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Brown Iron Ores as Cavity Fillings

By Edwin C. Eckel*

SYNOPSIS—In a Virginia limestone quarry, caves and fissures were encountered in which brown iron ores were being deposited by surface waters percolating through shales carrying some iron. The dissolved iron was reprecipitated in the open cavities of the limestone.

Rock masses of any type or kind may contain cavities of greater or less extent, even if nothing more than spaces widened out by solution along joint-planes. Limestone, however, is peculiarly subject to attack by even slightly acid waters, and by far the majority of large open cavities or caves occur in limestone. Waters penetrating from the surface, and charged with carbon dioxide or other acid agent, readily dissolve out channels and chambers in the rock.

So much being accepted, it is obviously conceivable that other waters, carrying iron carbonate or other iron salt in solution, might refill such solution cavities with a deposit of iron ore; and this possible mode of origin has been given consideration in various published discussions on the formation of brown iron-ore deposits. Evidence in its favor is, of course, afforded by the frequent occurrence in brown-ore deposits of stalactites and other curiously shaped masses of brown ore, which could hardly have assumed these particular forms except in an open space of some kind.

In my opinion it is easily possible to lay too much stress upon this particular mode of brown-ore origin. It is undoubtedly true that brown-ore deposits can originate in this way; it is also true that in almost all our brown-ore deposits a certain amount of such cavity filling has taken place; but it is highly improbable that any large deposit at present worked has originated entirely or principally in this way. Replacement has been a far more important method.

Virginia Limestone Quarry, in Which Brown Iron Ores Were Filling Cavities

In spite of frequent discussion of cavity filling as a mode of genesis, no published accounts of the actual formation of iron ores in caves have ever come to my attention. Under these circumstances, the following account of a small ore deposit still in progress of formation may be of interest. It is prepared from notes made at various intervals some years ago, while engaged in development work in the iron region lying along the Chesapeake & Ohio Ry. in Virginia.

The old fluxing quarry of the Lowmoor Iron Co., near Lowmoor station, is located in flat-lying limestone beds,

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belonging to the upper portion of the Helderberg or Lewistown series. It was worked in great rooms or chambers, carried up to a roof of Oriskany sandstone, which in turn is overlain by black Devonian shales. The sandstone is firm, but fairly porous; the shales contain a rather high percentage of iron, in the form of carbonate nodules, of pyrite, and of oxide.

During operation the quarry rooms at several points broke into old water channels and caves, varying greatly in size. One of these was, at the time of my study of the district, filling with a deposit of brown iron ore. The deposited material was derived from infiltrating waters, which had become charged with iron carbonate during their downward passage through the black shales above the quarry.

Water enters this particular cave at several points, either percolating through the strata or flowing through small channels dissolved out of the limestone. This water carries various materials, some in solution and some in suspension, and the different products of deposition are of interest.

One of the larger channels, for example, brought into the cave a large quantity of fine clayey material, carrying it, of course, entirely in suspension. This clay was spread out as an even deposit over the floor of the cavity. Samples which I took were analyzed by J. H. Gibboney, with the results shown in the table.

ANALYSES OF DEPOSITS IN LIMESTONE CAVITIES

	Clay	Precipitated deposits 1	2	3
	%	%	%	%
Silica	55.64	5.40	6.29	24.46
Alumina	23.80	11.87	5.45	9.10
Ferric oxide	6.18	....	....	....
Titanic oxide	0.10	....	....	....
Lime	0.52	0.24	0.16	0.20
Magnesia	0.54	0.24	0.33	1.28
Soda	0.51	....	....	....
Potash	5.20	....	....	....
Metallic iron	....	46.88	54.56	29.84
Metallic manganese	....	1.12	0.49	4.16
Sulphur	....	0.05	0.03	0.06

This analysis corresponds quite closely with a number of analyses of the unaltered black shale; and the cave clay has probably been subjected to relatively little change during its transportation and deposition.

The waters seeping through the strata, having been filtered fairly free from all suspended matter, give deposits of strikingly different character from the clay just mentioned. The seepage waters carry iron carbonate in solution and this is deposited where the waters encounter air and free space on entering the cave. The deposition takes place in two distinct forms: (1) as an ocherous powder or mud, sometimes aggregated into hard lumps, on the cave floor, and (2) as iron stalactites hanging from the roof of the cave. Samples of these iron deposits were also analyzed by Mr. Gibboney with results as shown.

Of these, No. 1 represents the composition of the iron stalactites hanging from the cave roof; and No. 2 is the average of several lumps of the hard ocher formed by deposition on the floor of the cave. Both of these, it will be noted, are good brown ores, far above the average commercial ore of that district, and comparing favorably with any of the better class of eastern or southern brown ores.

Sample No. 3 is of fine ocher mixed with the cave clay and might perhaps be accepted as representing the average of the material with which the cave would finally be filled, provided the two classes of deposits should keep coming in at about their existing rate.

Certain irregularities in the analyses may be noted, i.e., the high manganese determination in No. 3 and the high alumina value in No. 1. The first of these requires little comment, for the presence of even a small nodule of manganese oxide in the sample would account for it. The high alumina of No. 1, however, is more noteworthy, for if confirmed it implies that the stalactites contain, in addition to brown ore, bauxite or some related aluminum hydroxide.

Variation in Hoist Design

The Newport Mining Co., of Bessemer, Mich., on the Gogebic range has under construction by the Nordberg Manufacturing Co., three large hoists, interesting for the fact that while two of them are corliss engines of highly economical design, the other is a simple slide-valve engine.

The two former are for the Anvil and Palm shafts. They are twin-tandem condensing corliss hoists, having cylinders 20 and 37 by 66 in. Each hoist weighs 550,000 lb. and has two drums 10 ft. in diameter to carry 2700 ft. of 1¼-in. steel rope, one drum being clutched on the shaft to permit hoisting in balance from different depths. The design is for a load of six long tons of ore, making with the skip, a total of 13,440 lb. on each drum to be hoisted ultimately from a depth of 2700 ft. at 2400 ft. per min., with a steam pressure of 150 lb., condensing. It is estimated that at the start these hoists will probably be operated from a depth of 1700 ft., making 62 trips per hr., thus giving a capacity of 372 tons of ore per hour.

The condensing apparatus for each hoist is a Nordberg special counter-current jet condenser with corliss air pump and plunger circulating pump. The design of these condensers calls for a large condensing drum to accommodate a large volume of water and maintain a vacuum during the period of heavy load in which acceleration goes on. It is expected, when operating at the capacity noted, 62 trips per hr., from 1700 ft., that a shaft-horsepower can be developed on 28 lb. of steam delivered to the hoist; the term shaft-horsepower being taken to mean the net work due to handling the load and including all losses, such as friction in the engines, ropes, skips, etc. The hoists are to be used for much greater depths than any hitherto used in the Michigan iron country.

The third hoist is to be used at the *D* shaft of the company at Ironwood and is a simple duplex machine weighing 525,000 lb., with 34x72-in. cylinders and two drums 12 ft. in diameter, to carry 3500 ft. of 1⅜-in. steel rope. One drum is keyed to the shaft, the other furnished with a clutch. The load for this hoist will be 17,920 lb., including the skip, to be hoisted in balance from a depth of 3500 ft. at 2000 ft. per min. under 120 lb. of steam, noncondensing. At the start, the regular hoisting depth will be about 2500 ft., from which depth 40 trips per hr. will be made and 320 tons of ore per hr. hoisted.

This latter is the largest hoist in the iron country. Its relatively simple design, as against the corliss, compound, condensing type, is due to the fact that it is to replace some old hoists; to utilize the exhaust steam from these, an exhaust-steam turbine was installed about two years ago, and it was desired to continue the turbine in use.

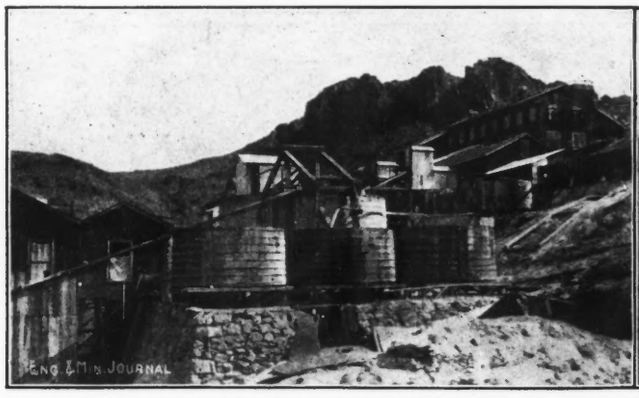
The Gold Road Cyanide Mill, Arizona

By Herbert A. Megraw

SYNOPSIS—An Arizona cyanide plant which has lasted many years and passed through the era of numerous metallurgical processes. Treatment is by the all-slime method, using Pachuca tanks for agitation. The most notable feature is the recent replacement of vacuum filtration by continuous decantation. Zinc dust is used as a precipitant and the precipitate is roasted and melted.

The mill of the Gold Road Mines Co. is situated at Gold Road, about 20 miles from the town of Kingman in western Arizona. Railroad communication is established at Kingman and connection with the mine is by wagon road over which freight is hauled by horses, and passengers by automobile stage. The region is arid, water is scarce and has to be conserved with care.

Local ores have gold as the principal valuable constituent, the metal being finely divided and distributed through a gangue consisting of quartz and some calcite.



Looking Toward the Crushing Plant

Upper Side View

Gold Road Mill, Gold Road, Ariz.

in a conntry of andesitic rock. There is no great quantity of sulphides, the gold being free and principally fine. On account of the fineness and wide distribution of the gold, a rather high degree of crushing is required and the total-sliming process is followed.

The mill is not an original construction, but rather a development; the remnants of machinery used in various processes, now relinquished, remain as reminders of the older systems of metallurgy. This changing of systems has also resulted in a scattering of the reduction plant over a good deal of territory, a fact which may be seen by a study of the accompanying photographs. Notwithstanding this circumstance, a plant of exceedingly good metallurgical performance is now in operation, the details of which are explained in this paper.

Preliminary Crushing at Mine

Installed at the mine is a No. 5 Gates gyratory crusher where the ore receives its preliminary breaking. From the crusher it is trammed to the mill, where it is delivered into a 1540-ton bin which supplies the mill as required. During the preliminary breaking at the mine, the required portion of lime is added to the ore so that by the time the material has passed through the bin and entered the stamp-crushing department, the lime has performed a great deal of its essential work, neutralizing the developed acidity and becoming more or less slaked and ready to offset the acids which may be formed later in the course of its treatment. This method of lime addition is advocated by many operators because of the advantages enumerated above, and further, because the lump form is progressively crushed as is the ore, and develops alkaline conditions, when the addition is at the appropriate rate, just as the ore develops acidity. Others advocate the powdered form of lime, sometimes previously slaked, and make additions at the point where and time when acidity develops. No doubt a greater percentage of CaO can be dissolved by careful slaking under favorable conditions, but whether the highest ultimate economy and efficiency are reached by so doing, is a question which will have to be solved for each individual problem.

Stamps Followed by Tube Mills

From the bin, Challenge feeders deliver the ore into a battery of forty 1050-lb. stamps, making 104 drops per min. through 7 in. The stamp crushing is done in solution. Screens of 4-mesh are used on the batteries, the stamp duty being about nine tons per stamp per day, or a total of 360 tons daily for the mill.

Pulp from the stamps is led to two distributing cones, one 4 ft. and one 6 ft. in diameter, from which it goes to six duplex Dorr classifiers, where the overflow slime is removed and the sand dewatered and delivered to the tube mills for regrinding.

There are four tube mills, each 5x22 ft., used in closed circuit with the classifiers, the delivery from the tube mills being elevated with 10x54-in. Frenier pumps and returned to the classifiers where any sand not sufficiently fine for treatment by agitation, is removed and returned to the tube mill for further grinding. El Oro linings are used in these mills and are said to be entirely satisfactory, each lining lasting a year before it is replaced.

Note—This is the seventeenth 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, Mar. 1, Mar. 8, Mar. 29, Apr. 5, Apr. 26, May 17 and June 14, 1913. The next article will deal with "Two Arizona Cyanide Plants," and will appear on Aug. 2, 1913.

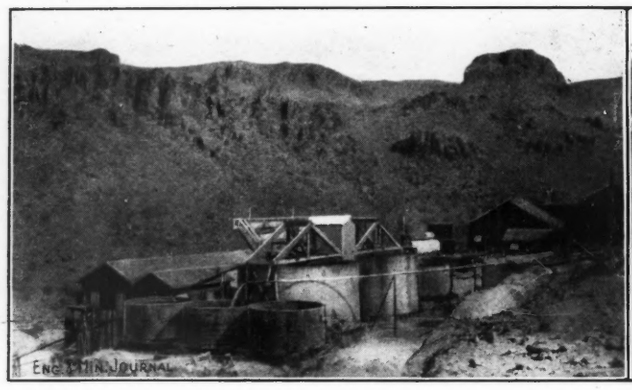
Imported pebbles are used in the mills, the consumption being 4 lb. per ton crushed.

It has been practically found unnecessary to grind this ore through a 200-mesh screen, the product passing a 100-mesh screen giving as good extraction results. In practice, the pulp delivered to the agitation treatment contains about 86 to 87% which will pass a 150-mesh screen. The specific gravity of the dry slime has been determined and is stated to be 2.63, a figure denoting about medium weight.

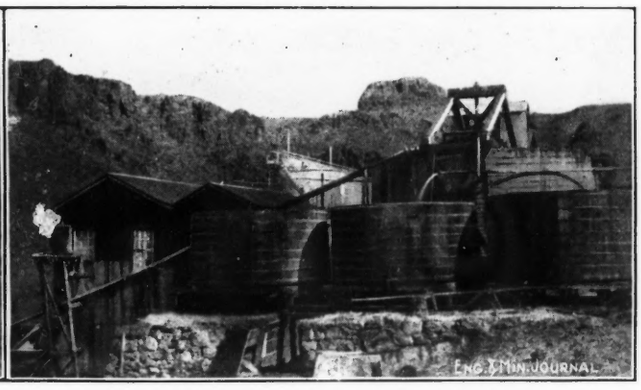
Pulp Thickened and Agitated in Pachuca Tank

The entire pulp from the grinding system is received in two 30x10-ft. Dorr thickeners, the overflow solution going to clarifying tanks and the underflow of thickened pulp being taken to the agitation system. This agitation installation consists of three 17x44-ft. Pachuca tanks which were used in series, but, having found that so long a time for agitation was not necessary to secure highest extraction, this, together with the inherent inconveniences of this kind of tank, resulted in cutting out two of them and the using of only one.

With the pulp of the grade and character customary at Gold Road, it is somewhat difficult to prevent settling of a portion of the solids, and in such cases the Pachuca tank has often been found unsatisfactory. Here the settlement became so great that the time of agitation was reduced to practically nothing. It is stated that the settlement was so hard and solid that one could step over the edge into the tank and walk about, keeping away from the center, without any inconvenience.



Agitation and Filtration Plant



Thickeners and Solution Tanks

Gold Road Mill, Gold Road, Ariz.

Thickened pulp, that coming from the thickeners into the agitation department, has the dilution ratio of about 1 to 1, and retains this consistency until after finishing the agitation treatment. Contact between the ore and cyanide solution was 36 to 48 hr. in the mill, counting from its first pulping at the cones, to its discharge. Owing to a change in the metallurgical system, this time of contact may have become somewhat protracted, but not because of any necessity of increasing the percentage of extraction. The greater part of the extraction is secured before the agitation treatment, and practically none after it.

Thickeners Following Pachuca Tanks

Issuing from the agitation system in the Pachuca tanks, the pulp is delivered to a series of thickeners where the pulp is successively dewatered and rediluted, thus washing out the dissolved metal in the pulp.

This treatment is not that which has been generally followed at the Gold Road mill. The former method, followed until a few months ago, involved delivering the slime from the agitation system into a slime-storage tank whence it was taken by a 120-leaf Butters filter installation and handled in the usual way. After the cake had been dropped from the filter leaves, it was mixed thoroughly in a tank containing mechanical agitators and discharged by gravity after passing an automatic mechanical sampler.

