobalt, Ontario.

T. Cory Brown, of Socorro, N. M., has been examining zinc properties in the Kingston district, New Mexico.

W. R. Ingalls, on Feb. 20, lectured on "The Metallurgy of Zinc," before the Lackawanna Chemical Society, at Scranton, Penn.

John T. Fuller, who has been superintendent of mines for the Canadian Copper Co., at Copper Cliff, Ont., has resigned that position. His present address is Honesdale, Penn.

B. K. Morse, formerly with the Henry S. McKay Co., during its operation of the C. O. D. and Golden Gem mines, is in Mohave County, Ariz., making examinations of properties.

T. H. Leggett has returned from the City of Mexico, where he was during the recent revolution. He says he saw only a little of the fighting, but that it was quite enough for him.

R. C. Jacobson has returned to Mohave County, Ariz., from Sonora, Mexico, where he has just completed an examination of the Ancient Gold Mining & Milling Co. property, near Ures.

E. A. Austin, manager of the Guggenheim interests in the Iditarod district, Alaska, recently visited Stanford University, Calif. Mr. Austin graduated from the university in the class of 1906.

A. B. W. Hodges, having completed his three years as general manager of the Cerro de Pasco Mining Co., in Peru, finished his contract on Feb. 28 and is returning to the United States.

Robert Anderson has resigned as geologist of the United States Geological Survey and will engage in professional work, in partnership with A. C. Veatch, specializing in the geology of petroleum.

F. Lewis Clarke, of Spokane, Wash., was a recent visitor in the Grass Valley and Nevada City Mining districts, California. It is reported that he is considering investments in mining in Nevada County.

Charles A. Banks, general manager of the Jewel Denero and Idaho Alamo mines, British Columbia, left New York, Mar. 1, on his way to London. He intends returning to British Columbia about the middle of April.

Allan Cunningham has resigned as superintendent of the Rhoads-Hall mine, Alaska, to take a position with the Rexall Co. Joseph Henderson, recently foreman for the Chatham Mining Co., is now in charge of the Rhoads-Hall.

Roger C. Knox, superintendent of the Black Oak Development Co., operating the Black Oak mine and opening other properties in Tuolumne County, Calif., is recovering from illness at Independence, Mo. He will return to California early in March.

A despatch from Maracaibo, Venezuela, Mar. 3, says: "Two American citizens, Guy N. Borge and William Leslie Taylor, of Duluth, were captured on Saturday by wild Motilonos Indians while making petroleum explorations near Lake Maracaibo. A later despatch reports their escape.

The Associated Geological Engineers announces the expansion of its business to include a new department devoted to examinations and reports connected with the mining and treatment of ores. This department is in charge of C. T. Grilswold, professor of mining, at Carnegie Institute of Technology. His headquarters will be at the Pittsburgh office.

OBITUARY

James McCauley died at Los Gatos, Calif., Feb. 11. He crossed the plains to California in 1849 and engaged in mining in Yuba County. He subsequently taught school and farmed. In later years he lived at Lone, in Amador County.

Cornelius C. O'Neil died at Jackson, Calif., Feb. 18. He was 79 years old, born in Ireland, and came to America in his youth. He went to California in 1851 and first engaged in mining at Mokelumne Hill, Calaveras County. For many years he was superintendent of the sulphuret plant of the Zeila mine in Amador County.

George Matthey died at Eastbourne, England, recently, aged 88 years. He was well known as a metallurgist and was for many years chairman of Johnson, Matthey & Co., being closely associated with the varied research work which has rendered the company famous, especially in connection with platinum and its associated metals.

Boris Garow, who was killed by the rebels at Taxco Guerrero, Mexico, was a Russian by birth, but a naturalized American citizen. He had been in Mexico for many years and was prominently and successfully identified with the revival of the Taxco camp, which took place about four years ago. Recently he has been building a branch road into the camp from the Mexican Central line.

J. Harvey Sternbergh died at Reading, Penn., March 3, aged 79 years. Forty-five years ago he established the Reading Bolt & Nut Works, which developed into an industry employing 1000 hands. It was later merged with half a dozen other plants into the American Iron & Steel Manufacturing Co., of which he was president. Mr. Sternbergh was an inventor of note.

Joseph F. Curtis died at Angels, Calif., Feb. 14. He was 63 years old, born in England. He went to California in early life, and was once owner of the Royal mine at Hodson, Calaveras County. In later years he engaged chiefly in prospecting new claims or reopening old mines and promoting their sale. His most recent venture in this line was the bonding and sale of the Waterman mine at Angels. His fair dealing in mining gave him an enviable reputation.

Carl Gustaf Patrik de Laval, a distinguished Swedish inventor, died recently at the age of 67 years. He is known best by his invention of the famous turbine, which was the outcome of his centrifugal fluid separating machine, also a noteworthy invention. The first de Laval turbine was brought out in 1889, and the inventor lived to see its successful introduction into many countries. De Laval also made several noteworthy metallurgical inventions. While still a young man he devised a method of producing sound steel ingots by providing a cap of non-fusible material to fit the top of the ingot mold. In the latter part of the 90's he invented an electric furnace for zinc smelting, which has been used at Sarpsborg, Norway and Trollhattan, Sweden, where the most extensive pioneer work in electric zinc smelting has been done. Dr. de Laval was born in Sweden and graduated from the University of Upsala. For several years he was in the employ of the Stora Koppenbergs company, the oldest mining and metallurgical company in the world. He was an engineer of great versatility and his investigations and inventions cover many subjects. The complex studies and experiments required before the steam turbine was brought into practical shape would alone have constituted a sufficient life work. He received many honors. He was a member of the Swedish Senate and of the Royal Academy of Science, and had received many medals and decorations from foreign countries.

SOCIETIES

Old Freibergers in America—The next regular meeting will be held March 25, 1913, at the Hofbrau-Haus, Broadway and 30th Street, New York. This is the 147th anniversary of the founding of the Freiberg Bergakademie. Dinner will be served at 7 p.m. At this meeting it is expected that definite plans will be made to hold a meeting in San Francisco and that arrangements will be made to get a large number of the members to plan to go over to Freiberg in 1916 and help celebrate the 150th anniversary of the founding of the old mining school.

American Mine Safety Association—At the National Mine Safety Conference, held in Pittsburgh, Sept. 23, 1912, a chairman and executive committee were appointed to prepare plans for a permanent organization "to promote the science of safety in mines and mining by the adoption of improved first-aid methods, and of logical methods of procedure in rescue and recovery work; to recommend the adoption of approved types of first-aid and mine-rescue and recovery appliances; to obtain and circulate information on those subjects; and to secure the coöperation of its members in establishing proper safeguards against loss of life and property by explosions, fires and from other causes." It is proposed to have two classes of members, individual and corporate, the latter to include mining companies and others. The chairman is H. M. Wilson, of the Bureau of Mines, Pittsburgh; the secretary, C. S. Stephenson, Pittsburg, Kansas.

Spokane Engineers' Meeting—This meeting of members of the various engineering societies was held in Spokane, Wash., Feb. 19-21, and was attended by about 150 engineers, from Washington, Oregon, Idaho, Montana and British Columbia. Several of the papers were illustrated with stereopticon views and were of high rank. Dr. D. B. Steinman's research in "Economic studies of Suspension and Cantilever Bridges," and Prof. F. M. Handy's discussion of "Vulcanism," involved original and notable research. J. C. Ralston's paper on "Engineering Education" brought out an hour's discussion, and was ordered printed. He spoke as a member of various societies, including the Society for the Promotion of Engineering Education. His plea was that engineers should broaden their technical vision and become men of affairs in their respective communities. The three days' session was concluded with a banquet at which entertaining responses were made to the toasts, the Civil Engineer, the Mining Engineer, the Electrical Engineer and the Domestic Engineer. It concluded with an outline of the "Future of Engineering in China and Its Relation to American Engineering," by Sylvanus E. Swan, Chinese government engineering student in America from Shanghai.

INDUSTRIAL NEWS

The Bucyrus Co., South Milwaukee, Wis., is shipping a 7½-cu.ft. gold dredge to Andrada Mines, Ltd., Beira, Portuguese East Africa.

Mecklenburg Iron Works, Charlotte, N. C., announces the death of Mrs. Jane R. Wilkes on Jan. 19, 1913. Mrs. Wilkes had been sole owner of the business since 1868. The business will be continued under the same name. J. F. and J. R. Wilkes have been appointed administrators of Mrs. Wilkes' estate.

Robins Conveying Belt Co., 13 Park Row, New York, has just completed ore bedding and reclaiming plants for the Calumet & Arizona Mining Co., Douglas, Ariz., and the Arizona Copper Co., Clifton, Ariz., being built from the plans of Repath & Macgregor. These installations are similar to those now in operation at the works of the Tennessee Copper Co. and the Cananea Consolidated Copper Co.

The Hardinge Conical Mill Co., 50 Church St., New York, has received an order from the Dorr Cyanide Machinery Co., Denver, Colo., for one Hardinge ball mill and one Hardinge pebble mill, both sectionalized, to be used in connection with an installation of Dorr machinery. At the Miami mill, Miami, Ariz., eight 6-ft. and fifteen 8-ft. Hardinge mills are in operation and more have been ordered. Ten of these mills have spur-gear drive, the rest bevel gear.

The personal property of the Allis-Chalmers Co. was sold at auction on Feb. 27, 1913, for \$4,000,000. James N. Wallace, John H. McLementy, and Francis S. Bangs, of New York, representing a reorganization committee, being the only bidders. The sale included all raw material, accounts, orders, stocks, bonds, and securities of all factories, the largest of which are situated at Milwaukee, Wis., Chicago, Ill., and Scranton, Penn. The real estate was sold on Feb. 3 for \$2,250,000. When the court approves of the sale of the personal property, a new organization will be formed, it is said, with a capitalization of \$42,000,000, of which \$27,000,000 will be common stock.

TRADE CATALOGS

Ingersoll-Rand Co., 11 Broadway, New York. Catalog No. 75. Water Lifted by Compressed Air. Illustrated, 68 pages, 6x9 in.

Deister Machine Co., Shoaff Bldg., Fort Wayne, Ind. Catalog. Concentrators. Illustrated, 15 pages, 9x6 in. This booklet contains descriptions and illustrations of various sand and slime concentrators, invented by Emil and William Deister.

Joseph Dixon Crucible Co., Jersey City, N. J. Catalog. Graphite productions. Illustrated, 104 pages, 6x9 in. Detailed information is given concerning graphite crucibles, stirrers, dippers and various other fire and heat-resisting devices. Another product listed is a clay and graphite compound, which is a highly refractory cement suitable for the repair of worn or cracked furnace linings. It is only necessary to mix this compound into a paste and apply.

NEW PATENTS

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

ALLOYS—Improvements in and Apparatus for the Electrolytic Manufacture of Alloys of Light Metals with Heavier Metals and the Continuous Treatment of such Alloys for Obtaining Final Products. E. A. Ashcroft, London, Eng., and Sande Gaard, Balestrand, Norway. (Brit. No. 1001 of 1912.)

DRY CONCENTRATORS—Improvements in Dry Ore Concentrators. International Concentrator Co., New York. (Brit. No. 11,904 of 1912.)

SEPARATOR. Francis C. Nicholas, New York, N. Y., assignor to United Mining & Trust Co., Wilmington, Del. (U. S. No. 1,053,855; Feb. 18, 1913.)

MALLEABLE IRON—Process of Improving the Quality of Malleable Iron and Steel. Otto Thallner, Remscheid, Germany, assignor to Elektrostahl G. M. B. H., Remscheid-Hasten, Germany. (U. S. No. 1,053,454; Feb. 18, 1913.)

ALUMINUM—Process for the Manufacture of Ammonia by Means of Aluminium Nitride. O. Serpek, Paris, France. (Brit. No. 10,036 of 1912.)

ALUMINUM SOLDER. Richard Seifert, Union Hill, N. J. (U. S. No. 1,052,693; Feb. 11, 1913.)

TIN—Process for the Reduction of Stannic Oxide. Zdenko Metzl, Rouen, France. (U. S. No. 1,053,624; Feb. 18, 1913.)

DRILL-ROD COUPLING. George Watson McAllister, San Francisco, Calif. (U. S. No. 1,053,622; Feb. 18, 1913.)

DRILLING—Water Swivel for Drill Rods. George Watson McAllister, San Francisco, Calif. (U. S. No. 1,053,621; Feb. 18, 1913.)

EXCAVATION—Digging and Cleaning Apparatus for Digging Machines. Herbert W. Sargent, Fort Dodge, Iowa. (U. S. No. 1,052,972; Feb. 11, 1913.)

ORE HANDLING—Brake Mechanism for Ore-handling Apparatus. Frank K. Hoover and Arthur J. Mason, Chicago, Ill. (U. S. No. 1,053,509; Feb. 18, 1913.)

PROPS—Improvements in or Relating to Props or Supports for Use in Mines and Similar Places. J. Humble, Doncaster, Eng. (Brit. No. 7583 of 1912.)

ROCK DRILLS—Sharpening Dies for Rock Drills. Carl Brown, Denver, Colo., assignor to Champion Forging Machine Co., Denver, Colo. (U. S. No. 1,053,476; Feb. 18, 1913.)

SAFETY LAMPS—Igniting Device for Miners' Safety Lamps. Paul Wolf, Zwickau, Germany. (U. S. No. 1,052,783; Feb. 11, 1913.)

SHAFT SINKING—Improvements in and Connected with the Sinking of Pits and Shafts. Charles Walker, Gresford, North Wales. (Brit. No. 892 of 1912.)

MAGNETIC SEPARATION—Process of Treating Ores Preparatory to Magnetic Separation. James B. Etherington, Winthrop, Mass., assignor to Campbell Magnetic Separating Co. (U. S. No. 1,053,486; Feb. 18, 1913.)

ORE CONCENTRATOR. Charles W. Eccleston, Los Angeles, Calif. (U. S. No. 1,053,367; Feb. 18, 1913.)

SEPARATION—Improvements in and Relating to Machinery for Separating Materials of Different Specific Gravity. P. J. Ogle and Mineral Concentrators, Ltd., London, Eng. (Brit. No. 22,452 of 1911.)

ALKALI METALS—Improvements in and Apparatus for the Manufacture of Alkali or Allied Metals. E. A. Ashcroft, London, and Sande Gaard, Balestrand, Norway. (Brit. No. 1005 of 1912.)

ELECTRIC FURNACES—Improvements in Electric Metallurgical Furnaces. V. Stobie, Sheffield, Eng. (Brit. No. 2081 of 1912.)

ROASTING—Process of Treating Ores, etc., in a Rotary Furnace. Arno Günzel, Ziebigk, near Dessau, Germany. (U. S. No. 1,053,381; Feb. 18, 1913.)

DREDGING—Ball Joint for Discharge-pipes of Hydraulic Dredges. Arthur W. Robinson, Montreal, Quebec. (U. S. No. 1,053,648; Feb. 18, 1913.)

BLAST FURNACES—Preparing Coke for Charging Blast Furnaces. Marcus Cassidy Steese, Youngstown, Ohio, assignor of one-half to Rollin C. Steese, Youngstown, Ohio. (U. S. No. 1,054,051; Feb. 25, 1913.)

LEAD OXIDE—Improvements in Apparatus for the Manufacture of Lead Oxide. W. Eckford, Flint, Eng. (Brit. No. 6002 of 1912.)

TIN—Improvements in the Reduction of Tin and Similar Ores or Oxides. A. V. Kemp, Ansdell Lodge, Singapore. (Brit. No. 1814 of 1912.)

TIN—Method of Preparing Tinned Sheet-iron Boxes, Etc., for Detinning. Hans Goldschmidt, Essen-on-the-Ruhr, Germany, assignor to Goldschmidt Detinning Co., New York, N. Y. (U. S. No. 1,053,908; Feb. 18, 1913.)

VANADIUM—Process of Extracting Vanadium from Carnotite Concentrates. Siegfried Fischer, Golden, Colo., assignor of one-fourth to Robert E. Booram, New York, N. Y., and one-fourth to C. R. Hill, Golden, Colo. (U. S. No. 1,054,132; Feb. 25, 1913.)

ZINC—Process for Condensing Metallic Vapors. Frederick W. Gordon, Fort Washington, Penn. (U. S. No. 1,053,592; Feb. 18, 1913.)

DRILL—Percussive Rock Drill. Carl Davenport, Sheffield, England, assignor of one-half to Richard Nicholson, Sheffield, England. (U. S. No. 1,054,181; Feb. 25, 1913.)

DRILLS—Improvements in Hammer Rock Drills and in Percussive Hammers and Similar Tools. A. W. and Z. W. Daw, London, Eng. (Brit. No. 1461 of 1912.)

EDITORIAL CORRESPONDENCE

SAN FRANCISCO—Feb. 27

The New Camp of Rochester, Nev., is exciting much adverse criticism of California investors who are looking to the new field for opportunities and overlooking equal chances in their own state. It is true, as some of the critics have asserted, that such mining news as starts stampedes in Nevada is often printed regarding California mines without creating a rush. The fault is largely a California fault. The mining men or investors of this state have not enough faith in their own resources. A new mine is discovered, or an old one reopened and again put in the producing class, without exciting the slightest interest as to the possibilities of the adjoining land. A number of former producing mines in various districts of the state have been allowed to remain idle for so many years that it is difficult to induce investors to make examinations. New mines are developed in the face of opposition and ridicule, and until the truth is forced upon them by the investment of capital from other states or foreign countries the people of the district refuse to believe in the resources of legitimate mining lands.

The Annual Report of State Mineralogist Hamilton for 1912 is announced by the issuance of press bulletin No. 14 as an advance chapter from the report. This chapter includes brief paragraphs on antimony, asbestos, bauxite and iron ore. It will be followed by other press bulletins containing similar paragraphs on such other products about which the returns are complete. It shows that deposits of antimony are found in Inyo, Kern, Merced and Riverside Counties, but no actual production of ore mined for antimony alone in the state since 1901. The production of asbestos in the year 1912, as reported to the state mining bureau, totaled 90 tons, valued at \$2700, as compared with 125 tons valued at \$500 produced in 1911. There are deposits of bauxite in both northern and southern California, but no ore has been produced and sold. The iron ore production in 1912 amounted to 2508 tons, valued at \$1 per ton, as compared with the production of 558 tons in 1911. The aggregate production of iron ore in the state beginning with 1893 and ending with 1911 was 2095 tons. There are deposits of iron ore in 31 counties of the state.

Title of Third Parties to Southern Pacific Land Holdings patented 36 years ago is the basis of a suit filed in the United States District Court at Los Angeles. The complainants are Robert Armour and Burdette Chandler who claim title under location, to 640 acres of oil land in the Whittier field in Los Angeles County. The locations were made in 1910 and 1911. The Central Oil Co. is defendant. The company has 2200 acres, but the 640 acres to be contested contains the principal development. There are 40 wells producing a total of about 20,000 bbl. per month. Negotiations are pending for the sale of the holdings to an English company at a price said to approximate \$3,000,000. The suit will bring up the same question as in the Burke case, now in the U. S. Supreme Court, as to the right of private parties to claim land under the mineral-exception clause, which was decided adversely by Judge Ross in the lower court. Chandler is also plaintiff in an identical suit against the Union Oil Co., now pending in the Superior Court of Los Angeles County. In the present suit Franklin Pierce, former Assistant Secretary of the Interior, is counsel for complainant. A similar suit by others is pending in the Superior Court of Orange County. Another suit was recently filed by the U. S. Government to oust entrymen from oil lands in Kern County. This action involves 160 acres of land said to be valued at \$500,000. There are 25 oil companies named as defendants. The principal ones are the Consolidated Midway, National Pacific, and the Standard. The government alleges that the defendants continued to operate the property despite the order of the President, dated Sept. 27, 1909, withdrawing the land from entry. The Elk Hills suit of the Government against the Southern Pacific is still in progress, and the indications are that the question of value of the oil that has been found in the district in controversy will develop into great importance. The final adjudication of these various suits will be of vast importance to the oil industry of California; but in some instances will work a hardship on innocent operators and stockholders if the contention of the Government prevails.

DENVER—Feb. 28

The Corporation Tax Question as to whether or not the tax may be collected on the proceeds received from the sale of minerals mined has been laid before the supreme court for solution. The eighth circuit court of appeals, in the suit over the collection of the tax from Stratton's Independence, Ltd., was uncertain as to the law and referred the case to the supreme court.

Colorado-Utah Construction Co. assets were sold at auction by Sheriff Sullivan to W. W. Watson, receiver for the Denver Railway Securities Co., for \$2,000,000, to satisfy a judgment for \$5,124,470, obtained in the district court some time ago. This is the company that built the Moffat railroad. This is merely one step in the proposed reorganization of the Moffat road by Newman Erb and his associates. Completion of the transaction will require about 60 days.

The Colorado chapter of the American Mining Congress has adopted the policy of holding weekly luncheons. Denver mining men expected to hold their first luncheon at the Albany hotel, Feb. 11. At the recent annual convention, held at Spokane, D. W. Brunton, of Denver, was elected president of the national organization. He is especially anxious to build up the Colorado chapter, and he has already given his cooperation in the matter of advising Governor Ammons concerning the needs of the mining industry in this state, as indicated recently by a special committee from the mining men asked for by the chief executive of the state.

Freight Tariffs and Passenger Fares were higher between Denver and Breckenridge after Feb. 27, when the new tariffs of the Colorado & Southern for the line which was recently opened by the state railroad commission's order became effective. Hereafter the railroads will regard all ores as of the same class so far as the freight tariffs are concerned. For several years these tariffs have been on a sliding scale, under which the low-grade ore had an advantage. Ores of a gross value of \$8 per ton paid \$1.50 per ton freight. Those valued at \$12 paid \$1.75, and \$18 ore paid \$2. All ore exceeding \$18 in value paid at the rate of \$3. The company defends its action in making a flat rate by stating that it cannot afford to haul ore at \$1.50 and rather than have the business it has established rates that are prohibitive.

The Silver Discoveries in Eagle County have been inspected by the state commissioner, Thomas R. Henahan, who states that a stampede has begun and that locations are being staked in every direction from the place of discovery. The ore is found in sandstone on Salt Creek near its junction with West Brush Creek. In some of the high-grade ore the silver-sulphide minerals are visible, especially the ore of banded structure. Ore has also been found on Squaw Creek in which the assayers are said to have reported the presence of vanadium. From the fact that some samples of ore believed to be high grade assayed only 20 oz. while others ran 500 to 1000 oz. it would appear that the ore is very spotty. Some ore has already been sacked and shipped to Leadville to be smelted.

SALT LAKE CITY—Feb. 27

During 1911, Utah Produced 7,268,530 tons of ore from 200 different properties, as shown by final figures prepared by V. C. Heikes, of the U. S. Geological Survey. This ore averaged \$5.07 per ton. Of the total amount of ore mined, 5,840,091 tons were milled, yielding 357,370 tons of concentrates, an average concentration of about 16:1. The total value of the output was \$36,837,457. Of this Salt Lake County contributed \$22,561,615.

Copper Smelting Has Been Resumed at the Tooele plant of the International Smelting & Refining Co. Three of the reverberatory furnaces were fired up Feb. 17. The copper plant was shut down in the fall of 1912, owing to the strike at Bingham, which deprived the International of its principal source of copper ores. Since that time copper ore has been stockpiled, and at the first of the year it is understood that there was 25,000 or 30,000 tons on hand. Lead smelting has been in progress, two and later three blast furnaces being operated. The fourth lead stack was blown in Feb. 20. [Later—Press despatches state that the flue-dust chamber at the sintering plant was wrecked by an explosion, but that operations are being continued.—Editor.]

HOUGHTON, MICH.—Mar. 1

A Banquet Was Given to the management of the Isle Royale Copper Co. by the citizens of Houghton, Feb. 24, to mark the event of the payment of the first dividend. The Isle Royale mine is near Houghton, pays a large portion of the taxes of the township and employs between 800 and 900 of its citizens. General Manager MacNaughton stated that the average yield of Lake Superior ore was 20½ lb. per ton and that the average cost was 9.19c. per pound of copper. In comparing the yield with other copper producing districts he gave the following figures: Average of the Butte, Mont., mines, 61¼ lb.; average of the "porphyry" mines of Utah, Nevada and Arizona 22 lb., and the sulphide mines of Arizona and Northern Mexico 74½ lb.; the costs of treatment per ton of ore being, Michigan \$1.86; Montana \$7.84; porphyry mines \$2.22 and \$8 at the sulphide mines.

COBALT—Feb. 28

Fountain Falls Will Be Developed, it is stated, by the Northern Ontario Light & Power Co. The falls are on Montreal River, and will give an additional 3000 hp. This company controls all the power supplied to Cobalt and in addition to this, has power enterprises in Porcupine and various other places. At present, the company is supplying a maximum of 19,000 hp. to the Cobalt mines, but during the seasons of low water there is frequently a shortage so that it has been decided to develop an additional 3000 hp. The maximum capacities of the present plants are as follows: Ragged Chutes, compressed air, 5000 hp.; Matabitchouan River, electric, 10,000 hp.; Hound Chutes, electric, 4000 hp., and Fountain Falls, electric, 3000 hp. This last power is only 1½ miles below Ragged Chutes where compressed air is being generated, and the company will be able to utilize the right-of-way which has already been cut.