For many reasons, this system has been dispensed with and the pulp from the agitation system is delivered to two thickeners.

Replacement of Filtration by Decantation

The solution overflow from these thickeners is pumped back to the head of the mill and used as mill solution, while the thickened underflow goes to two more thickeners, before reaching which, however, it is diluted with solution previously precipitated. The solution overflow from this second pair of thickeners is sent back to dilute the pulp entering the first pair of thickeners. This solution, overflowing from the first pair of thickeners, does not require immediate precipitation as it consists largely of precipitated solution as has been shown. The first solution for precipitation is taken from the overflow of the Dorr thickener, through which the pulp passes before reaching the agitation system in the Pachuca tanks.

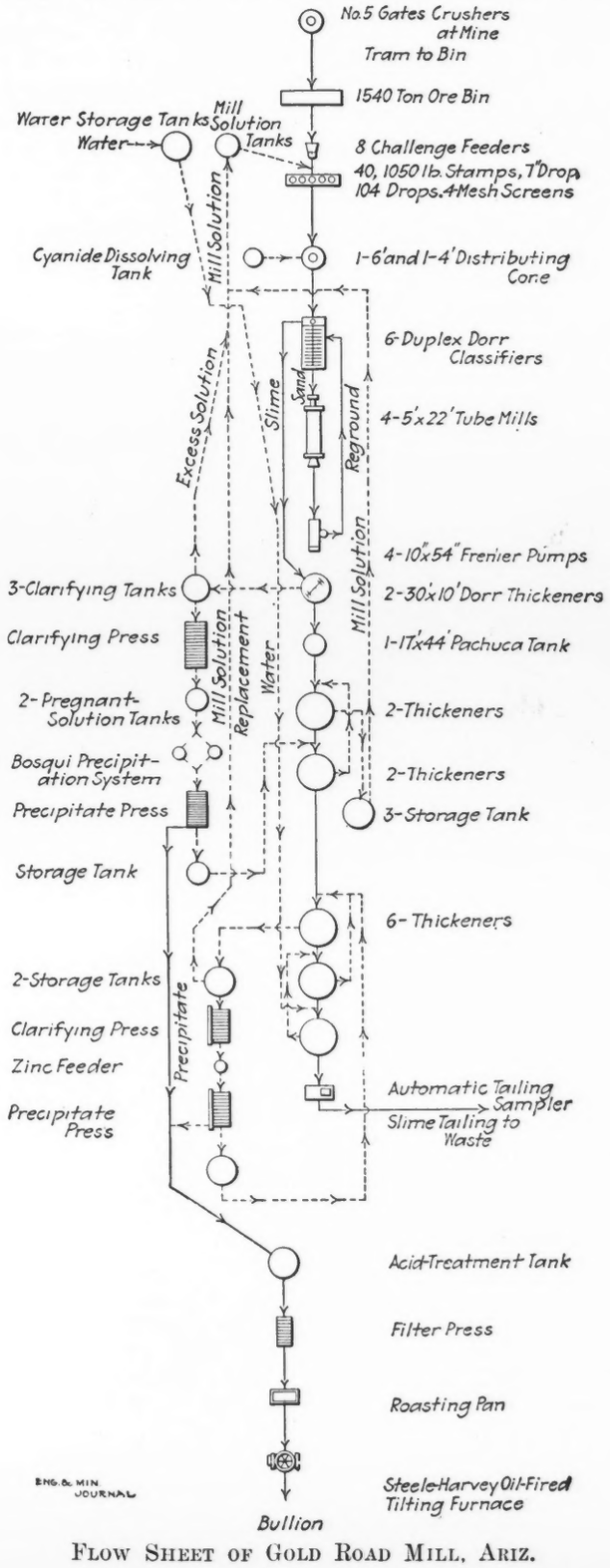
A Second Thickening System

As a final result, then, the pulp from the agitation system going into the first thickening unit, consisting of two pairs of thickeners, issues from it in form of a thick pulp of about the same consistency at which it entered, having been meantime diluted with barren solution, and twice thickened. The barren solution has passed through the pulp, diluted the metal-bearing solution, and carried most of its value to the mill solution circulation. From this circulation a great proportion of the solution passes to precipitation from the first Dorr thickener, which follows the tube mills, avoiding any extensive building up of value in solution.

Underflowing from the first thickening system, the thick pulp goes to a second system, which consists of three pairs of thickening tanks. In this unit the pulp is

repeatedly thickened and washed, water in this case being the washing medium. The counter-current system is followed, water entering at the final thickener and progressing backward to the first of the series, the solids taking the opposite direction.

There is provided a separate precipitation circuit to accompany this washing unit, with facilities for diverting the solution either into the mill-solution circuit, before precipitation, or into the washing circuit itself after precipitation. The precipitate joins the bulk of that from the main precipitation system, which is carried to the refining department. The movement of pulp and solution is graphically shown in the accompanying flow sheet.



FLOW SHEET OF GOLD ROAD MILL, ARIZ.

AN EXAMPLE OF PREFERENCE FOR DECANTATION

Undoubtedly, the adoption of this system will be regarded with interest by everyone connected with the process. Not merely is it interesting as an example of continuous counter-current decantation, noteworthy as it is from that point of view, but more particularly because that system has supplanted a large, modern, vacuum-filter installation with results, according to statement of the operators, better than those obtained under former method of operation.

There is food for considerable serious thought in this change, but there is danger of falling into popular form of error, and regarding the procedure as a reversion to a system already discarded, or, in other words, a step backward. A little thought, however, will make clear the fact that it is nothing of the kind, but rather a refinement of an earlier process, than which no change can be more progressive. It is clear to the most casual observer that the system used at the Gold Road mill is not applicable to all mills, although it may, as in the present instance, be applied occasionally with favorable results both as to percentage of recovery and cost of operation. It is applicable in its present form only where solutions carrying low cyanide percentages can be used and where the amount of metal in solution is comparatively small, conditions which are manifestly present when low or medium-grade gold ores are treated. Where high-grade solutions are used, it would be impossible to use the system in this form because a large loss of cyanide would be entailed, but by following up the decantation with a form of continuous filtration which would reduce the moisture content of the residue to about 25%, the system is not only feasible, but advantageous. To steer clear of generalities is necessary for the intelligent consideration of any innovation, so that in estimating the value of this one, it must not be considered revolutionary nor reactionary, nor anything more than a simple, clear application of a newly developed system to a particular case.

PRECIPITATION IS BY ZINC DUST

Solutions of both circuits are precipitated with zinc dust, the special feeders and presses being provided in each case, as is shown in the flowsheet. Square-frame presses are used, and not the triangular form usually found in Merrill installations. A variation of the general filter-press practice is the use of three filter coverings for each plate. The layer next the cake of precipitate is of filter paper, the intermediate one of light muslin, and the outer one of the usual canvas. The paper is removed and burned with each precipitate cake, the intermediate sheet lasts for several clean-ups, while the canvas, by careful cleaning, is made to last indefinitely.

The method of precipitating and also of adding zinc dust to the solution is the Bosqui system, controlled by the Merrill Metallurgical Co. and, as is usual, the Trent agitator is used for emulsifying. The consumption of zinc dust amounts to about 0.4 lb. per ton of solution precipitated. Precipitate is handled in the usual way. Formerly

acid treatment was not resorted to, but at present a preliminary acid "cutting-down" is made and the mass of precipitate is then roasted. The dry product of the roasting pan is fluxed and melted in a Steele-Harvey oil-fired furnace.

Experience at this plant has been such as to demonstrate that solutions containing exceptionally low percentages of cyanide can be precipitated successfully when the percentage of lime carried is sufficiently high. Solutions containing as little as 2c. to 15c. in gold and very weak in cyanide, solutions from washing systems, are successfully precipitated by carrying high alkalinity.

As has already been mentioned, the lime is added at the mine crushing plant. The consumption amounts to about 0.65 lb. per ton treated. Treatment solutions usually carry 2 to 2½ lb. CaO, per ton of solution.

Cyanide Added in Tube Mill

The regular addition of cyanide for keeping up the strength of mill solutions, is at the tube mill. This is often considered an excellent point for addition of cyanide, as it is immediately crushed and put into solution; besides, the energetic agitation in the mill, together with the somewhat elevated temperature, gives the best opportunity for dissolving the greatest possible quantity of metal.

Solutions, at the Gold Road mill, are carried at about 2 to 2½ lb. KCN per ton, only one strength being in use. The consumption is about 0.4 lb. per ton of ore treated.

Extraction of gold is usually about 94% or more, and is calculated by using the combined content of bullion produced and tailing discharged as the content of the ore milled. Recognizing the limitations of this system, careful duplication and check samples are taken continuously in various parts of the mill.

The total milling process requires 530 hp. for its operation and 20 men are employed continuously, two of these being repair men.

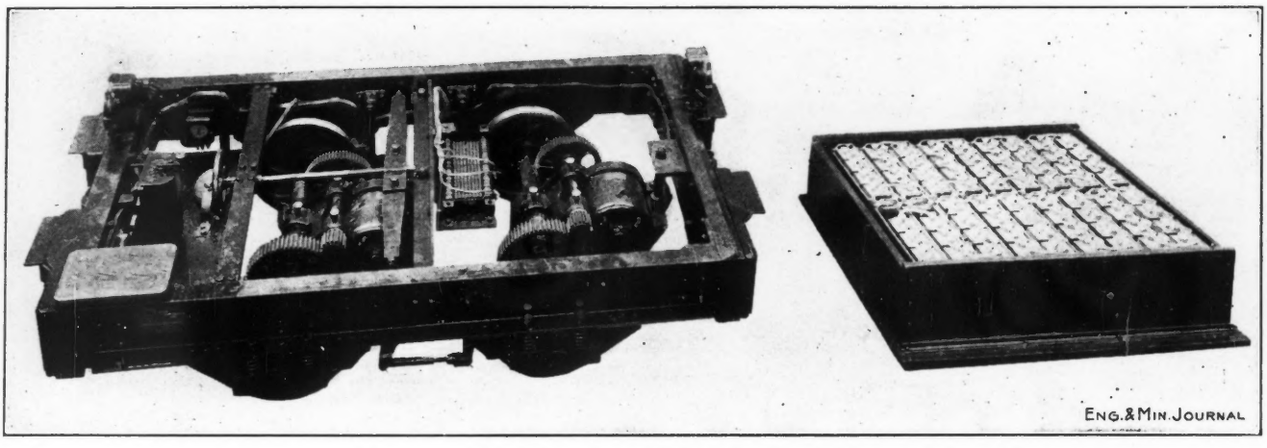
Detailed cost data on this installation would be exceedingly interesting, but unfortunately the policy of the company is adverse to such publication, and for that reason no figures can be given. It may, however, be said that the expenses are altogether reasonable and in conformity with those found satisfactory in the best installations of its kind.

Storage-Battery Locomotive for Gathering Work

One of the latest applications of the storage-battery locomotive is for gathering work in coal mines. One of these locomotives was recently installed in the Glendower colliery, of the Philadelphia & Reading Coal & Iron Co., for this service.

The locomotive is equipped with two 85-volt motors and controller, and type A-8 Edison 70-cell batteries, having a 300-amp. capacity with a discharge rate of 60 amp. for five hours. The cells are grouped in 18 trays and mounted on top of the locomotive frame in a wooden case. The rated drawbar pull is 1000 lb., and the speed 3½ miles per hour. At the full rated drawbar pull and speed, one charge of the batteries is sufficient for nine miles. Assuming a car and track friction of 30 lb. per ton on level track, this rating is equivalent to 300 ton-miles on one charge.

The frame of the locomotive consists of steel channel sides and steel plate ends held together rigidly by bolts and steel angles. The end plates are faced with wooden bumpers to which suitable couplings are attached.



Storage-Battery Locomotive Used for Gathering at Glendower Colliery

The motors are series wound, totally inclosed and are of the automobile type. One motor is mounted on each axle in a cast-steel suspension cradle. The motors drive the axles through double-reduction gearing. The illustration shows the truck and battery arrangement.

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Occurrence of Pyrrhotite in Wisconsin

What appears to be the first reported occurrence of pyrrhotite in the state of Wisconsin is described by Rupert Mather Bragg (*Econ. Geol.*, June, 1913). It occurs near the town of Mountain in the northeastern part of the state. The mineral mass is found in a gabbro dike traversing pre-Cambrian granite. The nature of its occurrence indicates that it was a magmatic separation out of the gabbro, since it is fresh near the surface and shows no secondary enrichment; merges into the gabbro along indefinite lines, and shows a spheroidal shelly structure near the outcrop. Its shape and size have not been well defined. It shows no nickel on analysis.

❖

The Broken Hill Proprietary Co. in the half year ended Nov. 30, 1912, produced 1367 tons of spelter and 212 tons of blue powder.

Milling in Southeastern Missouri—III

By Claude T. Rice

SYNOPSIS—At the Federal mill, described in detail, 4000 tons per day are treated, an average recovery of 85% being made. The ore is crushed by Symons gyratories, Symons disk machines and rolls to a maximum of 10 mm. The oversize of 1¼-mm. trommels is treated on Hancock jigs, especial care being taken to produce a clean concentrate. The middlings product is treated on other Hancock jigs. Drag classifiers, in conjunction with hydraulic classifiers, provide an excellent feed for concentration on Wilfleys and vanners. Magnetic-separator and canvas plants add to the extraction.

In this article will be described the milling practice of the Federal Lead Co., Flat River, Mo. At this mill I believe the best work in the district is being done at present, for the mill is in no way crowded as to tonnage. The ore is accurately sampled and weighed so that the recovery can be ascertained with certainty. This recovery averages about 85 per cent.

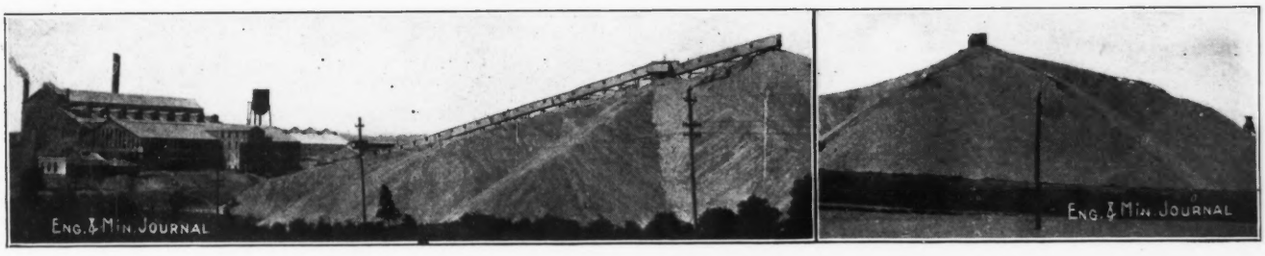
Excellent Results Obtained

The excellence of this milling work is largely due to the method of keeping the slime out of the table feed. Moreover, more attention is paid to the recovery of the slime than at some of the other plants in the district. One of the greatest contributing factors toward the excellence of the recovery is the high standard of the Hancock-jig practice. Also, great care is exercised to obtain a thoroughly mixed ore for feeding to the different concentrating devices. A notable feature of the mill is its completeness. Not only are the fine sizes of galena followed about as far as possible, commercially, but the concentrates and middlings are re-treated until, finally, the pyrite and chalcopyrite are taken out of the middlings concentrates by a preliminary roast and magnetic separation. The tailings from the magnetic separator are sent back to the mill where the galena and blende in them are separated.

Mechanically, the mill is not so interesting as the Doe Run No. 3 mill. There is a separate breaker house connected by a belt conveyor to the fine-ore bin at the head of the mill building proper. In the design of the mill building the ordinary lines of construction were followed with launder feed to tables, overhead drive and overhead distribution of wash water.

The mill has two terraces and four floors. On the bottom floor are carried the main settling tanks and the vanners. Above is the main table floor, which is carried by the structural-steel frame at the same height as the second terrace. On the second terrace are the foundations for the fine-ore bin, the rolls for recrushing middlings from the jigs as well as the elevator pits and settling tanks for gathering together the coarse concentrates. On the floor above are placed the jigs. In a sort of gallery floor, still higher, are carried the drag classifiers, while even with the top of the fine-ore bin is the trommel floor. To aid in getting from one floor to another a man elevator of the ordinary belt-and-handle type is put in near the sampling plant. The canvas plant is in a separate building.

Most of the ore comes to the mill from No. 1 shaft, where it is handled in skips. This dumping into the skip pockets underground followed by dumping into the receiving pockets at the surface and the further transferring by pan conveyor to the mine bins results in a thorough preliminary mixing. At the other shaft of the Federal company the ore is hoisted in cars, and dumped into mine bins. The ore is hauled to the bins of the crusher house from the different shafts in 45-ton side-dump railroad cars over the tracks of the company. The ore is discharged into two small sloping-bottom bins, a bin being provided for each of the two sections of the crusher house.



Federal Mill and Tailings Pile, Flat River, Mo.
(Method of distributing tailings by launders from top of pile is shown.)

Ore Broken by Symons Gyratory Crushers

The ore is fed through a bin gate of the upward-working slide type, operated by compressed air. These gates can be opened or closed quickly, so that if a boulder gets caught under the gate the valve on the cylinder is quickly reversed, the gate raised slightly, and closed again as soon as the boulder has slid past. The ore goes directly to the Symons 7½ C gyratory crusher used in each section. The feature of the Symons coarse crusher is the fact that the crusher head itself does not rotate, but is pushed straight in and out by an eccentric sleeve that is carried on the rigid shaft of the crusher head. Owing to the fact that the eccentric causes the movement of the head through direct contact with it, the movement of the crusher head is as much at the top as at the bottom. Consequently, there is a better gripping of boulders and a quicker breaking of them with this gyratory when they approximate the maximum feed for the crusher than in the case of the gyratory-shaft type.

An important feature in the Symons crusher is the great saving in height made possible by the form of the eccentric. This amounts to a saving of about 5 ft. in the case of the 7½ C size, and largely decided Mr. Guess in

its favor, as he had only a limited amount of head room at his disposal. There is also a saving of about 40% in the weight. On the crushers at this mill manganese-steel crusher heads are used. These are slightly corrugated to aid in the crushing. The capacity of these crushers was much more than the rated capacity, which necessitated intermittent feeding at first. To enable the attendant to feed them in this way without excessive power consumption a Bristol recording ammeter was installed at the loading platform. The necessity of intermittent feeding was remedied by cutting down the throw of the eccentric so as to reduce the movement on the crusher head.

The ore from each of these crushers drops to a belt conveyor and is taken past two electromagnets to the launder which feeds the Symons disk crushers. This double precaution to insure the removal of iron from the feed is necessary because of the trouble it would give in the disk machines.

Symons Disk Machines for Intermediate Crushing

In the design of the Symons disk machine, a rather new combination of crushing principle is used. It is the combination of a nip such as is obtained in the Blake crusher, with the spreading of the feed each time that it is broken, so that centrifugal force can discharge the undersize material as fast as it is formed. There is no grinding action in the crusher such as characterizes other types of disk machine, for the two disks rotate in the same direction at the same speed. Since the undersize is thrown out by centrifugal force as soon as formed, the ore is crushed in one operation from 4 in. to ¾ in., without any marked production of slime. Owing to the loose bed in the crushing zone, the Symons disk machine can be started when full of ore without any excessive torque.

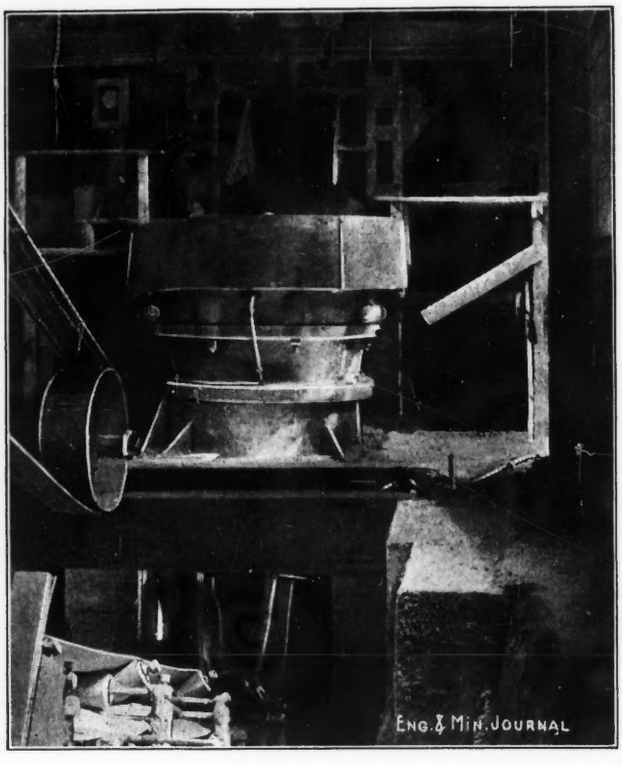
One of these 48-in. disk machines will crush 50 to 60 tons an hour, requiring 60 to 65 hp. to run it. The costs of upkeep and attendance are small. From the experience at this mill it is judged that the cost for repairs and maintenance is 0.2c. per ton of feed. The Symons disk machine seems destined to make a field for itself in the crushing of ores. It must be remembered, however, that it is not a fine crusher, but an intermediate one, and the manufacturers do not like to make machines for crushing much finer than ⅝ in. In fact, experience has shown that the disk machine works best when crushing to a size not less than twice the movement of the disk jaws. In finer crushing, especially noticeable at about ⅜ in. size and under, there is a tendency for a sort of grind to develop. This is because of the small movement that can be allowed the jaws without the production of a large amount of oversize.

At the Federal mill the ore is elevated from the disk crushers to 48x144-in. trommels having 10-mm. screens punched from No. 10 gage sheets. These screens last about three weeks. On the bucket elevators the cups are only 14 in. wide, while the belt is 28 in., the cups being spaced 9 in. apart and staggered, so as to load the belt more uniformly. On all the dry elevators, the buckets are staggered in this way.

Rolls for Fine Crushing

From the trommels the oversize goes to 24x48-in. rolls, the product from which is elevated to trommels with 10-mm. screens similar in every way to the previous set. These return their oversize to the rolls that feed them. The undersize from all these trommels is taken by a 24-in. Robins belt conveyor up past the sampling mill to the 24-in. conveyors and traveling tripper that beds it in the bin. The progress of the ore through the sampling plant is shown in the accompanying flow sheet. A sample amounting to $^1/_{1600}$ of the whole is taken, and in order to allow the ore coming from each mine to be sampled separately, if desired, a sample bin is provided with eight compartments, into any of which the samples can be run.

The old crushing system used at this plant included a Blake and three sets of rolls in each of the two sections of the crushing plant. While a great improvement has resulted as to the fines in the mill feed, the advantage has come from increased simplicity, allowing fewer



Symons Coarse Crusher, Showing Recording Ammeter

crushing devices to be used, with an increased capacity of 1000 tons per day and a decreased power consumption of 100 horsepower.

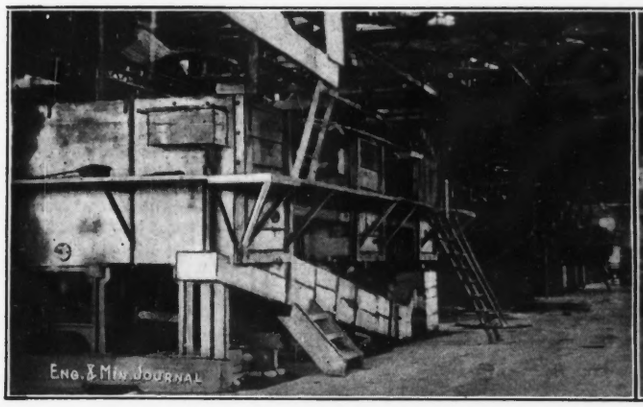
The ore from each fine-ore bin goes to a shaking chute fitted with springs, so as to put it in tension. Owing to these springs, although the chutes are about 15 ft. long, no trouble is experienced. There are three double sections in the mill proper, and a shaking chute is placed at the head of each single section. The shaking chute discharges to a bucket elevator, which takes the ore to the top of the mill building where water is added before the ore is sent to the trommels. On these trommels 1¼-mm. screens are used, which are finer than those used in the other mills of the district.

Mr. Guess does not believe in using Harz jigs on these low-grade lead ores, except in handling a small product like the chalcopyrite-galena-pyrite middlings that he gets

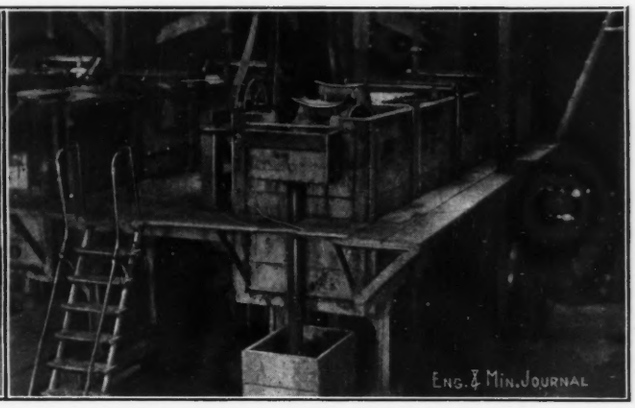
from the Hancock jigs. What is too fine for treatment on the Hancock jig he thinks should go to tables. Owing to the fineness of these screens, they are subjected to great wear, but as they are punched from No. 18-gage steel they last about 15 days. This makes the cost about 0.5c. per ton of ore milled. Owing to the fact that the tough limestone tends to break into chunky fragments and not into needle-shaped chips, like the chert does at Joplin for instance, there is practically no trouble from blinding of the screen. An important aid in keeping the screen from blinding is the use of a strong jet of water, which is kept playing on the sides of the screen just above the point where the bed of pulp rides in the trommel.

present in tabling; apparently, far better than any other method so far devised for this purpose in connection with the bottom-discharging classifiers of the ordinary type. Indeed, prior to this, one of the few instances where any attempt was made on a large scale to get rid of the slime at the start of milling operations and to send it to the department where it belonged before being excessively diluted, was in the design of the present Washoe concentrator at Anaconda, Mont., where a sloughing-off spitzkasten is used to float off the slime.

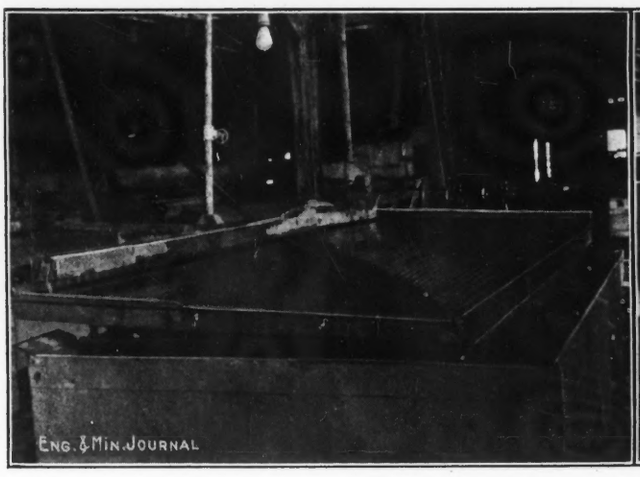
The sending of pulps to the place where they belong just as soon as possible in the treatment is a principle of milling that is not appreciated enough. It is a mistake



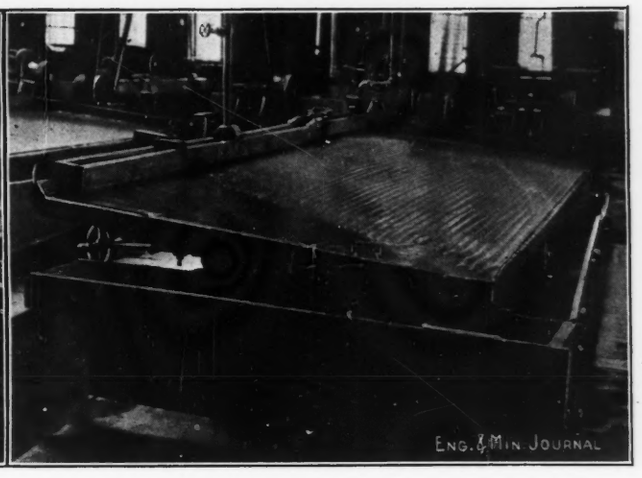
HANCOCK JIG FLOOR, FEDERAL MILL



SHOVEL DISCHARGING JIG TAILINGS



ONE OF THE WILFLEY TABLES HANDLING FIRST-SPIGOT PULP



ONE OF THE MIDDLINGS TABLES, SHOWING IMPROVED RIFFLING

This jet generally knocks any fragments of rock out of the holes of the screen before they are fairly caught in them.

DRAG CLASSIFIERS DO GOOD WORK

The oversize from the 1¼-mm. trommel goes to the Hancock jigs, while the undersize goes to a sloughing-off box that removes some of the water and finest slime, sending it to the slime spitzkasten. The underflow from this sloughing-off box goes to an Esperanza-Federal drag classifier, which was described in the JOURNAL of Sept. 28, 1912. This apparatus works admirably in eliminating the troublesome slime water that ordinarily is

to let slime and the finer sand reach the classifying compartments of a hydraulic classifier; especially one of the present standard types, in which the coarser sizes are drawn off first and the finer sizes last. If the slime is removed before the classifier is reached the type of classifier does not matter so much, but if not, there will always be dirty table water coming off every fine table fed from these classifiers. The method of removing slime in the Overstrom system will be described in the next article of this series, but where the bottom-discharging classifiers are used, there does not seem to be any better way of getting rid of the slime than by the use of drag classifiers.

The cost of upkeep on the drag classifiers is not great, and they make an excellent separation of sand and slime. While the accompanying screen analysis shows the nature of the slime overflow from the machine, the test of the freedom of the overflow from sand contamination is best shown by the comparative absence after weeks of running of any sand bed on the vanner belt between the feed box and the wash-water drips. This condition of the separating field of the vanners is an excellent test of the efficiency of previous classification. It is of importance that this fact should be considered, for it is doubtful whether good work on vanners can be done when the slime concentrate has to be dragged up through such an interfering field of irregularly classified sand.

Good Work from Hancock Jigs

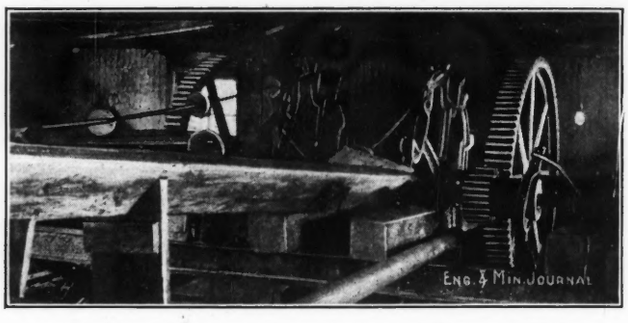
We have now come to the Hancock jig. The jigging practice here is probably the best in the country where Hancock jigs are used, since the tendency of free galena to get into the middling compartment is carefully guarded against by the use of a special middlings jig. By this method, good results are not so dependent upon the constant watchfulness of the attendant, as at the Doe Run mill. Moreover, a clean concentrate is obtained from the lead hutches of all the jigs. In most mills in the district, there is a disposition to save the galena in a somewhat coarser condition, so as to avoid sending heavy coarse concentrate to the rolls along with the middling. But at the Federal it is thought better to make a clean concentrate since it is believed that there is little real sliming of the galena resulting from passing it through regrinding rolls. The saving of the extra cost of railroad haul and smelting because of the smaller tonnage of concentrates to be treated is deemed sufficient to warrant this procedure.

In order to obtain clean concentrates from the jigs, it is necessary to maintain a fixed bed all the time. The more even grade of the ore coming to the Hancock jigs at the Federal mill through the excellent mixing and bedding which the ore gets, aids greatly, I believe, in the maintenance of the jigging beds. Mr. Guess, however, does not think that the evenness of the grade plays any especially important rôle in obtaining high-grade concentrates from these jigs. Of course, the most important factor in determining the thickness and maintenance of the bed is the mesh size of the sieves.