SUDBURY—Feb. 28

The Dominion Nickel-Copper Co. will erect a smeltery in the Sudbury district, it being understood that this decision was made by the new interests that have lately come into control of the company. Surveyors are now on the ground laying out the work and construction will be started as soon as possible. It is stated that \$5,000,000 has been appropriated to cover the costs of construction and equipment for the mines and smelteries. It is also stated that the company will refine nickel on the ground. In this event its market will be largely foreign as with Canadian refined nickel, it will be impossible to compete in the American market with the International Nickel Co. Mine development will, for the present, be centered at the Murray mine, which already has large reserves of ore.

JOHANNESBURG, TRANSVAAL—Jan. 29

The Production of the Cape Copper Co. mines at Ookiep is still 1000 tons of 13% ore, and at Naba Reef, 4500 tons of 3.8% ore monthly, but diamond drill exploration has shown the existence of lower-grade ores in both mines. The profit for 1912 was £80,500. The Tilt Cove property in Newfoundland is worked out and will be abandoned; the new mine, the Rajdoha at Chola Nagpur province, India, is developing well, showing 190,000 tons developed, assaying 4% ore.

The Year Has Not Closed without Another Unpleasant Surprise for Investors—Shares in the New Kleinfontein company have fallen from 27s. to 20s. and the directors have issued a report showing that the life of the mine is estimated at 13 years from January, 1913, instead of 16 years as anticipated before. As a matter of fact, many were well aware a year ago that a barren zone in the western section some 800 ft. wide, had reduced the life greatly and they acted accordingly. In addition, a debt of £205,000 has been incurred, which represents a year's profits of the company. The Lancaster West mine, which was producing over £25,000 per year, has shut down, owing to the poorness of the ore.

There Will Be Few Old Mines Falling Out During 1913. The Jumpers and Treasury mines being almost the only ones. There is however, the fear that some of the poorer mines may have to shut down. The great reduction in the number of producers is not due for three to five years yet, and several new producers will be added to the list, so that the output for 1913 should show an increase. The Randfontein Estates, the parent company of the Randfontein Central mines, after being in existence since 1895 has at last declared a 5% dividend. The Randfontein Central mines on which 1000 stamps are erected, including the 600-stamp mill, are showing improved results. They also declared a 5% dividend. In April, 1912, 700 stamps crushed 199,578 tons of ore containing gold worth 24s. 3d. at a cost of 18s. 5d.; in November, 750 stamps crushed 217,089 tons, containing 24s. 7d., at a cost of 16s. 10d. The ore reserves were increased

by 15,000 tons and total 6,653,100 tons. About 9.28% is sorted. The capital of Randfontein Estates is £3,000,000 and of Randfontein Central £4,500,000, besides certain debentures. Last year the mines of the Consolidated Gold Fields of South Africa increased the average extraction of the ore treated from 94.167% to 94.569%. This added \$16,884 to the profit.

The Messina Copper Mine in November milled 1793 tons, of ore, producing 215 tons of concentrate, assaying 49% copper, which was carted 70 miles to the railroad and exported, and also 182 tons of 10% ore, which was stacked. The mine is in the Northern Transvaal near the Limpopo River. Copper lodes are being opened in shear zones in granite under extensive old workings. The mine has produced concentrates of a value of £280,000 to date, producing 10,861 tons, assaying 52.7% from 76,135 tons of ore, besides seconds and middlings stored. These concentrates have had to be carted 70 to 130 miles to the railroad, thence to Delagoa Bay and exported to Europe. A railway should reach the mine in 1913. The lodes have been opened over a length of 3800 ft. and to a depth of 800 ft. and numerous old workings over a stretch of several miles remain unexplored. The ore occurs in shoots; 15,333 ft. of development assays 13.1% copper over 60 in. and on the fifth level an ore shoot assays 19.5% over a width of 75 ft. The reserves blocked out are 170,000 tons of 10% ore and the probable ore above the 1000-ft. level amounts to 500,000 tons. A coal field is being opened in the vicinity and a mill to treat 120,000 tons per year is under order. The ore is easily concentrated and an extraction of 80% is expected in the new mill.

H. H. Webb Is Returning to the Rand to make a special report to the Consolidated Gold Fields as to the possibility of adopting a system of selective mining of the richer ore in the mines to increase the present annual profits at the expense of future work. It may be confidently predicted that, owing to the condition of the mines, any such scheme is impossible. The Knights Reef mine of this group, which is mining large bodies of low-grade ore, has already abandoned surface sorting entirely, considering it cheaper to crush the 3000 tons per month formerly sorted than to reject it. The percentage of sorting on the Rand is declining; in 1908, 15.5% was sorted from ore of an average grade of 7.39 dwt. and in 1911, 13.01% was sorted from ore of an average grade of 6.57 dwt. In cases such as that of the East Rand Proprietary mines, this step has been a retrograde one, but where large mills have to be kept going, in which the total reduction costs are only about 3s. 6d. per ton, it may pay to crush waste assaying 1 dwt., rather than sort it. In the Langlaagte Consolidated mine, which has recently started a 100-stamp mill with 10 tube mills, the South Reef which is the main gold producer is so indistinct that sorting is impossible. In the New Rietfontein Estate mine, the reef also often consists of a mere streak or parting, but in this case the presence of distinct grains of black carbonaceous material renders sorting possible.

The Dividend Declarations for 1912 in South African mineral industries are somewhat disappointing, but show an improvement on those of 1911. Those for the Transvaal for 1912 and 1911 respectively were as follows: Gold, £8,331,575 and £8,066,437; diamonds, £360,000 and £300,000; coal, £284,907 and £215,787; tin, £108,700 and £133,250; totals of £9,085,182 for 1912 and £8,715,474 for 1911. Rand gold mines declared £8,000,492 of this total as compared with £7,763,086 in 1911. From 1887 to 1912, a total of £88,199,587 has been paid in dividends by Rand mines. The total output from Witwatersrand mines for 1912 was £37,182,795, with a declared working profit of about £12,648,000, as compared with 1911 figures of £33,543,479 and £11,415,861. The declared dividends are only about 65% of declared profits. Large sums have been kept in hand or spent on equipment and excess development. The Premier diamond mine paid, beside dividends to shareholders, an additional £540,000 in profit shares to the Union government. In November, there were 186,881 natives at work in the Rand gold mines.

Earnings of White Men in 1912 will probably for the first time show a decline of over £300,000. This is due partly to the cessation of expensive new construction and development and probably to the centralization policy adopted. A larger proportion of white labor is being employed to increase the efficiency of the native by better supervision. Efficiency results show that in 1907-1908 the labor employed per 1000 tons milled was 0.89 white and 8.83 native, while in 1911 the figures were 0.97 white and 7.78 native. Expressed in tons milled per laborer per year, in 1907-1908 it was 1125.9 for whites and 113.3 for natives; in 1911 it was 1030.9 for whites and 132.5 for natives. Underground for 1000 tons developed per day 109 whites and 1563 natives were employed in the year 1907-1908 while in the year 1911, 115 whites and 1281 natives were employed.

THE MINING NEWS

ALASKA

DISCOVERY OF GOLD ON SILVER CREEK is causing considerable excitement.

ALASKA GOLD MINES—New Machinery has just been ordered which is to be installed in the near future; Bart L. Thane, Juneau is manager.

PENNSYLVANIA—McCarty & Furstengau, the owners, have ceased work on this property. It is understood that they will start development work on an adjoining claim.

TEDDY R.—A shipment made by Ford & Pomeroy, the lessees, to the mill of the Pioneer Mining Co., on Chatham Creek, netted \$25 per ton. The ore was taken from the shaft during sinking.

HELEN S.—This claim on the extension of the Teddy R. vein, is being developed by the owners, Crites & Feldman. An adit has been driven 200 ft. into the hill from the Moose Creek side.

GOVERNOR—An option and lease has been given to Keys, Larson & Ellis, who plan to commence active development work at once. In the 78-ft shaft the vein is from 6 to 48 in. wide. A test run on picked ore gave a return of \$73 per ton.

CHATHAM MINING CO.—Considerable difficulty has been experienced in obtaining sufficient ore to keep the mill operating steadily. The adit is being advanced into the hill as fast as possible, and additional stopes will be opened soon.

CHENA MILLING, SMELTING & REFINING CO.—The 10-stamp mill at Chena, is crushing a shipment of 300 tons of ore from the Rainbow mine in Skoogy gulch. Owing to the scarcity of water, it has been found possible to operate the mill only intermittently. The well is to be cleaned out where it caved while the plant was idle, however, and it is thought that there will then be plenty of water.

HUDSON BROS.—This Ester Creek property, formerly considered one of the best in the camp, has proved so far to be a disappointment at depth. Development on the 70-ft. level has failed to show the extension of the phenomenally rich ore passed through by the shaft nearer the surface. The operators plan to extend the drifts both ways along the vein and to lift raises at a distance of 200 ft. from the shaft.

RAINBOW—This property in Skoogy gulch was purchased by Roy Maddocks and associates. Ore is being taken from the stopes above the 100-ft. level. A shipment of 300 tons will be milled at the 10-stamp mill of the Chena Milling, Smelting & Refining Co. The ore will be hauled to Gilmore, on the Tanana Valley Ry., by sleds each of 7½ tons capacity. A trestle has been built at the station so that the sleds can be dumped directly into the freight cars.

HOMESTAKE—A test run of 26 tons of ore from this property was recently completed at the Newsboy mill on upper Cleary Creek. The yield was \$77 per ton in free gold besides a small quantity in the concentrate. The ore was taken from the drift on the vein first cut by the main adit. This stringer, though small where first found, has maintained an average width of 18 in. for the last 150 ft. Drifting will be continued and stopes will be opened, but no ore will be stoped until the cost of hauling and milling is reduced.

ARIZONA

Cochise County

BLACK PRINCE—Leasing is being done on this property at Johnson. A proposal to drill the ground is being considered. Dr. R. N. Bell, of Denver, Colo., is president.

STANDARD—This new company is exploring on a group of 20 claims north of the Centurion on the quartzite contact. Owen T. Smith is in charge.

PEABODY COPPER MINING CO.—This company is shipping from surface workings of the old Peabody mine. No new development has been done recently.

PEACOCK COPPER MINING CO.—This company is developing surface copper outcrops in the limestone near the Peabody mine, near Johnson. H. L. Marmon is in charge.

JOHNSON COPPER DEVELOPMENT CO.—This property, near Johnson, is being developed in charge of J. T. Tong. Henry Krug, of St. Louis, Mo., is president.

ARIZONA UNITED—This company is shipping from its Republic mine near Johnson, from ore taken out in development. The small smelting plant installed some years ago is idle. Mr. Libby is manager.

TEXAS & ARIZONA—This company is operating a lead-zinc-silver mine on the eastern edge of the Johnson-Dragoon basin in the limestone formation. Sidney Webb, of Bellview, Texas, is president. P. R. Hubbard, engineer, and M. R. Birdwell, manager.

EMPIRE COPPER & GOLD CO.—This company, operating in the Johnson-Dragoon district, expects to resume shortly after a suspension due to the death of H. H. Morrow, the secretary and chief holder of the stock. The new work will be on the Princess group at Dragoon chiefly. Seth Merrill is manager.

ARIZONA & MICHIGAN DEVELOPMENT CO.—The financial troubles of this company have been adjusted and work resumed on a small scale. A. J. Pidgeon, of San Diego, Calif., is president and E. J. Matlock is in charge. The company owns a short railroad connecting with the Southern Pacific at Dragoon.

Gila County

GIBSON—Operations were recently interfered with and the working force was reduced by half on account of the severity of the weather.

SOUTH LIVE OAK—It has been impossible to begin drilling at hole No. 7 because of the severity of the weather. The results at hole No. 6 are reported as satisfactory.

MIAMI—Beyond the installation of a reinforced concrete arch on the line of the switchback beneath the tramway that lifts supplies from the valley to the Miami mill and shafts there has been little surface work done at the property during February because of the severe storms.

SUPERIOR & BOSTON—The rich ore that was traversed throughout the raise from the 800-ft. to the 600-ft. level southeast of the McGaw shaft continues above the 600-ft. level. The ore dips under Quo Vadis hill so it seems certain that an extensive body of mineral will be disclosed to the southeast and below the present ore disclosure.

OLD DOMINION—While a normal output of ore was no doubt made in February, the severe storm at the last of the month and the severe weather that prevailed all through the month caused the cessation of all construction work at the mine. The Great Falls converters, installed in January, are now in satisfactory operation.

INSPIRATION CONSOLIDATED—The work at the mill-site, on railroad grading and in the mines was discontinued for several days because of the severe weather that has made outdoor work impossible and prevented fuel and other supplies from being delivered. The storm abated Feb. 23, and it was then expected that all work would be promptly resumed. At the Live Oak fuel and supplies were on hand in sufficient quantity to enable continuation of work through the bad weather at normal rate.

Mohave County

MCCRACKEN—An examination of this property was recently made by L. A. Dockery and the Qualey Bros., of New York.

MIDNIGHT—The new concentrator on this property at Chloride is running. Development work of recent years has opened much milling ore and there are also many tons of milling and high-grade ore on the dump.

GOLD ROAD—Bullion from this property produced in a recent week was valued at \$21,000. While the force of miners has been greatly reduced, the mill is being operated steadily and many improvements are planned.

MACKBERRY—An option on this old mine has been given to George E. Gunn, of Salt Lake City, by the owners represented by W. B. Ridenour. Development work is to be started immediately. There is an incline shaft on the property extending to a depth of 600 ft. on the dip of the vein.

A DISCOVERY OF GOLD has been made at Wallapai Springs, about 15 miles east of Kingman, by Walter Meyer. The discovery was made on the outcrop of a dike traceable for several miles across country at the north end of the Wallapai Range. Telluride ore has been found along the same dike about two miles to the east.

CALIFORNIA

Amador County

KENNEDY—The shaft has been sunk to the 3850-ft. level. The four wheels under construction for elevating the tailing from the 100-stamp mill over an adjoining low hill to a ravine on company property are nearing completion. They are each 56 ft. in diameter.

CENTRAL EUREKA—The inclined working shaft caved, Feb. 20, about 150 ft. below the collar. The caving moved upward and closed the shaft. The mine has been idle since Jan. 9, the date of a similar caving of the South Eureka shaft. The two mines adjoin and are connected at one of the lower levels. James A. Davis, of Sutter Creek, is superintendent.

Butte County

HUPP—It is reported that this mine in the Magalia district is closed down on account of an excess of water that cannot be handled by the pumps.

CHEROKEE—It is reported that a large acreage covered by debris from this old hydraulic mine has been bonded. It is thought that some gold may be recovered by reworking the gravel.

CALIFORNIA DIAMOND DRILL & ENGINEERING CO.—Drilling has been started at Magalia to prospect the old channel believed to underlie the McLain, Ingraham and Warren properties. These claims and other ground are reported to be bonded to San Francisco men, who have employed this company to drill to a depth of 500 or 600 feet.

Calaveras County

MORGAN—Ore is being mined for test runs in the Finnegan mill. It is said the dump will also be milled.

ISLAIS CONSTRUCTION CO.—This San Francisco company is reported to have 70 mules, wagons and men at work grading for the extension of the railroad from Milton to Copperopolis.

CALAVERAS COPPER CO.—The new smelter is in operation, it being claimed that the smoke problem has been solved. The shaft is 1000 ft. deep. The ore has recently been

hauled by wagons and auto trucks to Milton, a distance of 14 miles, for rail shipment. J. H. Trerise, manager.

Kern County

BUTTE—Fifteen tons of screening treated at the Red Dog mill recently returned \$17 per ton; Edward Shipsey, leaser.

SIDNEY—This group of mines at White's Camp, six miles west of Randsburg, is being surveyed for patent; A. C. White, owner.

CONSOLIDATED MINES CO.—The 5-stamp mill at the Good Hope mine and the concentrating plant were practically completed, Feb. 10, and are ready for operation as soon as the Southern Sierras Power Co. is ready to deliver power.

PLACER GOLD CO.—The new sluicing and concentrating plant is completed. Regular operation of the plant will await the extension of the electric-power transmission line of the Southern Sierras Power Co. from the Randsburg substation. The Cummings separator is reported to be giving satisfactory results in separating the gold from the scheelite and black sand; E. Coppock, secretary.

Modoc County

HESS—A large body of ore, some of it high-grade, is reported to have been disclosed at this mine in the Winters district, near Adin. The removal of the cyanide mill from Pit River to the mine, a distance of one mile, is contemplated. Keegle & Harvel are working the mine on a lease.

Mono County

PITTSBURGH-LIBERTY—The purchase of this mine in Masonic district by Stall Bros. has been consummated by the approval of the stockholders and creditors. The mill will be remodeled for treatment of the ores from this mine and the Serita recently purchased by Stall Bros. W. M. Fuller, of Masonic, is superintendent.

Nevada County

SOUTH YUBA—This company is having an examination made to decide whether the mine on San Juan ridge shall be reopened. C. D. Tregoning, of Nevada City, is consulting engineer.

PENNSYLVANIA—The old tailing dump, which is on the Larkin ground adjoining the Pennsylvania, is being sampled by Homer Rhyne and Peter Eastman, of British Columbia. If the ore can be profitably treated a cyanide plant will be built.

Placer County

JUBILEE—A new oil burner was recently installed; new boilers will now be installed. The property is on the Grass Valley road, near Auburn. Mr. Contente is superintendent.

KING—This gravel mine on a branch of Secret ravine, near Roseville, will be reopened by a new company organized by San Francisco and San José men. E. O. McGrath, of San José, is the principal incorporator.

Plumas County

PETINGER—This old mine in Taylorsville district is being reopened; A. L. Beardsley, of Taylorsville, superintendent.

DROEGE—Work has been resumed in this mine and mill in Crescent Mills district after a temporary closing down on account of freezing of the water supply. W. E. Cahill, of Greenville, is superintendent.

Riverside County

IN THE MENEFFEE DISTRICT, 25 miles southeast of Perris, and near Crown Valley high-grade ore has been discovered at shallow depth by J. H. Whitman, who purchased the claims from Dan Miller and Samuel Black, of Perris.

San Benito County

HERNANDEZ—It is expected that extraction and treatment of ore will be resumed at this quicksilver mine southwest of Idria. The use of auto trucks is contemplated; H. G. Larsen, of Hollister, general manager.

Shasta County

GAMBRINUS—The mill has been closed down temporarily. **DESMOND**—An 8-ft. vein has been uncovered at this mine near Whiskytown in the Stella district. Jerry Desmond is owner.

MOONLIGHT—Electric power has been substituted for steam for driving the new 5-stamp mill. The mine is at Ingot in the Afterthought district. Power is furnished by the Northern California Power Co.

Trinity County

BONANZA KING—The stamp mill, which was destroyed in January by snowslides will be rebuilt as soon as the snow and debris can be cleared away. It is expected to resume mining and milling early in the spring.

COLORADO

Clear Creek County

STANDARD—Development work has been resumed. Drift No. 13 west is being advanced to prospect the continuation of the ore found at the crosscut; John Mollard is superintendent.

JOE REYNOLDS—Litigation which has forced this property to lie idle for several years has recently been satisfactorily settled. Two of the main levels are being overhauled, retimbered and placed in working order preparatory to the resumption of operations. This property includes 29 patented lode claims and four mill sites, with a total area of 129 acres. It is thoroughly equipped with a mine plant, sampler and concentrating mill. A substantial ore reserve is available and an effort will be made to rapidly increase this by development; R. B. Morton, of Idaho Springs, is manager.

Eagle County

ON SALT AND BRUSH CREEKS between 20 and 30 men are working claims. Several have reported the discovery of

silver ore, but not in large quantity. Men from Denver are trying to secure a lease on a group of six claims. Miners and prospectors have come in from surrounding camps until it has been difficult for them to find lodgings. A new hotel has been started that will be ready next summer, but at present the town is crowded.

Leadville-Lake County

STONE—Lessees are sending out the customary six carloads per week. The ore comes from the intermediate old stopes and levels.

LITTLE ELLA—The lessees on this claim in Big Evans gulch, have opened a rich streak of ore close to the surface. Shipments have already been sent to the smeltery.

STAR OF THE WEST—Reed & Mack, lessees, recently shipped 35 tons of ore, which gave smeltery returns of 1000 oz. silver per ton. These men are also working the Tip Top mines.

LOUISVILLE—Hanifen & Reynolds are doing considerable work below the 300-ft. level of the Yak tunnel on a well defined oreshoot that carries gold, silver, copper and a little iron. Regular shipments of two classes of ore are made daily.

San Juan Region

TOMBOY—The new tramway is now in satisfactory operation. Within a few weeks practically all of the company's up and down freight will be transported over the tram and packing on the county road will be discontinued; D. A. Heron is general manager.

SMUGGLER-UNION—The milling plant is now treating about 350 tons per day. The new cyanide equipment is in satisfactory operation. A substantial portion of the ore treated is now being drawn from the old stopes in the Smuggler and Ansborough properties; Bulkeley Wells is president and manager.

SAN BERNARDO—As a result of development work during the last year several promising oreshoots were opened in the lower levels of this mine near Ophir Loop. The operators regarded the development sufficient to justify the erection of a new mill and tramway. This equipment has been installed and is now ready for operation.

Summit County-Breckenridge

SIMCOE MINING & MILLING CO.—This company was organized in Leadville, and will operate the Country Boy mine, that has a record as an old-time producer of blende. H. J. Jones is superintendent.

RELIANCE GOLD DREDGING CO.—This company's boat is running steadily and is making semimonthly cleanups of placer gold. The boat is equipped with a steam-heating system, which permits it to be operated during the coldest weather.

Teller County-Cripple Creek

HENRY ADNEY—A station is being cut on the seventh level of the main shaft. The shaft was raised from the seventh level of the Old Gold and connection was made 113 ft. above.

OLD GOLD—Two machines are being worked in the development of this mine on Beacon Hill by Oscar Fogleman, lessee. After sinking the shaft to a depth of 700 ft., laterals were driven. Early in the spring the shaft will be sunk another 100 feet.

CRESSON—The shaft has been sunk to the 13th level, and a crosscut to the main orebody has been started, it is understood. A winze has been sunk from the 12th level on the ore. Richards Roelofs, general manager of the property, has effected some changes in operations, which have materially reduced the costs.

MICHIGAN

Copper

MAYFLOWER—Drilling of the new holes, Nos. 27 and 28, is underway.

KEWEENAW COPPER CO.—Drill hole No. 38 on Sec. 11, T. 58, has passed through the Ashbed lode and found the formation to be about 20 ft. through and of good character. Drilling will be continued for some time and the formation tested in several places.

SOUTH LAKE—Another copper-bearing formation has been encountered in the shaft, making a series of four so far reached within a depth of about 300 ft. It is stated that a crosscut will be started at a depth of 300 ft. to cut these formations, but it is not likely that any extensive opening will be done until a depth of about 500 ft. has been reached.

SUPERIOR COPPER—This company is now shipping about 600 tons of ore daily, using one head of the Lake Milling, Smelting & Refining Co. plant. All shipments to the old Atlantic mill have been discontinued. Recent developments on the main lode have been very good, and on the West lode opening of rich ground continues. No. 2 shaft is being sunk to the 17th level, where the two shafts will again be connected. A large amount of openings have been done down to this level, but results so far have been discouraging.

HANCOCK—This company has shipped several carloads of ore to the stampmill for treatment. The property has not yet entered the producing list, and shipping this amount of ore was done only to avoid starting a stockpile as all the bins are filled, and it will be about mid-summer before underground conditions will permit of steady producing, although the main loading stations are completed and the second large skip has been attached so that as soon as sufficient ground is developed shipment will be maintained to the mill of the Lake Milling, Smelting and Refining Co., near Dollar Bay.

Iron

BENGAL—A change house, 102x34 ft., is being built at this mine of Pickands, Mather & Co. The material is brick similar to the engine house recently built. A new electrical compressor has been received from the Ingersoll-Rand Co.

HOMER—At this mine of the Wickwire interests, to be operated under the name of the Buffalo Iron Mining Co., and

comprising the Donahue and McGovern properties taken over from the Niagara Iron Mining Co., a hoisting shaft, 12x14 ft., is being sunk, well back in the black slates.

PITTSBURG & LAKE ANGELINE IRON CO.—This company, a subsidiary of Jones & Laughlin, and operating the Lake Angeline mine at Ishpeming, will reopen the old shaft near Iron Mountain Lake. Machinery and power drills will be installed. Iron Mountain Lake is one of the lakes from which the city of Ishpeming obtains its water supply.

DULUTH DIAMOND DRILL CO.—This company is preparing to drill on the Miller and Hammer properties in the Iron River district; two drills will be operated. This property is in the immediate vicinity of the discovery of iron ore made last year when a single hole was drilled to test the site for a railway station. The properties lie between Iron River and Stambaugh.

MINNESOTA

Cuyuna Range

WILLIAMS-CARLSON—The overburden on this company's property, near Ironton, will be removed by hydraulic mining and the ore be mined by the Pittsburgh Steel Ore Co.

Mesabi Range

PEARSON—Although the ore shipping season will not be open until May, operations have been resumed on this mine after having been suspended for the winter.

PITTSBURGH STEEL ORE CO.—This company has been incorporated with \$500,000 capital by E. H. Binder, W. F. McCook, W. H. Rowe, all of Pittsburgh, and P. H. Neison, of Duluth. The head office will be at Duluth.