Precautions to Maintain Jig Bed

Mr. Guess uses finer screens over the concentrate hutches than those used on the Doe Run Hancock jigs, although he crushes to 9 mm. as they do. Over the first hutch, Mr. Guess uses a 5-mesh, No. 16 brass-wire screen, and on the second and third a 4-mesh screen, having the same size brass wire. On the fourth compartment he uses No. 10 gage iron, having 10-mm. holes punched in it, and over the fifth, or last, hutch, the same gage is placed, with 9-mm. holes. In this way the concentrates are kept from working through the sieves so fast that the bed will get thin, and, therefore, what concentrates do work through are as clean as with other types of jigs, where the maintenance of a cleaning thickness of concentrates is more assured. As a further precaution, the space between the first two slats of the tray is blocked, so that the rush of the feeding current will not stir up the bed, and cause unclean concentrates to work their way through the screen into the hutch. Iron slugs are also added, to help form the bed, especially on the fourth and fifth sections of the tray. The only drawback to the use of a fine screen on the Hancock jig is that more of the coarse galena is thrown into the middling, but after the crushing of this ore most of the galena is fairly fine. The question of what size screen to use on the Hancock jigs is the important point to decide in practice, when treating an easily slimed material like galena ore. As coarse a screen should be used as consistent with cleaning the concentrate properly.

The Hancock jigs in the Federal mill run at 195 reciprocations per minute. The upward movement of the stroke is ½ in., and the forward and back movements, ¾ in. A strong bump is used. The Hancock jigs are of wood, and are set directly upon the concrete floor, so that they are carried rigidly. The jigs are built along standard lines, except that the company buys the iron work from the licensees, the Allis-Chalmers Manufacturing Co., and supplies its own lumber, thus obtaining a somewhat better box and tray at approximately the same cost. The tray supports are all cast steel. All the jigs in a unit are



Lug Concentrates Conveyor at Federal Mill

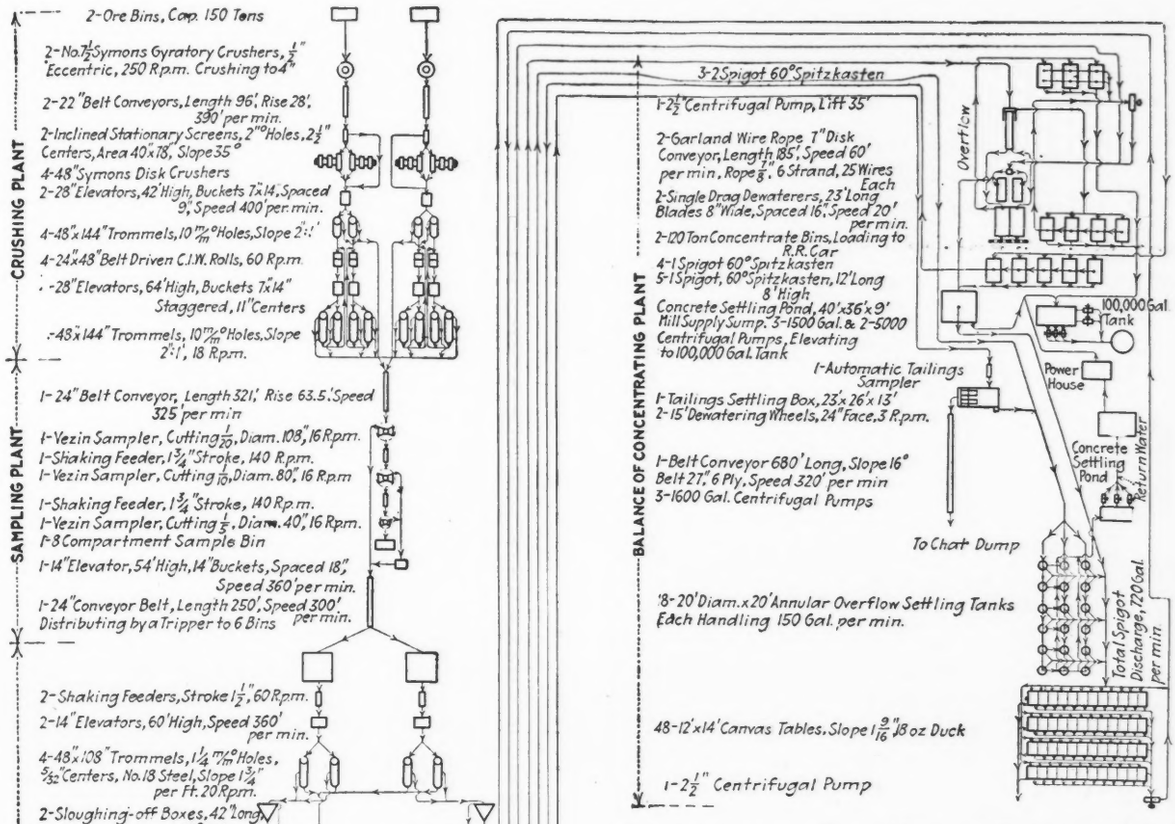
driven from a line shaft, which also drives the drag classifiers and the trommels.

The feed to a Hancock jig is about 350 tons of original feed, with about 200 tons of middling feed. These Hancock jigs make concentrates on their first three compartments. The concentrates of the first two hutches on a jig are clean galena, while those from the third hutch contain pyrite and chalcopyrite with a little blende. The concentrates from the first hutch assay about 77½%, those from the second, 71½%, while those from the third assay 60% lead.

Concentrates from Third Hutch Re-treated

The concentrates from the third hutch are sent to a dewaterer, the thickened product flowing to a 2-mm. trommel. The oversize is practically clean galena, which is sent to the concentrates bin; for, owing to the greater friability of pyrite and chalcopyrite, and the finer particles in which they occur in the ore, these minerals, as well as the blende, tend to go into the finer sizes when the ore is crushed. Indeed, the oversize from the 2-mm. screen averages 70% lead, and the undersize only 35% lead. The undersize from the 2-mm. screen goes to a two-compartment Harz jig having a 5-mesh, No. 16 brass-wire screen on both compartments, and a heavy bed of coarse concentrates obtained from the Hancock jigs, and replenished each morning.

The tails from the Harz jig go to a centrifugal pump and are raised to a Wilfley table, by means of which the



FLOW SHEET OF NO. 3 MILL OF FEDERAL LEAD CO., FLAT RIVER, MO.

small amount of fine galena is obtained as a concentrate, while a middling product, containing zinc, lead, iron and copper, is drawn off for treatment in the magnetic plant. In the latter it is roasted along with the middlings from the middlings tables, and the pyrite and chalcopyrite removed by a Cleveland-Knowles magnetic machine. The tailings from this magnetic machine are returned to the mill, and treated on two James tables, so as to separate from the blende what little lead may still be left in the tailings. It is because the Federal ore contains more chalcopyrite than most of the ore in the camp that it pays the company to do this magnetic work. About 60 tons of magnetic concentrates, assaying 7% copper and some silver, are obtained in a month.

MIDDLINGS TREATED ON OTHER HANCOCK JIGS

Returning to the Hancock practice, the middlings from the fourth and fifth compartments of the original Hancocks go to a drag dewaterer, and thence to the boot of the wet elevator serving the section. They are sent to the middlings jig, where they are joined by the oversize from the 1½-mm. trommels, handling the reground middlings coming from the middlings jig. In this way, any coarse concentrates that may have worked into the middlings compartment of the original Hancocks, are caught to form the bed on the middlings jig, being there worn fine enough to pass this screen, and thus kept out of the middlings compartment. This wear is so rapid that it requires constant replenishment to keep this up to thickness.

The bulk of the pulp that has come from the original Hancock goes to the fourth and fifth compartments, and

is drawn through and sent to drag dewaterers, which are somewhat shorter, and have a steeper angle to the draining bottom, than those handling the original feed. In this way, the water in them is greatly reduced, and the fines are floated off and taken to the slimes department. The thickened pulp is sent to 16x36-in. rolls, which discharge to the wet elevator that feeds 1½-mm. trommels. The oversize from these trommels goes to the middlings Hancock jigs, thus completing the middlings circuit.

Before leaving the subject of Hancock jigging, I wish to call attention to the great improvement that has been made at the Federal mill in discharging the tailings from the jig. This is accomplished by the use of a drag belt. The tailings are thus discharged in a practically dewatered condition. In an accompanying halftone is shown the dewatering wheel which was used on some of the jigs until the drag belt was found to be better. The tailings are shoveled out where they can be readily seen by the attendant, thus enabling him to keep better track of the work of the jigs.

On some of the jigs an arrangement is also installed for drawing middlings from the top of the screen at about the end of the third hutch compartment. The coarse middlings, too large to go through the screen, that are drawn off in this manner, drop down into the fourth hutch through an opening at the bottom of the screen. This is an innovation that was copied from one of the mills of the Federal Mining & Smelting Co. in the Cœur d'Alene district.

POWER DATA, MILL OF FEDERAL LEAD CO., FLAT RIVER, MO.

Motor List	Number	Hp.	Total Hp.	Hp.-Operating Ave.
Crushing plant	2	250	500	490
	2	10	20	18
Conveyor and sampling plant	1	50	50	20
	1	3	3	1.5
Conveyor over bins	1	20	20	12
Jig room	3	50	150	102
Elevators and screens	3	50	150	106
Regrind rolls	3	50	150	80
Table room	6	20	120	78
Concentrates conveyor	1	10	10	9
	1	3	3	2.5
Chat dewaterers (1-motor reserve)	2	25	50	12
Chat conveyor and pump	3	50	150	106
	1	20	20	
Concentrates pumps	5	10	50	35
Mill supply pumps	2	250	500	170
Mill supply pumps	3	75	225	50
Mill supply pump	1	50	50	27
Return-water pump	1	85	85	82
Return-water pumps	2	40	80	
Canvas plant	2	20	40	31
Canvas plant	1	10	10	7
Magnetic plant	1	25	25	18
Magnetic plant	1	20	20	9
Magnetic plant	1	10	10	8
Total			2491	1474

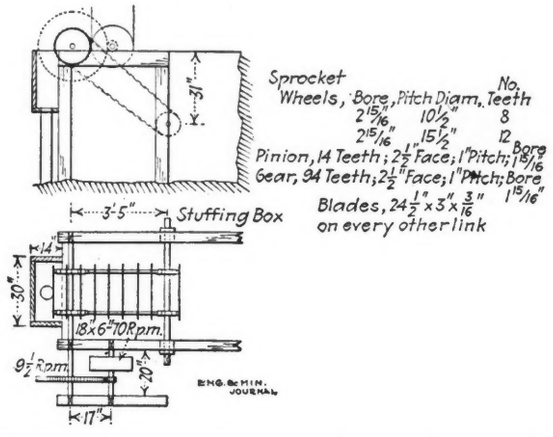
Hancock Jig Operating Data

Having reviewed the principal points in the Hancock jigging practice it may be well now to take up the operating data. Each 25-ft. Hancock jig, in the opinion of Mr. Guess, will handle 350 to 400 tons of original feed without crowding. It will treat feed down to 1 mm. size fairly well, but the fines are not handled so efficiently as the coarser sizes. It takes 5 hp. to drive one of these jigs. The life of the screens is from six to eight months. The upkeep, exclusive of screens, is about $8 per jig per month, or 0.1c. per ton of original feed. Before shovel wheels were installed on the jigs, the amount of water required per jig was 300 gal. per minute, or about 1 gal. per ton of feed to the jigs. With the shovel wheel the amount of water required is 200 gal. per minute per jig, or ⅔ gal. per ton of feed. With the drag belt probably about ½ gal. per minute per ton of ore is required.

The grade of the Hancock concentrates is about 75% lead, although at times they have averaged as high as 77%. Approximately 58% of the concentrates recovered at the mill comes from the jigs. The average assay of the Hancock jig heads is 3.5% lead by wet assay, while the tailings assay about 0.65% lead. The accompanying table, giving analyses and assays of the different sizes, shows that with this ore there is little more lead in the larger sizes than in the smaller sizes. Table tailings assay about 0.2% lead. It is not thought that finer grinding of the tailings would pay on this ore. Only in the fine sizes coming off with the jig water is there any notable increase in the grade of the different sizes. When the increase does come, the proportion of that size by weight to the total amount of tailings is small. With this ore there can be no question but that the Hancock jig has an evident field, especially when the question of cost is considered. At this mill it is only 3c. per ton of total mill feed, 75% of which is treated on Hancock jigs.

Hydraulic as well as Drag Classifiers Used

Classification at the time of my visit was mainly done with Richards vortex devices, but in some sections the type of classifiers used in two of the concentrating plants of the Cœur d'Alene district of Idaho is used, and it is possible that in the improvements being made in the mill



Drag Dewaterer on Hancock Jig at Federal Mill

this type of classifier will in time be installed in all sections. This Bunker Hill & Sullivan classifier is similar in principle to the Yeatman slot type illustrated in Richards' "Ore Dressing." The whole principle of this classifier is the use of a slot by which the hydraulic water is introduced in a broad band. The hydraulic water is fed into a large pressure compartment, so as to insure the discharge from it of an even upward current.

The sand from each drag classifier goes to two three-spigot hydraulic classifiers. The overflow from these joins the overflow from the drag classifiers and the sloughing-off cones ahead of them, and goes to spitzkastens for settlement prior to treatment on tables and vanners. The first-spigot product of each of the classifiers treating original feed assays about 15% lead.

Coarse Jig Tailing Treated on Wilfleys

The first-spigot product from both of the original-feed classifiers in a single section of the mill goes to four Wilfley tables. The smooth cleaning portions of the decks

of these tables are almost completely covered with concentrates, yet the tailings assay only 0.2% lead by wet assay. On these tables there is about 8 or 9 ft. of almost clean water coming off along the tailings side which, were it not for the drag classifiers, would on the finer sizes be a slimy water. The second-spigot product from each hydraulic classifier goes to a single table. This feed assays 5% lead, and the tailings 0.2%. The third-spigot products from both classifiers are united, and go to one Wilfley table. The heads assay 5% and the tailings 0.4% lead.

The undersize from the trommels handling the reground middlings, goes to a sloughing-off cone that feeds the underflow to a drag classifier, which in turn feeds the dewatered pulp to two hydraulic classifiers; the middlings from two single sections are kept separate from the original feed. The pulp coming from the first spigot

SCREEN ANALYSES, FEDERAL MILL

(Symons Disk Crusher Product)

	%
+ 1 in.	36
+ ½ in.	35
+ 10 mm.	16
+ 4 mm.	11
— 4 mm.	2
	100

of these classifiers is not nearly so rich as that coming from the corresponding spigot of the classifiers receiving original feed, as it only assays about 6% lead. The first-spigot product of the two classifiers is taken by a common launder to one Wilfley table. The tails from this

FEED TO CONCENTRATING MILL

	%
+ 7 mm.	13
+ 4 mm.	34
+ 2 mm.	22
+ 1½ mm.	10
+ ¾ mm.	4
+ 80 mesh	7
— 80 mesh	10
	100

table assay about 0.25% lead. The pulp from the second spigots of these classifiers goes to one Wilfley, the heads assaying 4% and the tails 0.25 per cent. The third-spigot products unite and go to one Wilfley table, the tailings assaying about 0.4% lead.

The overflowing pulp from the hydraulic classifiers treating original feed, goes, as I have said, along with the drag-classifier slime to a spitzkasten. From this, three different pulps are drawn off at the bottom. The

VARIOUS SCREEN ANALYSES AND ASSAYS AT FEDERAL MILL, HANCOCK JIG FEED*

	Weight %	Assay % Pb.	Lb. Pb. in 100	Value %
+ 1 mm.	93.3	2.81	2.622	75.9
+ ¾	3.2	12.00	0.384	11.1
+ 60 mesh	1.9	14.70	0.279	8.1
— 60	1.6	10.5	0.168	4.9
	100.0		3.453	100.0

* Oversize of trommels having 1-mm. screens instead of 1½-mm., as at present.

first spigot, in each instance, feeds a Wilfley table, the tailings product from which is then thickened in a spitzkasten and passed for second treatment over a vanner.