A **DOUBLE-TRACK RAILROAD** from the Mesabi range to the Head of the Lakes, will be ready at the opening of the shipping season when the Great Northern Ry. will begin operating 65 ore trains. It is expected that 17,000,000 tons will be handled during next season.

Vermilion Range

GLEASON EXPLORATION CO.—This company has secured an option on the property between the Chandler mine and Long Lake, and has begun sinking test pits. If this testing results satisfactorily diamond drills will be used to explore the ore at greater depth.

MONTANA

Butte District

BUTTE-MINNESOTA—The stockholders of this company, which owns six claims about five miles southwest of Butte, recently held a meeting at Butte and elected the following directors: P. E. Peterson, A. W. Havela, Angus McLeod, William Vuoti, J. E. Porthan, John Lampi, John Kukko, A. Herranen, and Emanuel Autio. The company expects to begin operations after Mar. 1, and will sink the shaft 100 ft. from its present depth of 35 ft. A steam hoist will be installed. The country rock is granite similar to that of Butte, and several veins have been traced across the property.

BUTTE-ALEX SCOTT—During 1912 drifting on ore to the extent of 1519 ft. was done, consisting of 246 ft. on the 200-ft. level; 293 ft. on the 600-ft. level; 178 ft. on the 1300-ft. level; 211 ft. on the 1400-ft. level; 296 ft. on the 1600-ft. level; and 295 ft. on the 1700-ft. level. Shipments of ore amounted to 55,054 tons, from which gross returns of \$477,061, and net returns of \$120,055 were received. The average grade of ore shipped contained 4.19% copper, and the average price received was 16.57c. per lb. Settlement was received for 5659 oz. of silver, and 20,941 oz. of gold. The payment of the first dividend of 50c. per share was made Aug. 15, and a second and equal dividend was paid Nov. 15. At the end of the year there was \$53,388 in the treasury after all expenses had been deducted. The company is planning to sink the shaft from the 1800- to the 2200-ft. level this year, and develop the 2000- and 2200-ft. levels.

Fergus County

NORTH MOCCASIN—During Dec., 1912, the Barnes-King Mining Co. treated 1757 tons of ore from this property at Kendall. In January, 3286 tons were treated, and up to the middle of February approximately 2000 tons were milled. Excellent results are being obtained from development work done on the 500-ft. level. The drift of this level is still in ore of good grade, and has attained a length of 275 ft. on the vein. The grade of ore being mined and milled is considerably higher this month than during any of the preceding months since operations commenced.

Lincoln County

BIG EIGHT—This property in the Troy district, consisting of two patented claims, one unpatented claim and a mill site, situated near Troy, has been sold to R. C. McCaffrey, with whom H. L. Day, of Wallace, Idaho, and J. D. Finley are interested.

Madison County

SAGE HEN—J. H. Wiant, of Twin Bridges, has secured a lease on this property in the Silver Star district, and is preparing to begin development work at once.

Sanders County

SUNSET PLACER MINING CO.—This company, which owns much placer ground on Vermilion Creek, is prospecting the property with a Keystone drill. In case gold is found in sufficient quantities to warrant the expenditure, the company is planning the installation of a gold dredge. G. M. Fowler and T. M. Rodda, of Butte, who are interested in the company, recently made a trip of inspection to the property.

NEVADA

Eureka County

WINDFALL—This company, until recently mining and milling low-grade ore at its property about 5 miles east of Eureka, is short of funds due to underestimating the cost of remodeling its mill. A sheriff's sale was to have been held Feb. 25.

MINERAL HILL CONSOLIDATED MINES CO.—This company lately installed for operation of the mill, one 60- and one 150-hp. Fairbanks, Morse & Co. gasoline engines. The company is milling and cyaniding old dumps said to contain about \$7 per ton in silver.

BUCKHORN MINES CO.—This company operating in the Buckhorn district has completed 1250 ft. of its 1700-ft. tunnel which is being driven to connect with shafts sunk on the hill. Work on the mill will be started in the early spring, excavation work only being performed during the winter months.

CREDO-EUREKA MINES CO.—This company has transferred its assets to the Adams Hill Corporation, of Washington, capitalized at \$500,000. The intention is to develop the property and continue sinking the Racine shaft to a depth of 800 ft. This shaft is now bottomed at 400 ft. L. W. Hope is superintendent, E. A. Moye of Spokane is president and general manager.

NEVADA CENTRAL COPPER CO.—This company is sinking a two-compartment shaft to the water level. The shaft was commenced Feb. 1, and on Feb. 20 was 105 ft. deep and the first station cut. Sinking is progressing at the rate of six feet per day timbered. Hoisting is done by a Fairbanks-Morse, 60-hp. oil engine. This is the first hoist in this part of the country operating on 32° stove oil and is found to be a great success. Two Ingersoll-Rand "Jackhammers" are used in drilling, air being supplied by two-stage compressor, belt driven by the hoisting engine. Jackhammers are an innovation in this district. The mines of the company are three miles east of Cedar switch on the Eureka-Nevada Ry.; H. A. Linke, manager.

Nye County

MIDWAY—The new oreshoot has now been drifted on for 53 ft., and is from 4 to 8 ft. wide, and the ore assays from \$40 to \$80 per ton.

TONOPAH MERGER—In completing the sump below the 1170-ft. level, a new vein was struck, but a heavy flow of water prevents its further exploration until pumps have been installed.

JIM BUTLER—Crosscutting has been started on the seventh level to cut the downward extension of the oreshoot from the sixth level, which has been drifted on for more than 300 feet.

TONOPAH-BELMONT—Judge Rellstab, of the U. S. District Court, at Trenton, N. J., granted this company three months, dating from Feb. 24, in which to remodel its plant to avoid infringement of the Moore filter patents.

BULLFROG MINING SYNDICATE—A shaft has been sunk on this company's property near Pioneer, to a depth of 175 ft. on a mineralized contact of limestone and quartzite. From the bottom of the shaft one drift has been driven 100 ft. to the north and another 50 ft. to the south, the material cut yielding gold upon being panned. A short tunnel, 50 ft. long, was driven into the hill before the shaft was sunk and very rich gold ore was found.

SHIPMENTS in tons from Tonopah mines for January:

Tonopah Mining.....	14,720	North Star.....	175
Tonopah Belmont.....	12,517	Mizpah Extension.....	.....
Montana-Tonopah.....	4,337	Jim Butler.....	1,684
Tonopah Extension.....	4,461	Tonopah Merger.....	495
West End.....	4,617		
Midway.....	200	Total.....	44,755
MacNamara.....	1,549	Estimated value.....	\$900,182

White Pine County

CUBA—This mine recently shipped a car of lead ore.

A **RECENT HEAVY SNOWFALL** while causing trouble in the steam-shovel pits is about 2 ft. deep in the mountains and insures there being a good supply of water in the spring.

NEW MEXICO

Sierra County

VANADIUM MINES CO.—The property of this company in the Cabalios range west of Cutter, has been sold and the mill has been dismantled and removed. It is reported that it will not resume operations as a vanadium producer. Several of the men formerly with the company are now associated with the American Vanadium Co., of Pittsburgh. The vanadium occurred in association with lead in a vein in limestone. Impurities in the ore made metallurgical treatment difficult. The deposit was opened to a depth of about 400 feet.

NORTH CAROLINA

Montgomery County

UWARRA MINING CO.—A shoot of ore has been opened on the 300-ft. level that is 3 ft. wide and assays from \$19 to \$20 per ton. This shoot is in the Iola vein. The 300-ft. level on the Montgomery vein is wider and richer than it is above and it has now been decided to start work on the 50-ton mill. Percy E. Barbour, of Candor, is manager.

Catawba County

KINGS MOUNTAIN GOLD MINING CO.—This company is about ready to start mining in the old Catawba mine, two miles from Kings Mountain. J. G. Moore is in charge of the operations and an ore treatment plant is being built.

OREGON

Baker County

MILWAUKEE—This placer property has been purchased by Dervy Bros., of Sumpter, who will install a dredge.

Josephine County

GOLD KING—Operations are to be resumed at this mine. M. Marks, Kerby, is principal owner.

ORIOLE—A 10-stamp mill has been purchased and will soon be erected on this property. J. C. Mattison, Galice, has charge of the work.

ALMEDA MINING CO.—R. C. Kinney, of this mine, states that underground work is progressing rapidly, and the company is preparing for a greatly increased output of ore. As soon as the roads are in condition for hauling a 16-table concentrator of 200 tons daily capacity will be built. The roads are in almost impassable condition now.

UTAH

Beaver County

MAJESTIC—Ore carrying 3½% copper and upward has been opened at four places. Drifting is in progress to reach this ore at greater depth.

MOSCOW—This company is shipping more than 300 tons of ore per month. The two compressors and enlarged boiler capacity have made increased development possible. Work with machine drills is being done from the 300- to the 600-ft. levels.

Juab County

TINTIC SHIPMENTS for the week ended Feb. 21 were 194 cars, showing a gain of 11 cars over those of the week preceding.

YANKEE—Development work is being done on the 1800- and 2000-ft. levels. Two cars of ore were shipped the week ended Feb. 21.

UNCLE SAM—Lead ore is being mined from below the tunnel level, a car of it having recently been shipped. Zinc ore is also being mined.

IRON BLOSSOM—According to an official statement the company has between three and four years ore supply assured above the 800 level.

BECK TUNNEL—New lead-silver ore has been opened in a drift on the 300-ft. level of the No. 1 shaft. Four cars were shipped the week ended Feb. 21.

EAGLE & BLUE BELL—During January 77 cars of ore were shipped. This came largely from the 700 to the 1250 level. Prospecting in new ground at depth is to be undertaken.

LOWER MAMMOTH—Ore is being produced from the 1500 level. On the 1800 level, a fissure has been cut, which is thought to be the vein which was productive in the early days near the surface.

DRAGON CONSOLIDATED—This company is said to be considering the installation of electric hoisting equipment. Between 100 and 125 tons of iron ore daily are being mined, making a total of 19 cars shipped the week ended Feb. 21.

TINTIC ZINC CO.—This company has recently been organized to take over claims in North Tintic. The capitalization is 1,000,000 shares, 500,000 of which have been used in payment for the claims which are south of the Scranton. N. A. Dunyon is general manager.

MAY DAY—Zinc and lead ore is being mined from between the 200- and 500-ft. levels. These levels have been the chief source of the mine's output for many years. The zinc ore left in the stopes in past work is now being mined. About 200 tons of lead ore per month is being shipped from the new orebody opened on the 1000-ft. level.

Salt Lake County

WASATCH MINES—The Columbus Consolidated, Flagstaff, and Superior Alta will consolidate under this name.

OHIO COPPER—Three sections of the mill are in operation and as much as 2700 tons per day are reported to have been treated.

YAMPA—This mine which has been idle for several months has resumed operations with a force of 100 men. It is planned later to increase forces. The property is controlled by the Tintic Mining & Development Co.

Summit County

PARK CITY SHIPMENTS for the week ended Feb. 21 amounted to 2,327,960 pounds.

ONTARIO—Yearly earnings of this company are given as \$10,000, coming from royalties and subsidiary companies.

DALY-JUDGE—A cave-in occurred recently on the 900-ft. level, and is reported to have exposed some good ore.

DALY—Two air receivers for the main tunnel have arrived, and it is understood that a compressor and hoist are to be installed at the Daly No. 2 shaft.

WABASH—The sale day on the recent assessment of 5c. per share has been postponed to April 10. This assessment, it is thought, will free the company of debt, and work may be resumed. Considerable development has been done.

WASHINGTON

Stevens County

STANDARD CHEWELAH—This mine will be put on a shipping basis. F. R. Clark, Chewelah, is president.

SECURITY COPPER—This company has been organized in Spokane, H. A. Sprague as president, and has purchased the Matterhorn group of claims in the Chewelah district.

WISCONSIN

Platteville District

BEACON HILL—Charles Kistler, of Platteville, has taken a lease on this property at Cuba.

CLEVELAND—This company is sinking a shaft on the Lawrence property at Hazel Green.

VON OEHSSEN—Micka & Druen are sinking a shaft on this property just north of the city limits of Platteville.

WISCONSIN ZINC CO.—This company has proved a big range of zinc ore ahead of the mine workings at the Federal mine recently acquired; the property lies just south of Hazel Green.

CANADA

British Columbia

INDIANA—Operations at this mine, in the Leadville district have been suspended because of the danger from snow-slides.

SILVER STANDARD—High-grade silver ore from this mine at New Hazelton, owned by Patrick Welch of Spokane and associates, was smelted recently at Trall. This was practically the first ore shipped for treatment.

RICH GOLD DISCOVERIES have been made, according to press dispatches, in Swan, Silver and other creeks, flowing into Teslin Lake at its southern end. The coarse gold is said to resemble the gold from the Atlin district, and has been found at depths of from three to six feet below surface.