The second spigot of each feeds a vanner, while the third-spigot products from the two spitzkasten are united and taken to one vanner. In all instances, the tailings from the first vanners after thickening go to a second vanner to be reconcentrated, before they are settled and sent to the canvas plant.

These vanner feeds average about 5% lead, the tailings from the first vanners average about 2.8%, while the tailings from the second set of vanners, which go to the canvas plant for final treatment, along with the other slime, assay about 2.2% lead. The riffling of the middlings tables is different from that of the tables handling original feed, for the pulp resulting from the rerushing of the Hancock middlings contains a large amount of chalcopyrite and pyrite, with some blende, as these minerals in the rerushing, go into the fines. The

HANCOCK JIG TAILING

	Weight %	Assay % Pb.	Lb. Pb. in 100	Value %
+ 9 mm.	3.9	1.46	0.057	8.3
+ 8	4.6	0.70	0.032	4.7
+ 7	6.0	0.48	0.029	4.2
+ 6	11.3	0.78	0.088	12.8
+ 4	31.3	0.80	0.250	36.5
+ 2	23.1	0.37	0.085	12.4
+ 70 mesh	18.8	0.33	0.062	9.1
— 70	1.0	8.35	0.082	12.0
	100.0		0.685	100.0

riffles are carried out beyond the ordinary line of termination, so as to begin to spread the concentrates well up on the smooth cleaning plane of the table. In this way, a broad banding is obtained, and the minor sulphides can be cut out as a middling product without much trouble, and sent to the magnetic plant for further treatment.

ESPERANZA-FEDERAL DRAG CLASSIFIER FEED

	Weight %	Assay % Pb.	Lb. Pb. in 100	Value %
+ ¾ mm.	4.4	13.50	0.594	5.3
+ 70 mesh	23.5	15.75	3.701	32.8
+ 150	8.1	18.50	1.498	13.3
Sand — 150	31.7	12.00	3.804	33.7
Slime — 150	32.3	5.20	1.680	14.9
	100.0		11.277	100.0

The top riffles extend to about 3 ft. of the end of the table, while the bottom riffle comes to about 3 in. of the edge. The intermediate riffles are cut off and the slanting line determined by these two riffles.

Both on the tables treating original feed, and on those treating the reground middlings, a true middlings product is cut out and is taken back to the drag dewaterer feeding the rolls, and in this way is returned to the system to be run through again. The tailings from jigs and tables go to a settling tank. The tailings are dis-

ESPERANZA-FEDERAL DRAG CLASSIFIER SAND DISCHARGE

	Weight %	Assay % Pb.	Lb. Pb. in 100	Value %
+ ¾ mm.	9.1	5.52	0.502	4.1
+ 70 mesh	33.5	7.40	2.479	20.1
+ 150	16.0	17.10	2.736	22.2
Sand — 150	35.5	16.90	6.000	48.7
Slime — 150	5.9	10.00	0.590	4.9
	100.0		12.307	100.0

charged from this tank at about 12% moisture by two 13-ft. shovel wheels to a 27-in. troughed conveyor belt that carries them up a slope of 29 ft. to 100 to the top of the tailings pile. Water is pumped to the top of the pile and added to the tailings as they drop off the belt, so that they can be distributed in all directions by means of launders. From 400 to 500 gal. per minute are pumped to the top of the pile for this purpose, when

ESPERANZA-FEDERAL DRAG CLASSIFIER SLIME OVERFLOW

	Weight %	Assay % Pb.	Lb. Pb. in 100	Value %
+ 150 mesh	0.4	5.00	0.020	0.4
Sand — 150	31.6	7.00	2.212	40.0
Slime — 150	68.0	4.85	3.298	59.6
	100.0		5.530	100.0

treating about 3500 tons of ore per day. The tailings pile now contains more than 2,000,000 tons, and has been built up close to 200 ft. in the air. An accompanying halftone shows the manner of distributing the tailings from the the top of the pile, and shows the approximate inclinations of the launders.

The tailings belt is made up of several sections, the first one is 200 ft. center to center, the next 300 ft., the last 100 ft. It takes 55 hp. to operate these stackers, while the centrifugal pumps for elevating the water to the top of the pile, require 30 hp. The cost of handling the tailings in this way is not high, as only three men are required on the pile, and the belt will last about eight months. The total cost is approximately 2c. per ton of tailings, 1c. of which is for maintenance.

The tailings from the vanners, and the overflow from the different settling tanks, all go to a concrete settling pond alongside the mill, that is 40 ft. long, 36 ft. wide and 9 ft. deep. The clear water overflow from this tank is elevated by centrifugal pumps to the 100,000-gal. tank at the head of the mill. The settled pulp, and the overflow from the shovel-wheel tank go to 18 settling tanks, 20 ft. in diameter and 20 ft. deep, that send a total of 720 gal. of thickened pulp per minute to the canvas plant, while the overflowing water is pumped back to the mill.

RICHARDS CLASSIFIER

	Weight %	Assay % Pb.	Lb. Pb. in 100	Value %
First Spigot				
+ ¼ mm	18.7	15.30	2.861	16.5
+ 70 mesh	57.0	16.10	9.177	52.9
+ 150	15.1	22.20	3.352	19.3
Sand — 150	7.0	25.00	1.750	10.1
Slime — 150	2.2	9.10	0.200	1.2
	100.0		17.340	100.0
Second Spigot				
+ 70 mesh	16.9	0.75	0.127	2.3
+ 150	45.8	1.75	0.801	14.3
Sand — 150	34.3	13.20	4.528	81.0
Slime — 150	3.0	4.35	0.130	2.4
	100.0		5.586	100.0

Canvas Plant Has 48 Tables

In the canvas plant are 48 tables, 12 ft. wide by 14 ft. long, covered with 18-oz. duck. The slope of these tables is $1\frac{9}{16}$ in. per ft. Four boys, under the supervision of a foreman, wash off these tables every 20 minutes. The boys work barefooted on the tables all the year around. These tables are arranged six in a row, the tables in each double row being placed back to back. There are two double rows on the top and two double rows on the bottom floor of the canvas plant. The canvas lasts about five months. During the first weeks, when the canvas still has more fuzz to its fibers, it catches the concentrates better than when it becomes worn.

The heads to this plant assay about 3% lead, and the tailings 1.8%, showing an extraction of about 40%. The concentrates assay from 15 to 16% lead. They are pumped back to the main mill, where they are treated on two Wilfley tables; the slime and middlings from these tables go to a vanner. Only a lead concentrate is made on the table and the vanner from this canvas-plant concentrate. It assays about 70% lead.

The manner of handling the concentrates is a nice one. The coarse concentrates from the jigs go to a settling box, and are scraped out of this box and up two long V-shaped launders, lined with a semicircular bottom of cast iron, by a Garland wire-rope conveyor. The latter has 7-in. cast-iron disks attached to the rope. The rope is ⅞ in. in diameter, and is made of six strands having 25 wires each, so that it will be highly flexible. This rope is run at a speed of 60 ft. per minute, by a gripping sprocket wheel that catches the lugs. This is a standard make of conveyor, put on the market by the Jeffrey company, and has been found highly satisfactory for handling the coarse concentrates. The upkeep of the conveyor is not over $150 per year, and it handles about 130 tons of concentrates per day. The power required is only 3 hp. for each conveyor, so the cost of handling the coarse concentrates is extremely low.

These conveyors feed the concentrates into one of two steel tanks, where what little water is left in the concentrates drains off at the top, and goes to the settling tanks that are used to dewater the table concentrates. The concentrates from the steel tanks contain about 5% moisture as loaded into railroad cars in which they are sent to the smeltery.

The table concentrates go to a series of settling tanks, the spigot products of which are elevated by centrifugal pumps to one of two large V-boxes, from which they are discharged by a chain scraper into the concentrate bin that is then receiving the concentrate. The overflow from these different concentrate settlers in the basement is pumped back into the mill circulation, and used as feed water on the tables.

Frue vanners and one Isbell vanner are used. The Isbell is liked much better than the older type, for the one which was in use at the time of my visit had given no trouble during the year it had been in operation. The only upkeep cost was that of lubrication. The belt on it had not been adjusted once in the year.

A total of 96 men on the three shifts is required in the operation of the whole plant. In milling 3600 tons per day, 7000 gal. of water are used per minute, or about 2 gal. per min. per ton of ore milled. Of this, 1500 gal. is new water added to the system. In the operation of the plant, 1500 hp. are used.

TAILINGS-BELT FEED

(Coarse Tailings Only)

+ 9 mm	1.0	1.00	0.010	1.5
+ 8	1.9	0.98	0.011	1.6
+ 7	5.8	0.91	0.058	8.8
+ 6	14.4	0.85	0.181	27.2
+ 4	34.2	0.50	0.171	25.7
+ 2	28.8	0.50	0.144	21.6
+ ¼	11.8	0.51	0.060	9.0
+ 80 mesh	1.4	1.00	0.014	2.1
+ 150	0.5	1.47	0.007	1.1
— 150	0.2	4.37	0.009	1.4
	100.0		0.665	100.0

Included in the Federal mill building is a testing plant where carload shipments from the different Guggenheim properties can be tested, under the direction of Mr. Guess. The Federal plant indirectly benefits from this testing work, for when any question of milling work comes up, there is a crew of men available to put on the working out of the problem; an advantage which is not possessed by the ordinary mill, where the mill men and the superintendent are generally too crowded with routine operations to engage in experimental work.

(To be concluded)

Shannon Copper Co.

The report of the Shannon Copper Co. for the first quarter of 1913 shows that 70,472 tons of ore from the Shannon group, and 13,208 tons from the company's outside properties were treated and produced 3,649,564 lb. copper, 724 oz. gold and 33,695 oz. silver. The cost of copper per pound was 12.856c. in January; 13.809c. in February and 12.699c. in March.

The average price received was 15.354c. per lb. Net profit for the three months was $75,847. The railway earned $5956 over bond interest. Actual cash and copper on hand Mar. 31, amounted to $248,482.

The Kedabeg Copper-Smelting Works

SYNOPSIS—Description of a profitable smelting plant in the Caucasus, handling low-grade ore. Ore is hand-sorted, producing a grade above 5% Cu, which is smelted and a grade about 3% Cu, which is leached. Ore for leaching is roasted sometimes two or three months and leached for from 10 to to 12 years. Precipitation is on iron shavings.

The Kedabeg Copper Works is the property of Siemens Bros., and is situated 46 miles southwest of Yelisavetpol, a station of the Transcaucasian railroad in the Little Caucasus Mountains, about 4490 ft. above the level of the Black Sea. The mine belonging to the works is situated on the cone-shaped Mis-Dag (copper hill), one mile distant. The ore occurs in numerous disconnected bodies and is composed of chalcopyrite, iron pyrite and pyrrhotite frequently intermixed with sphalerite. The ore is mined through tunnels. It is roughly sorted underground and dressed by hand on the surface where two classes are made; rich ore, with more than 5% Cu, and that with less than 5% Cu, called poor ore. The annual output of the mine averages about 50,000 tons. Reduction is performed both by the dry and wet methods, the rich ores being subjected to the first, while the poor ores, averaging about 3% Cu, are treated by wet process.

Ore Is Hand Sorted and Screened

At the ore station of the smelting works, at the foot of the Mis-Dag, the ore is sorted by hand into rich ore, poor ore and waste, and both classes of ore are divided into coarse and fine. The fine portion of the rich ore is still further separated, by means of bumping screens, into screening (under ½ in. diameter) and ore of nut size.

The sorting is performed by boys who have to look especially to the removal of barite and sphalerite which would be detrimental to the subsequent smelting process. The quantity of coarse ore is estimated at 40% of the total, that of the fine about the same and that of nut size, at 20%. As fuel, wood and charcoal (both from deciduous trees), anthracite from the Don country and crude naphtha are used. Wood and charcoal are hauled 19 miles to the smelting works on a narrow-gage railroad from a leased forest which furnishes about 85,000 cu.m. of timber annually. The locomotives are of 50 to 60 hp. and draw four or five cars of 6.5 tons each. One pood (36.11 lb.) of anthracite, hauled by ox-team, costs on an average of 41 kopecks (22.5c.), and 1 pood of charcoal, 24 kopecks (13.2c.). Since 1 pood anthracite corresponds in calorific value to 2 poods of charcoal, the difference in cost of each fuel is not of great moment. The transportation of crude naphtha, of which 20,000 tons annually are consumed, is effected from a station called Dolljar on the Transcaucasian railroad by a pipe line 28 miles long. About halfway, near the village of Tscherdachly, at a height of 4149 ft. above the level of the Black Sea, there is an intermediate station. At Dolljar station where the naphtha arrives in tank cars, as well as at Tscherdachly, there are two steam pumps in operation. The first part of the pipe line consists of seamless steel pipe tested for a pressure of 300 atmospheres; the actual pressure is in summer 100 to 115 atmospheres, in winter about 120 atmospheres. The second part consists of welded wrought-iron pipe tested for 120 atmospheres pressure. The actual pressure obtaining in the pipe is about 40 atmospheres. To protect the pipe line against the influence of temperature, expansion joints, bent similar to a figure 8, are inserted at intervals. The pipe line raises the cost per pood of naphtha only by 1.5 to 2 kopecks. The naphtha is used in roasting and smelting the ores, in refining the copper and for steam generation. All materials needed about the smelting works are made on the ground in the shops of the company. There is a plant for making firebrick which is burned by naphtha, two stamp mills for crushing quartz and other fire-resisting material, a brick yard with a wood-fired kiln that holds 80,000 bricks and a modern machine shop.

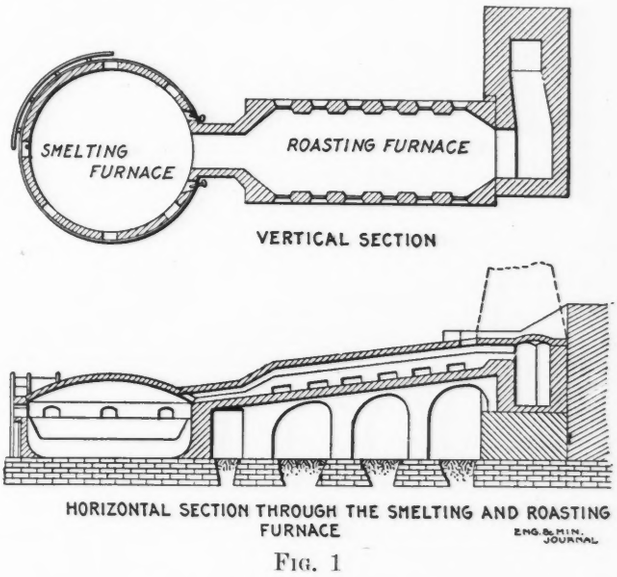


Fig. 1

Method of Roasting Depends on Physical Character

The ore is roasted in three different ways, according to the size of the material. Lump ore is roasted in kilns and after that, twice in heaps on a bed of wood. Each of the eight kilns has a cross-section of 7 ft. by 7 ft. 1 in. and a height of 10 ft. 5 in. They are operated without intermission and need fuel only when starting. In 24 hr., up to 15 tons of ore are put through, yielding about 10 tons of well roasted product and about five tons incompletely roasted. The latter is added again to the crude ore. The roast contains about 8% S and is piled on wood soaked in naphtha in heaps of 80 to 115 tons. The roasting operation takes about three weeks. Hence there are required from seven to eight weeks for two fires. After the second fire the ore still contains from 5 to 6% S.

The nut-size ore is roasted in a long-hearth furnace which is placed between the smelting hearth and the chimney, as shown in Fig. 1. The temperature of this furnace, which is provided with an inclined floor and is heated by the waste gases of the smelting hearth, is high, so that only the part nearest the chimney can be used for roasting purposes. The ore is charged through an

Note—Translated by O. H. Hahn from the article by Golwatschew and Lange, in "Glückauf," May 10, 1913.

opening in the roof near the end of the furnace and is rabbled by hand, being moved to the hotter part of the furnace and discharged through the lower working doors. The labor required per 24 hr. is four men; the yield of roasted product in the same time is from 8 to 13 tons. If the temperature is too high so that there is danger of sintering, a small quantity of slightly roasted ore is added. The roasting of the fine ore is performed in Gerstenhöfer furnaces which have a cross-section of 7 ft. 4 in. by 1 ft. 9 in. and are 24 ft. 5 in. high from the furnace bottom to the arch. In the arch there are four charge-holes operated mechanically, under which 14 rows of bearers, made of brick, are arranged. One row contains 10 bearers, 7 in. in width. Under the bearers of the furnace front there are two heating arrangements using naphtha. The works contain 14 furnaces of this type arranged in pairs and provided with dust-chambers. The yield of a furnace per 24 hr. amounts to 11 tons of fine ore and the consumption of naphtha to 573 lb. The roasted ore retains on the average 3% S. The flue dust from the chambers assays up to 5% Cu, which is principally in the form of sulphate and is consigned to the copper-leaching plant. At each furnace two men are employed per shift.

Roasted Ore Smelted in Reverberatory Furnaces

Smelting of the roasted ore is performed in circular reverberatory furnaces, designed by F. Siemens, with naphtha as a fuel. There are eight of these furnaces like that shown in Fig. 1. The interior diameter of a furnace is 19 ft. 7 in., the depth of the hearth 25 in., the distance from the arch to the level of the supporting wall 33½ in. and the entire height of the arch above the floor of the hearth 6 ft. 3 in. The walls of the furnace are constructed of firebrick and are 14 in. thick at the charge doors. At a height of 5 ft. above the furnace floor there is a cast-iron ring resting in part on the walls of the furnace and in part on iron bearers, which serves as a base for the firebrick arch. The floor of the hearth is tamped with crushed quartz. On the outside, the furnace is encased in iron plates which are held in place by rails. The latter stand with their lower ends in the foundation of the furnace while the upper ends are held by a broad steel band.

Furnace Fired with Naphtha Burners

The furnace has seven working openings closed by doors and is heated with naphtha by means of two burners, arranged one at each side of the flue. The construction of the burners, called "Foresunken," reminds one of the gas burners used in laboratories with compressed air. The burner, which is made of phosphor-bronze, has an annular opening and rests in a cylindrical tuyere through which compressed air is blown. The naphtha enters the burner under ordinary pressure and is atomized by steam coming out of a small central pipe under a pressure of 4 or 5 atmospheres. The combustion of the naphtha is almost perfect at a distance of one foot. The axes of the two burners converge at an angle of 60°. Originally burners were applied without using blast, but the temperature attained thus was insufficient, especially for ores already pretty well desulphurized. The consumption of naphtha depends upon the degree of roasting and amounts to from 20 to 25% of the weight of the ore. The smelting mixture for a furnace is composed of 1000 kg. lump ore, 500 kg. nut-sized ore, 1000 kg. screenings and 200 kg. flux. As a flux, an igneous rock with high silica content, called trachyte, which is found in the vicinity, is used. If the slag should be rich in Cu, 150 to 250 kg. of basic slag from black-copper smelting is added. The working method is as follows: At equal intervals during 48 hours, 20 charges are placed into the hot furnace. After the last charge has been melted, the slag is skimmed and during the next 24 hours, 10 more charges are put in. After the slag has been skimmed again, copper matte is tapped. Matte and slag are run into two separate sand beds of 27 ft. 10 in. length by 10 to 13 ft. width. If, after drawing off the molten masses, congealed crusts of iron should form, which is frequently the case with too-well roasted ores, slightly roasted rich ore or unroasted copper matte is added. At the smelting furnaces, one foreman and five helpers are employed on contract in each 12-hr. shift. A furnace campaign lasts one year or more. The copper matte contains 35 to 45% Cu. A single tapping yields 12 tons on an average. Matte with more than 45% Cu is not desirable, because then the copper content of the slag will rise. The slag contains 0.4 to 0.6% Cu and is composed as follows: SiO_2, 23.87%; FeO, 50.52; Al_2O_3, 0.27; CaO, 5.02; MgO, 0.78; ZnO, 1.50; Cu_2O, 0.58; As, 0.12; $BaSO_4$, 16.15; S, 1.13%; total, 99.94%. If the slag should contain more than 30% SiO_2, it is

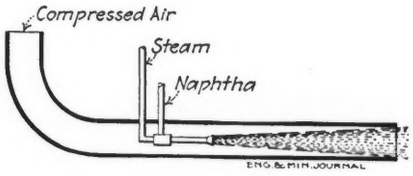


Fig. 2. Naphtha Burner

used as a flux in smelting for black copper; ordinarily it is used for building purposes and for ballasting roads. The excess goes over the dump.

Copper Matte Roasted Like Lump Ore

The copper matte broken to small size is roasted in the same manner as lump ore, viz., once in kilns and twice in heaps, on a bed of wood. The yield of one of the seven kilns amounts to five tons of well roasted and 2.5 tons poorly roasted copper matte in 24 hr. The poorly roasted matte is roasted again in the same kiln as the raw matte. The large amount of poorly roasted matte might be considered a detriment if it were not for the fact that its addition to the crude matte is necessary to prevent sintering of the latter. The roasted copper matte contains 8 to 10% S and is burned in heaps of 200 to 250 tons. A heap will burn about two weeks.

Black Copper Melted in Cupolas

The smelting for black copper is performed in cupolas or shaft furnaces of trapezoidal section, 11 ft. 6 in. high. The length of the back wall is 3 ft. 5 in., that of the forewall 2 ft. 7 in. and the distance between the two 3 ft. 11 in. The furnace has four tuyeres which are placed in the back wall 2 ft. 3½ in. above the bottom of the furnace. The latter is tamped with ground quartz and the walls are lined with firebrick. The arrangement of the hearth is peculiar. A forehearth which is filled once in 24 hr. by tapping the copper, communicates with the interior hearth by a slot about 20 in. high by 2¾ in. wide. During the smelting, the forehearth as well as the

slot is closed with a mixture of red clay and powdered charcoal, leaving only a small hole in the latter for tapping the slag from the interior hearth when it is full. Previous to tapping the metal, the hole in the slot is closed and an excavation of about 16 in. in diameter is scooped out to the depth of the furnace bottom. After that the composition in the slot is broken out altogether.

There are four cupolas in the plant which make campaigns of a year or more. The smelting mixture is made up as shown in the accompanying table.

SMELTING MIXTURE

	Kg.	%
Roasted copper matte	8,350	56.7
Slag from refining copper	1,475	10.0
Foul cupola slag	3,275	22.2
Flux (trachyte)	1,640	11.1
Total	14,740	100.0

This is the task of one furnace in 24 hr. The trachyte may be replaced by slag from the smelting when it does not contain less than 30% SiO_2. Originally smelting

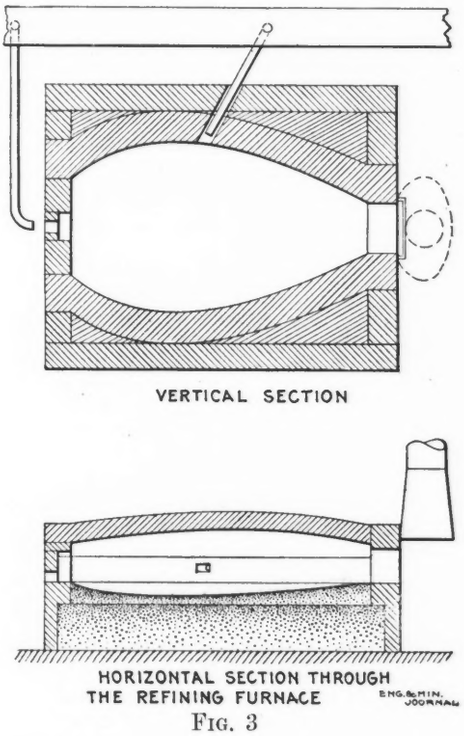


FIG. 3

for black copper was done with charcoal, by charging the smelting mixture and the coal in two separate perpendicular columns. On account of the high cost of charcoal, anthracite was substituted, whereby the consumption of fuel was reduced one-half. At the same time the number of tuyeres was reduced to three, the old style of half-conical tuyere was replaced by water-cooled conical ones and the charging was done in horizontal layers. By this method it was observed, however, that the black copper instead of coming out 93 to 94% fine in Cu, assayed only 88% fine. To remedy this evil, both kinds of fuel were mixed in suitable proportions to produce the best results. In the 12-hr. shift, three men are employed, working on contract. For generating blast, four different kinds of blowers are used.

COPPER CONTAINS MANY OTHER ELEMENTS

The furnace is tapped for metal once in 24 hr., yielding on an average 3300 kg. black copper. The latter is removed from the forehearth in cakes by means of hooks. The black copper has this composition: Cu, 93%; Fe, 2.50; Zn, 1.50; Ni + Co, 0.05; As + Sn, 1.70; Pb, 0.75; Sb + Bi, traces; Ag, 0.08; Au, 0.0049%. In all probability it also contains sulphur which has, however, not been determined. As the roasted copper matte contains from 1.5 to 2% of sulphur, there is also a matte with 50 to 60% Cu formed aside from the black copper. With the furnace in good condition it should not exceed 3 to 4% of the weight of the copper matte charged; however, frequently as much as 10 to 15% is obtained. This matte differs from the black copper by the absence of precious metals and by a smaller amount of undesirable admixtures. It is roasted along with the ordinary copper matte and resmelted. The resulting slag contains on an average 0.6% Cu. Its exact composition is as follows: SiO_2, 22.86%; FeO, 23; CaO, 1.34; Al_2O_3, 3.2; MgO, 1.4; As + Sb, 0.2; ZnO, 4.81; S, 1.59; $BaSO_4$, 0.3%.

Refining of the copper is carried out in reverberatory furnaces, of the type shown in Fig. 3. The arch and the walls of the furnace proper are constructed of firebrick; the thickness of the roof is one brick and that of the walls 1½ bricks. The hearth is tamped in its lower part, the upper part, cut out basin-shaped, is filled in with a grouting of finely crushed and washed quartz and 14% fire clay. The opening for charging the black copper is at the small end of the furnace below the chimney. At the opposite side there is the opening for skimming through which also the blast is admitted. The furnace is heated with naphtha, using the burner previously described. In this case the atomizing of the naphtha is not effected by steam, but by air under a pressure of 1¼ in. mercury. The consumption of naphtha in 24 hr. is 1310 kg. The burner is placed in one of the long walls at an angle of 60° toward the axis of the furnace. The two furnaces are placed so that the discharge openings are directly opposite one another. In 24 hr., 2450 kg. black copper are inserted from two to three times. The refining process consists in melting down, blowing, oxidizing, poling, blowing again, and poling tough. The slag is drawn three times or more. The first slag drawn after melting down contains about 12% Cu, while the one skimmed last shows Cu as high as 70%. The labor required is one foreman, one overseer, and five laborers who are, however, required only when charging and discharging the furnace. The refined copper is cast in bars of 8 and 16 kg. The yield is 80 to 83% of the black copper charged. The composition of the refined copper is the following: Ag + Au, 0.09%; Cu, 99.57; Pb, 0.027; As, 0.038; Sb, 0.06; Ni + Co, 0.031; Fe, 0.009; O, 0.089; Bi + S, trace; total, 99.91%. From one charge about 650 kg. refinery slag with 35 to 50% Cu is obtained. It is resmelted with the roasted copper matte for black copper.

WET-TREATED ORES AVERAGE 3% CU

Ores assaying less than 4% Cu are treated by wet process. On an average they assay only 3%. They are first roasted to form sulphates and oxides and to loosen the whole mass. It has been mentioned already that the Kedabeg ores furnish much fine material and it is especially the poor ores which crumble up as soon as the air acts upon them for any length of time because they contain much pyrite and pyrrhotite. If such an ore is roasted and water poured upon it, it falls by itself into pieces from

pea size down to fine sand. This property of the ores is of great commercial importance, for the cost of crushing it by machinery might be the factor which would make impossible the profitable treatment of 3% ore.

Heaps Roasted 2½ to 3 Months

The poor copper ores are separated on bumping screens into an oversize (30 to 40%) and undersize. Formerly the oversize ores were first roasted in kilns and afterward in heaps. This practice was, however, discontinued because it was found more economical to roast in heaps, as the slow burning and the longer action of the heat favors that formation of sulphates. The coarse ores are now burned only once in heaps of 100 to 165 tons. As soon as the heap is on fire, it is covered over with crude fine ore in order to prolong the time of roasting, which takes from 2½ to 3 months. The heap is then soaked with water or mother liquor for several days whereby the lumps break up to powder. The liquor running off contains now considerable quantities of Cu as sulphate and is, therefore, subjected to precipitation (also called cementation). The heap itself is shoveled over, exposed to the action of the atmosphere for some time and then conveyed to the leaching yard.

The undersize is roasted in Gerstenhöfer furnaces. Their smaller consumption of naphtha (359 lb. in 24 hr.) is due to the fact that in this roasting the desulphurization is not required to be so close as for the reduction by the dry way. The roasted fine ore retains about 8 to 10% S. Water or mother liquor is poured over the ore while still hot.

Ore Leached in Heaps

The roasted ores so prepared are now shoveled up into a large heap holding 1000 to 160 tons on a plane having an inclination of 5° to 8° and exposed to atmospheric action and that of the mother liquor which contains considerable quantities of sulphates of iron. The oxides and the sulphides of copper and iron in the ore are gradually converted into sulphates which go into solution. To allow the air to penetrate the interior of the heap, channels made of loosely built-up slag bricks are provided in it before the ore is piled on. Perpendicular channels are carried up to the surface from the points of crossing of the horizontal ones. The floors of the roast heaps were formerly made of asphalt which soon proved to be unsatisfactory; they are now made by simple tamping. Through the action of the hydrated oxide of iron and the basic iron salts of the mother liquor, the floors become firm, smooth and impermeable in a short time. On the surface of the heaps which form frustums of pyramids 6 to 10 ft. high, shallow basins are scooped out which are filled by means of movable launders, at first with mother liquor, then with liquors of less strength. This operation is only carried on in the warm season from the middle of March to the middle of November. After the lapse of a year the heap is shoveled over at the beginning of winter in such a way that the upper layers of the old pile will form the center of the new one. The progress of leaching is watched by analyzing the liquor running off from time to time. On an average, the process is finished at the expiration of 10 or 12 years. A large portion of the Cu, about ⅓ of the total, is leached out in the first year. The exhausted heaps, which still contain 0.7 to 0.9% Cu, are conveyed to the waste dump. Rains of short duration will not harm the process; the liquor running off will show even a higher copper content because the rain leaches also the sides of the heap which are exposed more to the air, but are less touched by the liquor. Rains of long duration which are of rare occurrence at Kedabeg, would, of course, greatly impair the work.

In order to hasten the decomposition of the copper sulphide and also with a view to obtaining a higher yield of copper, experiments were made using an SO_2 solution, made from the waste gases of the Gerstenhöfer furnaces, instead of the regular liquor. But the solution proved to be too weak for successful work. After that, experiments were made roasting the ores with 10 to 12% of sea salt in the Gerstenhöfer furnace and leaching them with an aqueous solution of the waste gases. The results were excellent, but the method proved to be too expensive on account of the high price of the salt. Therefore, it had to be abandoned.