TREASURE MOUNTAIN—The crosscut tunnel being driven on this property in the Leadville district is 330 ft. in and 200 ft. more remains to be driven. Several hundred feet of stoping ground will be added to the lead-silver ore opened at a depth of about 100 ft. The ore is wide and the concentrating ore carries streaks of smelting grade.

Ontario-Cobalt

COBALT STAR—This property will be sold at public auction to satisfy claims of creditors.

CASEY-SUTTON-COBALT—This is a new English company, capitalized at £100,000. The property comprises 200 acres near the Casey-Cobalt.

CITY OF COBALT—A special general meeting of the shareholders has been called to vote on the sale of the entire property to an English Syndicate.

WETTLAUER—No action regarding the dividend was taken at the recent meeting. There seems to be no possibility for further dividends at the old rate.

CASEY-COBALT—The capacity of the mill is to be doubled and an order has been placed for 10 additional stamps. This will give a total capacity of between 50 and 60 tons per day.

TRETHEWEY—Work will be resumed from the No. 4 shaft. The annual report for 1912 shows net profits from operations of \$338,640, with a surplus of \$178,744. Ore reserves are estimated at 590,600 ounces.

SHIPMENTS of ore and concentrates, in tons, from Cobalt for the week ended Feb. 21, were as follows:

Bailey.....	Kerr Lake.....	30 64
Beaver.....	La Rose.....	65 22
Buffalo.....	Lost and Found.....	
Casey Cobalt.....	McKinley-Darragh.....	76 19
Chambers-Ferland.....	Nipissing.....	
City of Cobalt.....	O'Brien.....	
Cobalt Lake.....	Penn.-Canadian.....	
Cobalt Townsite.....	Provincial.....	100 50
Colonial.....	Right of Way.....	
Coniagas.....	Seneca Superior.....	
Crown Reserve.....	Silver Queen.....	
Dominion Reduction Co.....	Timiskaming.....	
Drummond.....	Trethewey.....	33 50
General Mines.....	Wetlaufer.....	
Green Meehan.....		
Hargraves.....	Total.....	229 11
Hudson Bay.....		

Ontario-Porcupine

MONETA—This company will diamond drill the property adjoining the McEnaney.

DANE COPPER CO.—This company will build a concentrator to treat its copper ores.

MAIDENS—It is understood that B. E. Cartwright and associates have taken an option on this property.

McINTYRE—The new mill is practically completed and will start running in a few days. It has a capacity of 150 tons per day.

DOME—The plant is now running on electric power. This will effect a very considerable saving as steam generated power costs about \$150 per horsepower-year.

Nova Scotia

DOMINION STEEL CORPORATION—A trial shaft about 300 ft. deep is to be sunk on this company's iron ore property at Glencoe, Inverness County. Tests of this ore show it to be of excellent quality.

Yukon Territory

BOYLE CONCESSIONS, LTD.—Joseph W. Boyle, president of this company owning a large area of Klondike placers, states that he has completed a deal in London, whereby it takes over at once the Northern Light, Power & Coal Co., of Dawson, and its subsidiary companies, the Dawson-Electric Light Co., Dawson Water Co., and the Yukon Telephone Syndicate all of which have a capitalization of \$3,250,000. Boyle Concessions is allied to the Granville Mining Co., and the entire combination now rivals the Yukon Gold Co. in its holdings in the region of Dawson.

MEXICO

Guerrero

CHONTALPAN—This Mexico City company is reported as shipping about 22 kg. silver ore from its Chontalpan mine in the Zacualpan district. The work of placing additional reduction equipment is nearing completion, and the plant soon will be handling 25 tons daily. The company is employing 500 men.

Zacatecas

MEZQUITAL MINING CO.—This Zacatecas mining company has begun the operation of its mill and cyanide plant.

THE MARKET REPORT

METAL MARKETS

NEW YORK—March 3

The metal markets were moderately quiet. Fluctuations in prices were generally moderate, but with an upward tendency.

Imports of gold in Great Britain in January were £5,288,475; Exports, £3,728,514; excess of imports, £1,559,961. Imports of silver were £1,597,943; exports, £1,750,420; excess of exports, £152,477. The excess of gold imports is considerably larger than last year.

Gold received at the Australian mints during 1912 was, in fine ounces: Sydney, 554,292; Melbourne, 601,528; Perth, 1,471,895; total, 2,627,715 oz. Of the total 2,606,548 oz. were from Australia and New Zealand; 11,588 oz. from Papua; 9579 oz. were from foreign countries, or were light coin.

Gold, Silver and Platinum

Gold—The price of gold on the open market in London was unchanged, at 77s. 9d. per oz. for bars, and 76s. 4d. per oz. for American coin. Egypt and India were the chief takers of supplies. New York sent an additional \$1,250,000 gold to Argentina.

Iridium—Supplies are still short, and it is difficult to fill orders. The price ranges about \$85 per oz. for what metal can be had.

Platinum—The market is steady, both here and in Europe. There has been some talk of lower prices, but they do not materialize. Dealers continue to ask \$45@46 per oz. for refined platinum, according to size of order; \$49@53 per oz. for hard metal.

Silver—The market during the past 10 days has had a severe fall owing to selling for several days in succession by the China Banks. Market seemed to touch bottom at 27½d. and owing to buying by the Indian Bazaars there has been a slight rally.

Exports of Silver from London to the East Jan. 1 to Feb. 20, reported by Messrs. Pixley & Abell:

	1912	1913	Changes
India.....	£1,289,300	£1,218,490 D.	£ 70,900
China.....	400,000	65,000 D.	335,000
Total.....	£1,689,300	£1,283,490 D.	£405,900

Shipments of gold from London to India were £272,000 for the week.

The valuation of the Straits dollar was fixed at 28d. on Jan. 29, and currency notes can be issued against gold at that valuation. A shipment of £300,000 in gold is reported from Egypt to the Straits.

Copper, Tin, Lead and Zinc

Copper—European consumers and speculators appear to have made up their mind that copper at around current prices is a good investment, and there seems to be a disposition on their part to replenish the stocks which they had allowed to run down to a minimum during the recent deadlock. As a result, the buying movement abroad during the last week has been of very large proportions, so that leading sellers have felt justified in gradually advancing their prices. The domestic consumers have been holding aloof and do not as yet seem prepared to follow the European market; apparently they are viewing the advance rather grudgingly. However, they have bought moderately both of Lake and of electrolytic copper during the week. Some of the Lake producers sold cheaply on Thursday and Friday on rather large quantities, but since the opening of the new month Lake has improved along with electrolytic. On March 5 special brands of Lake copper fetched 15c., cash, New York, but the ordinary prime brands were offered at 15c., delivered, 30 days, for March, and at 14¾c., same terms, for April, the coming resumption of navigation having a bearing in this market. Electrolytic is offered by nearly all of the agencies at 14¾@15c., delivered either in Europe or America, usual terms. The market is not yet established on a 15c. basis, but cer-

tain of the agencies are expecting that price and better and in the meanwhile are holding aloof from the market. The close is strong at 14.70@14.80c. for electrolytic copper in cakes, wirebars and ingots, and 14¾@15c. for Lake copper. We quote casting nominally at 14.45@14.50c. as an average for the week.

The London standard market has reflected the activity in business in refined sorts, and prices have advanced from day to day, the close being cabled strong at £66 2s. 6d. for spot, and £66 7s. 6d. for three months.

Base price of copper sheets is now 21@22c. per lb. Full extras are charged, and higher prices for small quantities. Copper wire is 16¾@16½c. base price, carload lots at mill.

Copper exports from New York for the week were 8465 long tons. Our special correspondent gives the exports from Baltimore at 1252 tons for the week.

Visible Stocks of Copper in Europe Feb. 28 are reported as follows: Great Britain, 23,940; France, 4080; Rotterdam, 4100; Hamburg, 4150; total, 36,270 tons, or 81,244,800 lb. This

DAILY PRICES OF METALS

NEW YORK

Feb.-Mar.	Sterling Exchange	Silver	Copper		Tin	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.
27	4.8740	60	14½ @14½	14.45 @14.60	47½	4.30 @4.35	4.15 @4.20	6.10 @6.20	5.95 @6.05
28	4.8740	58½	14.70 @14.80	14.50 @14.60	47½	4.30 @4.35	4.15 @4.20	6.10 @6.20	5.95 @6.05
1	4.8745	59½	14½ @14½	14.50 @14.60	47½	4.30 @4.35	4.15 @4.20	6.10 @6.20	5.95 @6.05
3	4.8745	59½	14½ @15	14.55 @14.65	47½	4.32 @4.35	4.17 @4.20	6.15 @6.25	6.00 @6.10
4	4.8765	59½	14½ @15	14.60 @14.70	48	4.32 @4.35	4.17 @4.20	6.20 @6.35	6.05 @6.10
5	4.8770	59½	14½ @15	14.70 @14.80	48½	4.32 @4.35	4.17 @4.20	6.20 @6.30	6.05 @6.15

The quotations herein given are our appraisal of the market for copper, lead spelter and tin based on wholesale contracts with consumers without distinction as to deliveries; and represent, to the best of our judgement, the bulk of the transactions, reduced to basis of New York, cash, except where St. Louis is specified as the basing point. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. and that for casting copper usually about 0.125 to 0.2c. below w that of electrolytic. The quotations for lead represent wholesale transactions in the open market for good ordinary brands, both desilverized and non-desilverized; specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium. Silver quotations are in cents per troy ounce of fine silver.

LONDON

Feb.-Mar.	Silver	Copper			Tin		Lead, Spanish	Zinc, Ordinaries
		Spot	3 Mos	Best Sel'td	Spot	3 Mos		
27	27½	64½	64½	69	216	210	16½	24½
28	27½	64½	65	70	216½	211	16½	24½
1	27½	.....	.....	.....	.....	.....	.....	.....
3	27½	66½	66½	71	217½	212½	16½	24½
4	27½	66	66½	70½	218	213½	16½	24½
5	27½	66½	66½	71	220	216½	16½	24½

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 = 2.17½c.; £15 = 3.26c.; £25 = 5.44c.; £70 = 15.22c. Variations, £1 = 21½c.

is a decrease of 520 tons as compared with the Feb. 15 report. Copper afloat from Chile is given at 2330 and from Australia 5800 tons. Adding this to the stocks above gives a total of 44,400 tons, or 99,456,000 lb.; a decrease of 490 tons from the Feb. 15 total.

Brass Prices—The American Brass Co. announces the following base prices, taking effect March 1: Sheets, high brass, 16½c. net per lb.; low brass, 18½c. Wire, high brass, 16½c.; low brass, 18½c. Rods, high brass 16½c.; low brass, 18½c. Tubes, brazed, 20¼c.; open seam, 19¼c. Angles and channels, 20c. Scrap allowances are 10¼c. net per lb. for high brass; 12¼c. for low brass.

Tin—The London market, during the second half of last week, displayed rather an irregular tone, being strong during the morning session and weak on the afternoon exchange. As business in this market is to its largest extent transacted

in the afternoon after receipt of the London closing quotations, the trade here was not affected by the large fluctuations abroad. In view of the favorable February statistics, the market became firm on Monday of this week and consumers made liberal purchases, especially for future delivery. The close is steady at £220 for spot, and £216 10s. for three months, and about 48¼c. in this market.

Receipts of Bolivian tin in Europe in 1912, reduced to the equivalent metallic tin were: Liverpool, 12,525; Hamburg, 7655; Havre, 525; total 20,725 long tons, which compares with 22,760 in 1911 and 18,090 in 1910. Only about 5% of the receipts are in bars or black tin, the balance being in barrilla, or concentrates, which run about 60% metal.

Messrs. Robertson & Bense report the receipt of tin ore and concentrates at Hamburg, Germany, in January at 1448 tons, all from Bolivia.

Visible Stocks of Tin on Feb. 28 are reported as follows: Great Britain, 4959; Holland, 650; United States, excluding Pacific ports, 6695; total, 12,304 long tons, a decrease of 1667 tons during January. Of the total stocks reported 3779 tons were in store and 8525 tons afloat.

Lead—Business has been rather more active and the market shows a firmer tendency, closing at 4.17½ @ 4.20c. St. Louis, and 4.32½ @ 4.35c. New York.

The London market has eased off somewhat, the close being cabled as barely steady at £16 5s. for Spanish lead, and 7s. 6d. higher for English.

The average price of lead for the week was 4.331c. New York.

Spelter—It would seem that the consumption of the metal is keeping up very well, since there are no stocks accumulating. Under the stimulus of a better inquiry, prices have advanced, and the close is very firm at 6.05 @ 6.15c. St. Louis, and 6.20 @ 6.30c. New York, according to delivery. Sales of rather large tonnages during the week are reported, the bulk at around 6 @ 6.05c. St. Louis, on March-April contracts.

The London market is weak at £24 15s. for good ordinaries, £25 2s. 6d. for specials.