Copper Precipitated on Iron Shavings

The liquor running off from the heaps is conducted by a canal to a reservoir of 60 to 70 cu.ft. capacity in which particles of ore carried off mechanically will settle. From here the solution is run into tanks divided into four compartments which communicate with each other, as shown in Fig. 4. They are filled with iron shavings. After passing two or three of these tanks, the liquor leaves the

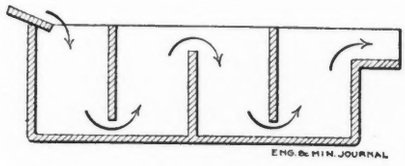


Fig. 4. Precipitation Box

last one barren. The barren liquor of several precipitation tanks is collected in a pit and by means of a pump and wooden launders distributed over the roast heaps again. The precipitate adhering to the iron shavings is washed in the trough over a 16-mesh screen. After the copper has settled, the liquor is drained off and the washing is repeated over a 64-mesh screen. The copper sinks to the bottom of the trough while the iron shavings remain on the screen. The washed precipitate contains 60 to 70% pure Cu and is melted at once without drying. Its principal impurities are the hydrates of iron and their basic insoluble salts. The consumption of iron shavings amounts to ¾ kg. for 1 kg. Cu precipitate. Aside from the copper precipitate from the roasted ores, the plant recovers in the same manner about 100 to 130 tons of copper precipitate from the cupriferous mine water.

One Charge Melted per Day

Refining is done in the same furnace used for black-copper melting. The charge amounts to about three tons of raw precipitate, two tons of which are charged in the beginning. After the charge is melted, a quantity of slag is skimmed off and the remaining one ton is charged. Prior to charging, about 5 or 6% pulverized anthracite is added to the precipitate in order to reduce any Cu_2O. The further manipulations are the same as in the refining of black copper. Since the melting of the fine precipitate proceeds very slowly, only one charge is worked to a finish in the 24 hr. The precipitate is always refined by itself

without any black copper and the yield is about 45% of pure copper on the charge. The products of the operation are the same as with black copper, only more refinery slag is produced, which contains on an average 25% Cu. The slag from the first and second melting of the copper precipitate is poor, the copper content varying between 5 and 10%. This is added to the ore charge in smelting. The content in precious metals of the copper from the precipitate is lower than that from the black copper refining.

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Brakpan Mines

The report of the Brakpan Mines for 1912 shows that 637,523 tons were milled for a recovery of 31s. 1d. per ton, working costs being 17s. 3.9d. per ton. The total working profit was £444,117; 17,348 ft. of development work was done, of this 12,619 ft. were on reef which averaged 9.36 dwt. over 37.67 in. The ore reserves are estimated at 2,457,000 tons of a value of 6.74 dwt., with a stoping width of 58 in. The unpayable ore developed to date is 1,806,000 tons, valued at 2.27 dwt., or 34%; 23 claims out of 1150 have been exhausted to date; 57% of the tonnage milled was broken by large machines, 34% by small 2½- to 2¾-in. machines, and 9% came from development rock. The stamp duty from 160 stamps and eight tubes was 13.74 tons. The recovery was 95.2%. This mine is working at a depth of between 3000 and 4000 ft. from two seven-compartment shafts and mining a reef dipping 7 to 15°. Working conditions are trying in the deeper areas owing to heat and humidity. Details of costs are as follows:

Stoping	4 s. 7.6 d.
Timbering and packing	1 s. 0.8 d.
Handling dump rock	0.25 d.
Shoveling in stopes and tramming	2 s. 8.8 d.
Undergrcund transport	5.8 d.
Surface transport	0.6 d.
Winding	10.25 d.
Pumping	8.01 d.
Other costs	8.37 d.
Development	1 s. 6.00 d.
Sorting and crushing	4.58 d.
Stamping	10.36 d.
Tube milling	8.48 d.
Sand	8.14 d.
Slime	7.04 d.
Recovery charge	4.66 d.
Miscellaneous	1 s. 0.16 d.
Total	17 s. 3.9 d

It will be noted that reduction costs are low, 3s. 7.25d. per ton. This is partly due to the use of Butters filters and an excellent conveyor of tailings.

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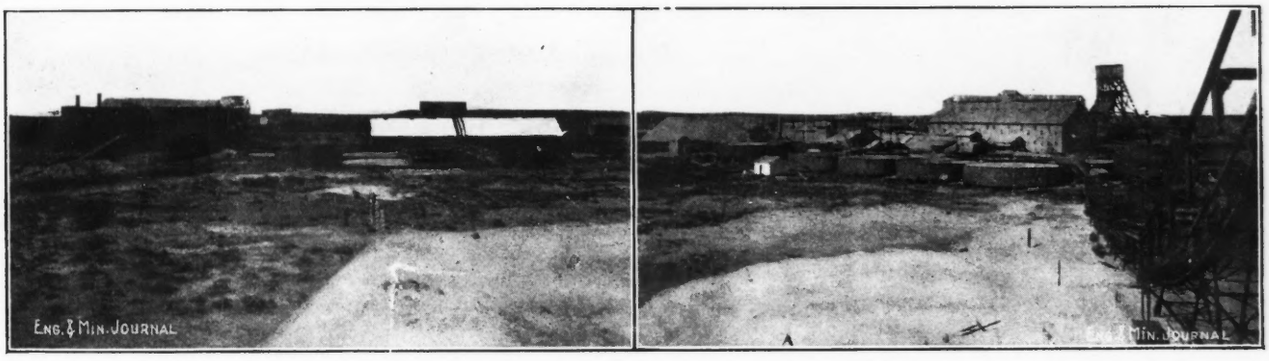
The Mineral Resources of Barbados are reported on by Consul Chester W. Martin. The report, with maps, will be loaned by the Bureau of Foreign and Domestic Commerce, and deals chiefly with manjak and oil prospects.

North Butte Mining Company

The production of the North Butte Mining Co., for the year ended Dec. 31, 1912, as shown by the official report, was 425,248 tons of ore and 49 tons of precipitates, from which 26,480,123 lb. of copper, 1,377,468 oz. of silver and 1367 oz. of gold were obtained. In 1912, four dividends aggregating $697,000 were paid.

Development work for the year amounted to 18,140 ft. divided as follows: Shaft sinking, 868 ft.; crosscuts, 8508 ft.; drifts, 6882 ft.; raises, 1777 ft.; stations, 82 ft.; winzes, 23 ft. The Granite Mountain shaft is now 50 ft. below the 2200 station, and stations were cut upon the 1800 and 2000 levels and 7 ft. of the station was cut on the 2200 level. This work will be continued until connections have been made with the lowest level of the Speculator shaft.

The principal feature of development work, in addition to finding the eastern extension of the ore on the Snowball vein, was the discovery of a body of ore on the Edith May vein on the 2400 level comparable with the ore disclosed in this vein on the upper levels, thus giving promise that this vein has again resumed its position as one of the principal ore-producing veins. The ore reserves were largely increased during the year and stand at a higher figure than at any previous time in the history of the company. This ore in reserve is estimated to average 4.5% copper and 4.5 oz. silver per ton.



SHAFT AND MILL, BRAKPAN MINES, SOUTH AFRICA

The mine was in operation 342 days, the average number of men employed being 902½ and the average number of tons hoisted per day, 1270. All of the lower levels down to the 2800 were connected with the upper levels by raises and this, together with the system of ventilating fans in operation, has secured comfortable working conditions in practically all portions of the mine.

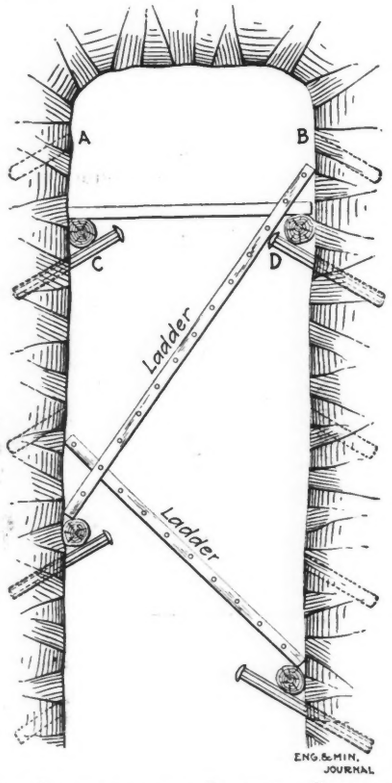
During the year electric haulage was installed on all of the levels of the mine below the 1600 and materially decreased the cost of handling material. The installation of a new Ingersoll-Rand air compressor with a capacity of 4000 cu.ft. of free air per min. was completed. It is the intention of the company to install a complete plant at the Granite Mountain shaft, including an electric hoist of sufficient capacity to operate to a depth of 5000 ft. The company acquired a three-quarter interest in the Sunset claim, which adjoins the John Emmit claim on the east, and also secured title by United States patent to the Henry claim, which adjoins the Leaf claim on the west.

DETAILS OF PRACTICAL MINING

Scaffolding in an Untimbered Raise

By Frank C. Rork*

The accompanying drawing shows a method of scaffolding applicable in driving an untimbered raise. The usual method is to cut a stull the right length and wedge it in; this is not an easy thing to do, working from a ladder, and more or less time is consumed in finding and cutting the timber, in measuring and in wedging the timber in place.



Raise Scaffold and Ladders Supported on Drill Steels

By the method here illustrated, when the round is finished, four holes are drilled, two at *A* and two at *B*, near the corners of the raise. The depth of these holes should be about 10 in., depending on the nature of the rock. They should be placed the height of one cut above *C* and *D* and will then be in the proper position to hold the scaffold after the round is fired.

The scaffold can be quickly erected on two stulls, resting on four pieces of steel inserted in the holes. As the raise progresses, the lower holes can be used to secure the ladders in the manner illustrated.

The shallow holes can be drilled rapidly and easily with all the equipment at hand and the drill steel consumed would probably be lost or wasted if not thus utilized.

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

Safety Rules—Conveyances in the Shaft*

(1) The hoisting or lowering of men through a vertical shaft should be permitted only in an iron-bonneted safety cage, except in shafts in process of sinking or repair.

(2) All man cages should be constructed as follows: There should be a bonnet of steel plate $\frac{3}{16}$ in. thick, sloping toward each side and so arranged that it may be readily pushed upward to afford egress from the cage to persons therein; it should cover the cage so as to protect those on the cage from objects falling in the shaft; there should be a sheet-iron or steel side-casing, not less than $\frac{1}{8}$ in. thick, or a netting composed of wire not less than $\frac{1}{8}$ in. in diameter; there should be doors made of suitable material which shall extend at least 5 ft. above the bottom of the cage and should be closed when lowering or hoisting men, except timbermen riding on the cage to attend to timbers thereon; there should be overhead bars of such arrangement as to give every man on the cage an easy and secure handhold; there should be a safety catch of sufficient strength to hold the cage or skip with its maximum load at any point in the shaft in the event that the hoisting cable should break.

(3) Safety catches should be kept well oiled and in good working condition.

(4) Cages should be inspected daily by some competent person appointed by the superintendent and the safety catches should be tested once each month.

(5) Where hoisting of men is done by skips or cages from two or more levels, a man should be employed to have charge of the loading and unloading of such cage or skip and to give all signals to the hoisting engineer.

(6) No open hook should be used with a bucket in hoisting. Safety hooks, with opening between point and shank closed, should be employed.

(7) All shafts from which hoisting is done by means of a bucket should be provided with suitable guides, put in accurately to gage, by a template made for the special purpose and always kept on hand.

(8) The bucket should be equipped with a crosshead to travel upon guides. The height of the crosshead should be at least two-thirds of its width. If it be a type not secured to the hoisting rope, a stopper should be securely and rigidly fastened to the hoisting rope at least 7 ft. above the rim of the bucket. It should have a clearance at right angles to the wide face of the runners not less than 1 in., nor greater than $1\frac{1}{2}$ in., and in the other direction not less than $\frac{1}{2}$ in. nor greater than $\frac{3}{4}$ inch.

(9) Riding on skips and on top of cages should be strictly prohibited, except when absolutely necessary and in emergency cases.

(10) No person should get off or on the bucket or cage while it is in motion.

*From Inland Steel Co.'s book of rules.

(11) No person should ride upon any cage, skip or bucket loaded with tools, timber, powder or other material, except for the purpose of assisting in passing such material through the shaft and then only after a special signal has been given.

(12) When tools, timber and other materials are to be lowered or hoisted, their ends, if projecting above the top of the conveyance, should be securely fastened to the hoisting ropes or to the upper part of the vehicle.

(13) In no case should a conveyance be lowered directly to the bottom of the shaft when men are working there, but it should be stopped at least 15 ft. above the bottom of the shaft until the signal to lower further has been given the hoisting engineer by one of the men at the bottom of the shaft, provided, however, that this rule shall not apply to shafts less than 50 ft. deep.

(14) When cleaning skip pits or doing other work immediately under skips or buckets, timbers should be placed across the shaft and the skip or bucket rested there while the work is being done and not removed until it is completed.

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Comparative Strengths of Blasting Explosives

In the course of its investigations of blasting explosives, the U. S. Bureau of Mines (*Bull.* 48) has made tests to determine the potential energy, the disruptive effect and the propulsive effect of some of the explosives in common use. The potential energy was measured by means of the bomb calorimeter in water. The disruptive effect was measured, using the Mettegang recorder, detonating fuse, Trauzl lead blocks and small lead blocks. The propulsive effect was measured in the Bichel pressure gage and by means of the ballistic pendulum. The tabulated results are given herewith, together with the approximate composition of typical examples of the various explosives. The percentages figured are rated against the effect of 40% straight nitroglycerin dynamite taken at 100 per cent.

The figures are fairly consistent with general practice, and it is believed that the classification will serve as a useful guide for comparing the practical value of explosives. It is worthy of note that the potential energy of 40% strength ammonia dynamite and of 40% strength gelatin dynamite, that is, the theoretical maximum work that these explosives can accomplish, is higher than that of 40% straight nitroglycerin dynamite, but that the disruptive and propulsive effects, which represent the useful work done as shown by actual tests, are less. Accordingly, straight nitroglycerin dynamite is more economical for general use in blasting operations if the conditions and character of the work are such as to permit its use; nevertheless, the ammonia dynamite and the gelatin dynamite are more efficient and economical for certain kinds of work that require explosives having a large propulsive effect and a comparatively small disruptive effect. For example, in blasting soft rock, 40% straight nitroglycerin dynamite, which has a very high percussive force, may be too quick in action, whereas the ammonia dynamite or the gelatin dynamite having practically the same heaving and pushing action and less percussive force will be more suitable. The tests also show that 60% strength low-freezing dynamite is not quite equivalent to the 40% straight nitroglycerin dynamite. It is worthy of note that black blasting powder has little disruptive effect, only about one-third that of granulated nitroglycerin powder.

TYPICAL ANALYSES AND STRENGTHS OF COMMON BLASTING EXPLOSIVES

	Percentage Composition									Percentage Strength		
	Nitro-glycerin	Combustible Material	$NaNO_3$	ZnO $CaCO_3$ $MgCO_3$	Nitro-substitution Compounds	NH_4NO_3	Nitro-cellulose	S	C	Potential Energy	Disruptive Effect	Propulsive Effect
Straight nitroglycerin dynamite, 30%	30	*a*17	52	1	..	..	..	..	..	93.1	84.1	96.8
Straight nitroglycerin dynamite, 40%	40	*b*15	44	1	..	..	..	..	..	100.0	100.0	100.0
Straight nitroglycerin dynamite, 50%	50	*b*14	35	1	..	..	..	..	..	111.0	109.2	107.4
Straight nitroglycerin dynamite, 60%	60	*b*16	23	1	..	..	..	..	..	104.0	119.8	114.9
Low-freezing dynamite, 40%	30	*b*15	44	1	10	..	..	..	..	....	....	....
Low-freezing dynamite, 60%	45	*b*16	23	1	15	..	..	..	..	60.2	93.5	91.2
Ammonia dynamite, 40%	22	*a*15	42	1	..	20	..	..	..	101.8	67.9	99.1
Gelatin dynamite, 40%	33	*a*13	52	1	..	..	1	..	..	105.7	78.4	95.8
Granulated nitroglycerin powder, 5%	5	*c*35	60	..	..	..	..	..	..	67.6	21.6	53.3
Black blasting powder	..	...	73	..	..	...	..	11	16	71.6	6.8	58.6

a Wood pulp, flour and sulphur.
b Wood pulp only.
c Sulphur, coal and resin.