Base price of zinc sheets is now \$8.25 per 100 lb., f.o.b. La Salle-Peru, Ill., less 8% discount.

COPPER SMELTERS' REPORTS

This table is compiled from reports received from the respective companies, except in the few cases noted (by asterisk) as estimated, together with the reports of the U. S. Dept. of Commerce as to imported material, and in the main represents the crude copper content of blister copper, in pounds. In those cases where the copper contents of ore and matte are reported, the copper yield thereof is reckoned at 95%. In computing the total American supply duplications are excluded.

	Nov.	Dec.	Jan.	Feb.
Alaska shipments.....	1,671,367	3,766,029	1,668,328	
Anaconda.....	24,250,000	23,400,000	21,000,000	21,250,000
Arizona, Ltd.....	3,000,000	3,100,000	3,100,000	
Copper Queen.....	8,807,940	8,805,568	7,554,966	
Calumet & Arizona.....	4,918,000	5,840,000	4,750,000	
Chino.....	3,911,169	3,368,850	2,903,030	3,813,998
Detroit.....	1,968,620	2,389,875	1,769,071	
East Butte.....	1,245,504	1,314,021		
Mammoth.....	1,805,869	1,850,000		
Giroux.....	ni*	625,000		
Mason Valley.....	1,500,000	1,550,000	1,575,100	
Nevada Con.....	4,160,533	3,975,631	4,169,705	
Ohio.....	573,644	566,816		
Old Dominion.....	2,758,000	2,727,000		
Ray.....	3,191,026	3,638,500	3,610,000	3,610,000
Shannon.....	1,435,709	1,361,420	1,232,000	
South Utah.....	ni*	ni*		
United Verde*.....	2,900,000	3,000,000		
Utah Copper Co.....	4,562,417	5,676,484	7,182,495	
Lake Superior*.....	20,400,000	18,300,000	17,500,000	
Non-rep. mines*.....	8,250,000	7,750,000	7,500,000	
Total production.....	97,310,698	102,805,194		
Imports, bars, etc.....	22,797,099	28,761,087		
Total blister.....	120,107,797	131,566,281		
Imp. in ore and matte.....	8,149,728	10,385,662		
Total American.....	128,248,525	141,951,943		
Miami†.....	2,972,000	2,913,840	2,932,369	2,817,200
Brit. Col. Cos.:.....				
British Col. Copper.....	881,582			
Granby.....	1,852,896		1,792,245	
Mexican Cos.:.....				
Boleo†.....	2,315,040	2,480,240		
Cananea.....	5,064,000	5,592,000	2,658,880	
Moctezuma.....	2,112,377	2,793,781	2,913,294	
Other Foreign.....				
Braden, Chile.....	1,028,000	910,000	1,484,000	
Cape Cop., S. Africa.....	907,200	750,560	770,540	
Kyshtim, Russia.....	1,523,200	1,489,600	1,644,160	
Spassky, Russia.....	974,400	974,400		
Exports from.....				
Chile.....	4,816,000	7,392,000	0,752,000	
Australia.....	10,752,000	9,856,000	9,744,000	
Arrivals in Europe§.....	12,976,320	16,363,200	17,689,280	

† Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.
§ Does not include the arrivals from the United States, Australia or Chile.

STATISTICS OF COPPER

Month	United States			Visible Stocks.		
	U.S. Refin'y Production	Deliveries, Domestic	Deliveries, for Export	United States	Europe	Total
II, 1912	116,035,809	56,228,368	63,148,096	66,280,643	154,851,200	221,131,843
III.....	125,694,601	67,487,466	58,779,566	62,939,988	141,142,400	204,082,387
IV.....	125,464,644	69,513,846	53,252,326	62,367,557	136,819,200	199,186,757
V.....	126,737,836	72,702,277	69,485,945	65,066,029	134,176,000	199,242,029
VI.....	122,315,240	66,146,229	61,449,650	49,615,643	117,801,600	167,417,244
VII.....	137,161,129	71,094,381	60,121,331	44,335,004	108,186,000	152,521,003
VIII.....	145,628,521	78,722,418	70,485,150	50,280,421	113,299,200	163,579,621
IX.....	140,089,819	63,460,810	60,264,796	46,701,374	113,568,000	160,269,374
X.....	145,405,453	84,104,734	47,621,342	63,065,587	107,408,000	170,473,587
XI.....	134,695,400	69,369,795	55,906,550	76,744,964	103,801,600	180,546,564
XII.....	143,354,042	58,491,723	65,713,796	86,164,059	96,947,200	183,111,259
Year, 1912	1,581,920,287	819,665,948	746,396,452			
I, 1913.	143,479,625	65,210,030	60,383,845	105,312,582	78,491,840	183,904,422
II.....				123,198,332	77,504,000	200,702,332
III.....					81,244,800	

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

Other Metals

Aluminum—The market has been quiet, so far as new business is concerned, but there is still some pressure for delivery on contracts. Quotations are about the same, at 26 @ 27c. per lb. for No. 1 ingots, New York. The foreign market is reported rather unsettled.

Antimony—The market has been very quiet, with no material change. Cookson's is quoted at 9¼ @ 9½c. per lb., and Hallett's at 8¾ @ 9½c.; while 8¼ @ 8¾c. is named for Chinese, Hungarian and other outside brands.

Quicksilver—The market is quiet, with business on a moderate scale. The New York quotation is still \$40 per flask of 75 lb., with 59 @ 60c. per lb. asked for retail lots. San Francisco, \$40 per flask for domestic orders and \$37.50 for export. London price is still £7 15s., but second hands are quoting down to £7 5s. per flask.

Zinc and Lead Ore Markets

JOPLIN, MO.—March 1

Joplin, Mo. Mar. 1—The high price of zinc sulphide ore is \$50, the base per ton of 60% zinc ranging from \$45 to \$48. Calamine sold at \$25 @ 28 per ton of 40% zinc, and the average of all grades is \$43.86. Lead sold up to \$53.50, on a base of \$53 per ton of 80% metal contents, and the average price of all grades is \$52.76 per ton.

SHIPMENTS, WEEK ENDED MARCH 1

	Blende	Calamine	Lead Ore	Value
Totals for week..	6,898,600	626,020	2,057,860	\$219,374
Nine weeks	93,734,520	5,704,840	17,106,910	\$2,879,685
Blende value, the week, \$156,109; 9 weeks, \$2,343,404.				
Calamine value, the week, \$8971; 9 weeks, \$86,617.				
Lead value, the week, \$54,294; 9 weeks, \$450,664.				

PLATTEVILLE, WIS.—Mar. 1

The base price paid this week for 60% zinc ore was \$45 @ 48. The base price paid for 80% lead ore was \$52 @ 53 per ton.

SHIPMENTS WEEK ENDED MAR. 1

	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Week	3,343,370	147,090	1,194,290
Year to date.....	28,668,840	1,176,430	9,855,440

Shipped during week to separating plants, 2,227,350 lb. zinc ore.

IRON TRADE REVIEW

NEW YORK—Mar. 5

The iron trade is active, so far as contract work and mill deliveries are concerned, while new business is increasing in volume considerably.

Railroad orders continued large, and the demand for structural steel shows no decrease. There has been also an increase in the new orders for smaller building material, bars, pipes and the like. The agricultural implement makers are beginning to place their yearly contracts for material.

Pig iron is stronger and more active than it has been for some weeks. The demand for basic iron is active. Prices have not advanced but are generally firmer.

The Make of Rails in the United States in 1912 is reported by the American Iron and Steel Institute at 3,327,915 long tons; an increase of 505,125 tons over 1911, but a decrease of 308,116 tons from 1910. Of the rails made in 1912 there were 1,099,226 tons rolled from bessemer steel; 2,105,144 tons from openhearth steel; 3455 tons from electric steel; while 119,390 tons were rerolled or renewed rails. No iron rails were made.

PITTSBURGH—Mar. 4

The steel situation is distinctly stronger than a week or two weeks ago. Specifications against contracts have, on the whole, exceeded shipments by a considerable margin, and by a slight margin there has been an excess for the entire period since Jan. 1. At the same time new buying has been light, and as mere contract obligations are replaced by actual specifications, the percentage of specifications to obligations has risen, from about 40% at the beginning of the year, to about 50% at the present time, which means that while the mills have almost the largest total obligations ever shown, the proportion which exists in the form of obligations on the part of the customer to take the material is the largest on record. Shipments have been at record rate, and deliveries are wanted as much as ever. Naturally the steel mills are practically undisturbed at the practical absence of forward buying, when they find business moving so very slowly at this time, and with prospects of full employment for months to come. Prices for the regular finished-steel products are firm all along the line. Premiums for early shipment, common in several products two months ago, have now almost disappeared. Prices of some manufactured products, like rivets, bolts and nuts have been quite irregular lately, but these are products which were unduly advanced last year.

The Connellsville coke market is very firm on the basis of about \$2.50 for both prompt and contract, representing an advance in the past 10 days. Production is heavier, but is well absorbed.

The old material market has stiffened slightly in the past few days, representing the first real firmness since the market started to go off late in October.

Pig Iron—While there are no clear indications, it seems not at all improbable that some of the large steel interests will shortly make important purchases of steel-making iron. There is no immediate future for foundry iron which is dull and soft. The pig iron averages, compiled monthly by W. P. Snyder & Co. from actual sales of Valley iron, are announced for February at \$17.25, Valley, for bessemer and \$16.317 for basic, representing no change from January in bessemer, and 13c. decline in basic. We quote: Bessemer, \$17.25; basic, \$16.25; No. 2 foundry, \$17; forge, \$16.50; malleable, \$17, f.o.b. Valley furnaces, 90c. higher delivered Pittsburgh.

Steel—The National Tube Co. has purchased 6000 tons of 6x6-in. openhearth billets, paying approximately \$29 at maker's mill or \$29.50 delivered, with deliveries running over the next few months. A small lot of billets is reported at substantially the same price. The large purchase mentioned is the bulk of the output available from the mill involved in the sale. It is only occasionally that any steel can be found, and sheet bars are scarcer than billets. It is doubtful whether a bid of \$30, maker's mill, would bring out any sheet bars, but on the other hand it is only in exceptional circumstances that the consumer of sheet bars can afford to pay such a price. There are no regular offerings for second quarter or later delivery. We continue to quote billets at \$29 and sheet bars at \$30, maker's mill, Pittsburgh or Youngstown, with rods at \$30, Pittsburgh.

Ferromanganese—The market continues quiet, with prompt material only moderately firm. We quote prompt and contract at \$65, Baltimore.

IRON ORE

Preparations are being made for an early opening of iron ore shipments on the Lakes. Vessels are being put in order to start as soon as the ice will permit.

Imports of Iron Ore into Great Britain in January were 578,409 tons in 1912, and 688,722 in 1913; increase 110,313 tons. Imports of manganese ores were 26,765 tons in 1912, and 63,685 in 1913; increase, 36,910 tons.

COAL TRADE REVIEW

NEW YORK—Mar. 5

The coal trade is just now between seasons, but with prospects for a good spring business. In the West the call for steam coal is steady, and prices are rather firm. An early opening of the Lake grade is expected.

The anthracite market is slow; dealers are pretty well up with orders, and are taking no more coal than they are obliged to, as the time for spring discounts is approaching.

Coal and coke passing over all lines of the Pennsylvania R.R. Co. east of Pittsburgh and Erie during January, in short tons:

	1912	1913	Changes
Anthracite.....	1,040,535	1,014,259	D 26,276
Bituminous.....	3,581,365	4,210,196	I 628,831
Coke.....	940,931	1,288,514	I 347,583
Total.....	5,562,831	6,512,969	I 950,138

The total increase this year over 1912 was 17.1%. Bituminous and coke showed heavy gains, anthracite a small loss.

German Foreign Trade in fuel, year ended Dec. 31 was, in metric tons:

	Exports	Imports	Excess
Coal.....	31,143,115	10,380,482	Exp. 20,762,633
Brown coal.....	56,966	7,266,116	Imp. 7,209,150
Coke.....	5,849,020	589,713	Exp. 5,259,307
Briquettes.....	2,746,536	187,735	Exp. 2,558,801
Total.....	39,795,637	18,424,046	Exp. 21,371,591
Total, 1911.....	34,501,721	18,792,903	Exp. 15,708,818

In 1912 there was an increase of 5,293,916 tons, or 15.3% in exports, and a decrease of 363,857 tons, or 2% in imports.

Coal Production of Germany year ended Dec. 31, in metric tons:

	1911	1912	Changes
Coal.....	160,742,272	177,094,917	I 16,352,645
Brown coal.....	73,516,789	82,339,583	I 8,822,794
Total mined.....	234,259,061	259,434,500	I 25,175,439
Coke made.....	25,405,108	29,141,070	I 3,736,962
Briquettes made.....	21,827,667	24,391,701	I 2,564,034

Of the briquettes reported in 1912 there were 19,058,050 tons made of lignite, or brown coal.

CHEMICALS

NEW YORK—Mar. 5

The general markets continue good, with fair business forward, especially in heavy chemicals.

Arsenic—Large supplies are coming in, and the demand is only moderate. The Mexican troubles do not seem to have interfered with production there. Prices are lower, at \$4 @ 4.25 per 100 lb., and are rather soft at that.

Copper Sulphate—Trade is more active as the spring demand opens up. Prices are unchanged at \$5.25 per 100 lb. for carload lots and \$5.50 per 100 lb. for smaller parcels.

Nitrate of Soda—The spring trade is being felt, and there has been some good buying by the fertilizer makers. Quotations are strong at 2.62½c. per lb. for spot and April; 2.60c. for May; 2.57½c. for June; 2.55c. for July and later deliveries.

PETROLEUM

The monthly report of the "Oil City Derrick" gives new oil wells completed in February as follows: Pennsylvania grade, 448; Lima-Indiana, 52; Kentucky, 23; Illinois, 107; Kansas-Oklahoma, 625; Texas-Louisiana, 141. In all the divisions 1396 wells were completed with a new production of 49,479 bbl. As compared with January there were 82 fewer wells completed and a decline of 6584 bbl. in new production. The loss in completions and new production was distributed among all the fields. New work shows a large increase, there being 718 rigs up and 1716 wells drilling.

Assessments

Company	Delinq	Sale	Amt.
Advance, Ida.	Mar. 15	Apr. 15	\$0.003
Alta, Nev.	Mar. 24	Apr. 14	0.05
Bell, Ida.	Mar. 12	Apr. 12	0.01
Black Horse, Ida.	Mar. 8	Mar. 27	0.005
Coeur d'Alene Vulcan, Ida.	Mar. 2	Mar. 22	0.005
Columbus Ext., Utah	Feb. 13	Mar. 13	0.01
Corbin Copper, Mont.		Apr. 22	0.50
Crown Point, Utah	Mar. 20	Apr. 15	0.01
East Hercules Ext., Wash.		Mar. 15	0.001
Gold M'tain Champ., Utah	Mar. 4	Mar. 22	0.01
Great Falls, Utah	Mar. 22	Apr. 22	0.01
Hypotheek, Ida.	Feb. 21	Mar. 14	0.01
National Copper, Ida.			0.01
New York Bonanza, Utah			0.03
Nicodemus, Ore.	Mar. 14		0.05
Overman, Nev.	Mar. 18	Apr. 8	0.05
Pacific Quicksilver, Calif.	Mar. 5		0.03
Pioche Metals, Nev.	Feb. 10	Mar. 17	0.01
Relonia M. & M., Utah	Mar. 6	Apr. 5	0.001
Spring Lake, Utah	Feb. 24	Mar. 15	0.001
Tar Baby, Utah	Mar. 10	Apr. 7	0.01
Tintic Central, Utah	Mar. 11	Mar. 29	0.01
Utah, Nev.	Feb. 25	Mar. 18	0.05
Wabash, Utah		Apr. 10	0.05

Monthly Average Prices of Metals
SILVER

Month	New York			London		
	1911	1912	1913	1911	1912	1913
January	53.795	56.260	62.938	24.865	25.887	28.983
February	52.222	59.043	61.642	24.081	27.190	28.357
March	52.745	58.375		24.324	26.875	
April	53.325	59.207		24.595	27.284	
May	53.308	60.880		24.583	28.038	
June	53.043	61.290		24.486	28.215	
July	52.630	60.654		24.286	27.919	
August	52.171	61.606		24.082	28.375	
September	52.440	63.078		24.209	29.088	
October	53.340	63.471		24.594	29.299	
November	55.719	62.792		25.649	29.012	
December	54.905	63.365		25.349	29.320	
Year	53.304	60.835		24.592	28.042	

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

COPPER

Month	NEW YORK				London, Standard	
	Electrolytic		Lake		1912	1913
	1912	1913	1912	1913		
January	14.094	16.498	14.337	16.767	62.760	71.741
February	14.084	14.971	14.329	15.259	62.893	65.519
March	14.698		14.868		65.884	
April	15.741		15.930		70.294	
May	16.031		16.245		72.552	
June	17.234		17.443		78.259	
July	17.190		17.353		76.636	
August	17.498		17.644		78.670	
September	17.608		17.698		78.762	
October	17.314		17.661		76.389	
November	17.326		17.617		76.890	
December	17.376		17.600		75.516	
Year	16.341		16.560		72.942	

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

TIN

Month	New York		London	
	1912	1913	1912	1913
January	42.529	50.298	191.519	238.273
February	12.962	48.766	195.036	220.150
March	12.577		192.619	
April	43.923		200.513	
May	16.063		208.830	
June	45.815		205.863	
July	44.519		202.446	
August	45.857		208.351	
September	49.135		223.762	
October	50.077		228.353	
November	49.891		227.619	
December	49.815		226.875	
Av. year	46.096		209.322	

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

LEAD

Month	New York		St. Louis		London	
	1912	1913	1912	1913	1912	1913
January	4.435	4.321	4.327	4.171	15.597	17.114
February	4.026	4.325	3.946	4.175	15.738	16.550
March	4.073		4.046		15.997	
April	4.200		4.118		16.331	
May	4.194		4.072		16.509	
June	4.392		4.321		17.588	
July	4.720		4.603		18.544	
August	4.569		4.452		19.655	
September	5.048		4.924		22.292	
October	5.071		4.894		20.630	
November	4.615		4.463		18.193	
December	4.303		4.152		18.069	
Year	4.471		4.360		17.929	

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

SPELTER

Month	New York		St. Louis		London	
	1912	1913	1912	1913	1912	1913
January	6.442	6.931	6.292	6.854	26.642	26.114
February	6.499	6.239	6.349	6.089	26.661	25.338
March	6.626		6.476		26.048	
April	6.633		6.483		25.644	
May	6.679		6.529		25.790	
June	6.877		6.727		25.763	
July	7.116		6.966		26.174	
August	7.028		6.878		26.443	
September	7.454		7.313		27.048	
October	7.426		7.276		27.543	
November	7.371		7.221		26.804	
December	7.162		7.081		26.494	
Year	6.943		6.799		26.421	

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

PIG IRON IN PITTSBURG

	Bessemer		Basic		No. 2 Foundry	
	1912	1913	1912	1913	1912	1913
January	\$15.12	\$18.15	\$13.32	\$17.35	\$14.00	\$18.59
February	15.03	18.15	13.28	17.22	14.01	18.13
March	14.95		13.66		14.10	
April	15.13		13.90		14.15	
May	15.14		13.90		14.12	
June	15.15		14.11		14.22	
July	15.15		14.38		14.38	
August	15.43		14.90		14.85	
September	16.86		16.03		15.63	
October	17.90		17.18		17.22	
November	18.07		17.09		18.00	
December	18.15		17.45		18.73	
Year	\$16.01		\$14.93		\$15.28	

STOCK QUOTATIONS

COLO. SPRINGS Mar. 4		SALT LAKE Mar. 4	
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.03	Beck Tunnel	.09
Cripple Cr'k Con.	.01	Black Jack	.10
C. K. & N.	.11	Cedar Tallman	.00
Doctor Jack Pot.	.05	Colorado Mining	.11
Elkton Con.	.60	Columbus Con.	.03
El Paso	5.75	Crown Point	.02
Findlay	.94	Daly-Judge	6.00
Gold Dollar	1.11	Grand Central	.74
Gold Sovereign	.02	Iron Blossom	1.37
Isabella	.12	Little Bell	1.10
Jack Pot.	1.05	Lower Mammoth	.03
Jennie Sample	.05	Mason Valley	17.50
Lexington	1.05	May Day	.12
Moon Anchor	1.008	Nevada Hills	1.05
Old Gold	1.02	New York	1.00
Mary McKinney	.63	Prince Con	.67
Pharmacist	.01	Silver King Coal	3.00
Portland	.98	Sioux Con.	.03
Vindicator	.96	Uncle Sam	.05
Work	1.04	Yankee	.13

TORONTO Mar. 4

Name of Comp.	Bid	Name of Comp.	Bid
Bailey	.09	Foley O'Brien	.24
Coniagas	8.00	Hollinger	16.20
T. & Hudson Bay	169.00	Imperial	.03
Timiskaming	34	Jupiter	.48
Wettlaufer-Lor.	.15	Pearl Lake	.79
Apex	1.02	Porcu. Gold	.28
Crown Chartered	.01	Preston E. D.	1.03
Dobie	1.25	Rea	.30
Dome	118.00	Swastika	.14
me Exten	12	West Dome	1.18

SAN FRANCISCO

Mar. 4

Name of Comp.	Cig.	Name of Comp.	Bid
COMSTOCK STOCKS		MISC. NEV. & CAL.	
Alta	1.03	Belmont	6.97
Belcher	.18	Jim Butler	.71
Best & Belcher	.03	MacNamara	.20
Caladonia	.77	Midway	.47
Challenge Con.	.02	Mont-Tonopah	1.52
Chollar	1.01	North Star	.20
Confidence	.32	West End Con.	1.32
Con. Virginia	.17	Atlanta	.16
Crown Point	.20	Booth	.05
Gould & Curry	.06	C. O. D. Con.	.06
Hale & Norcross	.06	Comb. Frac.	.07
Mexican	.62	Jumbo Extension	.31
Occidental	.70	Pitts-Silver Peak	.58
Ophir	.18	Silver Pick	.05
Overman	.24	St. Ives	.05
Potosi	.02	Tramp Con.	1.01
Savage	.03	Argonaut	12.00
Sierra Nevada	.10	Bunker Hill	11.50
Union Con.	.08	Central Eureka	.09
Yellow Jacket	.20	So. Eureka	2.50

N. Y. EXCH. Mar. 4

Name of Comp.	Cig.
Amalgamated	70%
Am. Agri. Chem.	51
Am. Sm. & Ref. com.	69%
Am. Sm. & Ref., pf. B	103%
Am. Sm. Sec., pf. B	84%
Anacoda	36%
Batopilas Min.	15
Bethlehem Steel pf	66%
Chino	39%
Federal M. & S., pf.	38
Goldfield Con.	27%
Great Nor. ore, ctf.	35%
Guggen. Exp.	47
Homestake	117%
Inspiration Con.	17%
Miami Copper	23
Nat'l Lead, com.	50%
National Lead, pf.	105%
Nev. Consol.	18
Phelps Dodge	200
Pittsburg Coal, pf.	88
Ray Con.	19
Republic I & S, com.	25
Republic I & S, pf.	88
Sloss Sheff'd, com.	36
Sloss Sheffield, pf.	91%
Tennessee Copper	38
Utah Copper	53%
U. S. Steel, com.	61%
U. S. Steel, pf.	108%
Va. Car. Chem., pf.	108%

N. Y. CURB Mar. 4

Name of Comp.	Cig.
Barnes King	1.85
Beaver Con.	.40
Braden Copper	.87%
B. C. Copper	.3%
Buffalo Mines	2.7%
Caladonia	1.40
Con. Ariz. Sm.	.3%
Davis-Daly	1.7%
Diam' field-Daisy	.05
Ely Con.	.15
Florence	.3%
Ghroox	3.7%
Gold Hill Con.	1.4%
Greene Cananea	8.4%
Greenwater	.04
Internat. S. & R.	117
Kerr Lake	.3%
Keystone	.12
La Rose	.2%
McKinley-Dar-Sa	2.5%
Min. Co. of A. new	2%
Motherlode Gold	1.60
Nev. Utah M. & S.	1.01
Nipissing Mines	.8%
Ohio Copper	1.1%
Pacific Sm. & M.	.3%
Puebla S. & R.	.2%
South Live Oak	.12
South Utah M. & S.	.3%
Standard Oil (Old)	1110
Standard Oil of N.J.	373
Stewart	1.1%
Tonopah	.5%
Tonopah Ex.	.1%
Tonopah Merger	.79
Tri-Bullion	.3%
Tularosa	.2%
Union Mines	1.2%
United Cop., pf'd.	.10
Yukon Gold	.3

BOSTON CURB Mar. 4

Name of Comp.	Last
Alaska Gold M.	18
Bingham Mines	.4
Boston Ely	.68
Boswyococo	1.01
Butte Central	17
Cactus	.06
Calaveras	.3
Chief Cons	1.1
Corbin	.70
Cortez	.35
Crown Reserve	.31
Eagle & Blue Bell	1
First Nat. Ccp.	2.1
Majestic	.46
Mexican Metals	1.1
Moneta Porc.	1.06
Nevada-Douglas	.28
New Baltic	.85
Oneco	1.1
Raven Copper	.16
Rhode Island Coal	.05
Smockey Dev.	1.1
S. W. Miami	.31
South Lake	.71
Trethewey	.40
United Verde Ext.	.70

†Last quotation.