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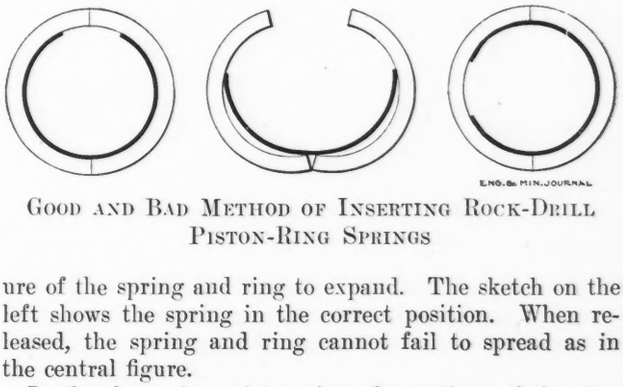
Inserting Rock-Drill Piston Rings

It is surprising how little care is generally exercised in placing the piston rings and springs in a rock drill. In many cases a ring and spring placed in an incorrect position will bring the same result as if no spring were included.

In the accompanying sketch, says J. R. McFarland, in *Mine and Quarry,* April, 1913, the spring on the right is shown in this incorrect position. The ring has the grip of a full half circle on the spring. This grip, when accompanied by sufficient adhesion, both results in the failure of the spring and ring to expand. The sketch on the left shows the spring in the correct position. When released, the spring and ring cannot fail to spread as in the central figure.



GOOD AND BAD METHOD OF INSERTING ROCK-DRILL PISTON-RING SPRINGS

In the three-piece piston ring, the sections of the ring are so small that no section can secure a sufficient grip on the spring to cause it to stick.

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Fifty-one men were killed in mining operations in St. Louis County, Minnesota, during the year ended June 30, 1912, according to the Minnesota Bureau of Labor, as quoted in an "Inland Steel Safety Bulletin." Of these 51 deaths, 19 occurred underground, and 32 in open pits. Of the underground deaths, 10 were due to falls of ground and cave-ins, two to blasting, two to haulage accidents, and two were attributed to skips and cages. It will be noticed that the proportion of deaths due to falls of ground, etc., is even larger than ordinary.

DETAILS OF METALLURGICAL PRACTICE

Williams' Amalgamation Process

A new metallurgical process has been devised by Sidney Williams, of San Francisco, Calif., for which he has been granted U. S. pat. No. 1,056,311. It is an attempt to provide a cheap and efficient process for extracting precious metals, such as gold, silver, platinum and others, by a variation of the well known amalgamation process. The novelty of the device consists in agitating the ground or pulverized material with a solution consisting of potassium sulphate and superphosphate dissolved in water. The potassium sulphate and superphosphate are mixed together in powdered or solid form, and the mixture is dissolved in a suitable quantity of water preparatory to mixing it with the ore. The superphosphate may be a single superphosphate containing substantially 18% of P_2O_5, or it may be a double superphosphate containing substantially 42% of P_2O_5. When single superphosphate is used, the ingredients are mixed in the proportion of one part of potassium sulphate and two parts of single superphosphate, and when the double superphosphate is used, the mixture is in a proportion of one part of potassium sulphate and one part of double superphosphate. These chemicals are mixed with the ore in the presence of mercury or amalgamated copper plates, the amalgamation proceeding with added rapidity on account of the efficiency of the solution in maintaining the mercury in a bright, active state, and of freeing the gold and increasing its affinity for the mercury.

Doubly Burned Dolomite for Furnace Work

The preparation of dolomite for use in furnace work by burning in a cupola and then in a rotary kiln is covered by U. S. pat. 1,063,102, issued to John E. Baker, of York, Penn. The material thus prepared is stated to be greatly shrunk, and to be free from unvolatilized carbon-dioxide, thus making it a much more desirable material than the singly burned dolomite for furnace work, and to be less easily hydrated, making it a more desirable material to store and ship.

Large Reinforced-Concrete Launder

By Claude T. Rice

A launder of reinforced concrete is used at the Baltic mill to carry away the overflow after dewatering the tailings for transportation on the belt conveyor. As the water is clear, it does not erode the concrete.

The launder is 36 in. wide and 18 in. deep, inside measurement, and is made in 16-ft. sections that are designed to carry a total load of five tons each. Its entire length is 400 ft. The joints are for taking care of expansion due to changes of temperature. They are filled with strips of wood ¼ in. wide, so as to be watertight. As in time the launder is to be buried by the tailings, it is covered with 2½-in. reinforced-concrete slabs.

The sections were cast in the mill building where sand was handy. Three sizes of material were used, consisting of three parts of ⅝-in. tailings from the jigs, three parts of ordinary mill tailings, running from ¼ in. to 10 mesh in size, one part of fine sand from the regrinders, and one part of cement. Strands of old hoisting cable were used for reinforcement and the cost of the launders was only about $0.75 per ft., while an iron pipe of equivalent capacity would have cost $2.40 per foot.

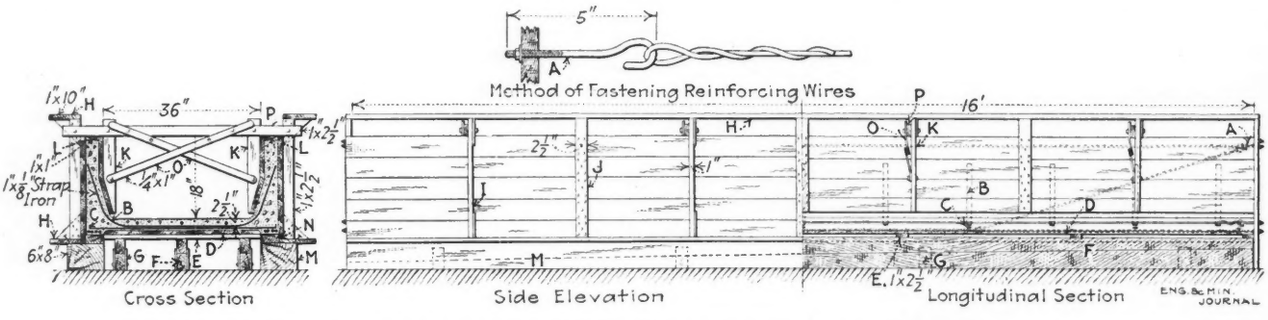

Fig. 1. Arrangement of Wood Forms for Concrete Launder

Sections of the launder (Fig. 1) show the method of reinforcing. The main longitudinal reinforcement consisted of ½-in. strands of rope, obtained by unlaying pieces of old 1¼-in. hoisting cable. Along the top, to take care of unusual tension that might result from handling during installing, a single strand was put in, while at the bottom of each side of the launder were two double strands. These were wrapped with wire about five feet from their ends, and two single strands, one for each pair, were taken up to the top of the side, while the other two were taken straight along to the end of the launder, thus caring for shearing stresses.

Before putting in the rope reinforcement, hooks *A*, Fig. 1, made of ⅜-in. rodding, threaded at one end, were fastened to the ends of each strand, the latter were heated to draw the temper, and the wires bent back and twisted around themselves so as to form loops to which the hooks could be fastened. The threaded ends of the

hooks were placed in auger holes through the ends of the forms with washers between the nuts and the wood, and the whole reinforcement tightened up so that the strands would sing when struck. In this way the stretch was taken out of the rope and with the reinforcement drawn tight, there was no danger of its being displaced during the pouring of the concrete.

To reinforce against shear between the sides and bottom of the launder, pieces of 1x⅛-in. strap iron *B* from the scrap pile, were put in at intervals of 18 in., running up both sides and across the bottom of the launder in continuous strips and to about every other one of these straps, to help reinforce the bottom of the launder, an extra piece *C* was added, running across the bottom only with a slight turn-up at each end for anchorage.

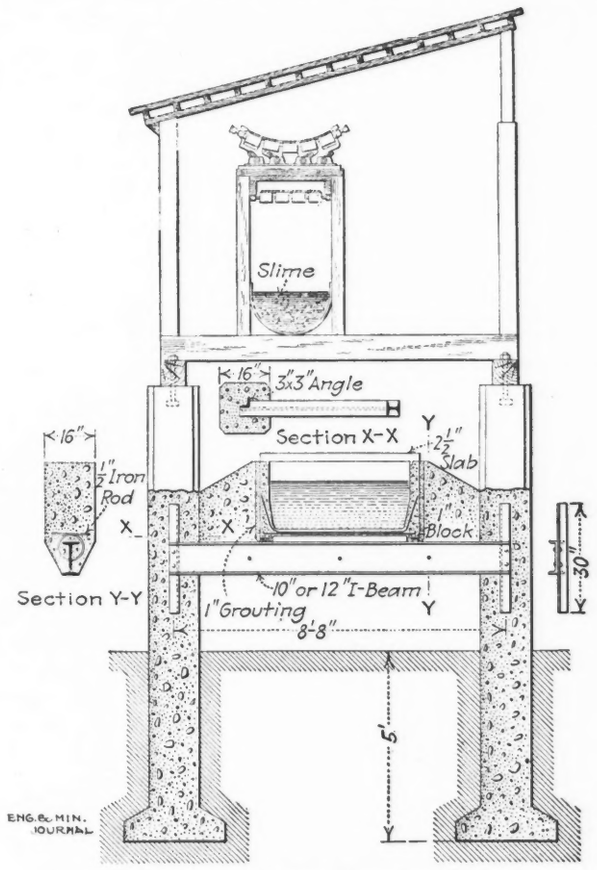

FIG. 2. SUPPORTING THE ERECTED LAUNDER

Longitudinal reinforcement of the bottom was obtained by three single ½-in. strands above the straps. The bottom was cast 2½ in. thick and the sides 3 in. increasing to about 5½ in. near the bottom; along the bottom of the sides there was carried a ridge 4 in. wide and 1 in. deep, on which the main weight of the launder rested when set in its supports. The top slabs for covering the launder were made in 4-ft. lengths, 2½ in. thick, reinforced with three single ½-in. strands running longitudinally and short pieces of the same rope running crosswise at intervals of about 2 ft. A 1x1-in. jog was made in the inside top corner of the sides for the slabs to rest in.

With the forms constructed as they were, it was possible to take the side forms off in 24 hr., and so only two sets of side-forms were necessary for making the 25 sections. However, it was not thought advisable to disturb the launders in the least until they had set some time, so about five bottom forms were required. These were simple panels and were not expensive.

The forms were built up from the floor of the mill as shown in Fig. 1. The bottom panel of 1-in planks *D*, held together by 1x2½-in. nailing strips *E*, about three feet apart, rested upon three wedges *F*, 16 ft. long, made by ripping diagonally a 2x10-in. hardwood plank. To keep the top wedge from slipping sidewise off the under one, three or four pairs of vertical cleats *G* were nailed to the sides of the under wedge to act as guides. To allow of these wedges being knocked out without disturbing the concrete, the sliding face between the two was greased. By removing the wedges, the panel was allowed to fall clear of the bottom of the launder.

There were two inside and two outside panels for the side forms. The outside panel was in the form of a channel, the vertical portion was built of 1-in. shiplap, cleated with 1x2½-in. pieces at 1½-ft. centers, nailed alternately with the 1-in. side *I*, and the 2½-in. side *J* against the panel; the top and bottom flanges *H* were of 1x10-in. shiplap fastened by triangular pieces to alternate cleats. The inside panels of the 1-in. shiplap had similar alternating stiffeners *K* and nailing strips but no flanges, since 1x2½-in. cross braces *P* connected each set of stiffeners of the four panels, being bolted to them. Along the inside face of the inside panel was nailed a 1x1-in. strip *L*, to form the recess for the top slabs. The forms were made as light as possible so that they could be put in place by one man, although to remove the sides at the end of 24 hours, it was thought wiser to use two men.

The outside panels were set on 6x8-in. timbers *M*, on top of which 2x4-in. pieces *N* were laid inside the side panels, to form the bottom of the ridge along the bottom of the launder. By means of the wedges, the height of the bottom panel was regulated so that the tops of the planks were just an inch higher than the tops of these 2x4-in. pieces. After the bottom forms were properly adjusted, the outside panels were secured against spreading by toe-nailing them to the 6x8-in. pieces, the nails being driven only part way so that they could be pulled without disturbing the concrete.

The spreading of the inside forms was prevented by braces of ¼x1-in. iron *O* bolted to the stiffeners of the inside panels at their bottom ends and to the cross-braces above. At their upper ends were two holes; with the bolts in the upper of these, the side panels were in their proper place; when it came time to lift off the side forms, the upper bolts were taken out, the inside panels swung in and the bolts put in the lower of the top holes, thus preventing the side panels from swinging and possibly battering the sides of the launder while being lifted off. It took about ¾ hr. to pour one section.

The completed launder was carried by the columns of reinforced concrete that supported the conveyor house. These were spaced at 16-ft. intervals, and were 16x16 in. in section, their corners slightly beveled, as shown in Fig. 2. They were reinforced with a ½-in. strand of wire rope in each corner, and rested on a concrete pedestal buried about five feet in the ground. These columns were from about 7 to 24 ft. high above the ground.

The cross-saddles for carrying the launders were put in to grade, allowing an inch in height for lining in.

These saddles were built up from a 10- or a 12-in. I-beam, according to what could be found in the scrap pile. The beams were anchored in the column by riveting to 3-in. angles set vertically in the column, the flanges on one side of the beam being sawed away to allow the web to lie flat against the angle as shown. The conveyor house was 10 ft. wide and the distance between post centers, 8½ ft. A good deal of concrete was therefore necessary to fill in between the posts on top of the beam so as to grip the launders. About 2 in. of side play was allowed for. This filling of concrete was made to flare from the bottom of the I-beam so as to attain a width of 16 in., and was carried high enough to come even with the top of the covering slab. In order to anchor this concrete securely to the I-beam, three holes were bored through the beam and through each of these was threaded a ½-in. rod bent into the shape shown in the cross-section of the saddle. The sections were butted against one another in the saddle and set to grade by means of level pieces. Then a grouting of one part of cement to one part sand was poured in around them, securely binding them to the supports. This concrete launder was devised by W. H. Schacht, assistant manager of the Champion Copper Co., at that time in charge of the Baltic mill.

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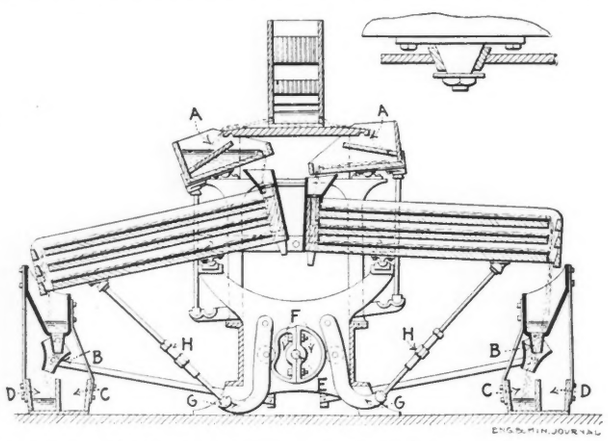
Wilfley Tilting Concentrator

A new multiple-deck tilting concentrator has been invented by Arthur R. Wilfley (U. S. pat. 1,056,388). The cross-section shows the general arrangement. The concentrating operation is intermittent and the two halves, consisting of three decks each, alternate in their sequence of operations. The feed launder *A* discharges on its section of the table while the latter is in a horizontal or slightly inclined position, shown in the right half of the drawing. The table is then tilted somewhat and the wash water admitted to dress the material deposited on the decks, the launder meanwhile having been tilted backward so as to shut off the pulp feed. During this period, the tailings are discharged through the spout *B* to the launder *C*. When the washing is completed, the deck is inclined more steeply to the position shown in the left half of the operation and the accumulated concentrates are washed off through the spout *B*, which has been swung to discharge into the launder *D*. When cleaned, the decks resume their original position and the cycle is repeated.



Multiple-Deck Intermittent Tilting Concentrator

The shaft *E* and the cam *F*, connected to the decks through the lever arms *G* and the rods *H*, accomplish the various motions. Similar devices regulate the tilting of the feed launders *A* and the swinging of the spouts *B*. The shaft *E* is given an extremely slow motion by means of successive reductions.

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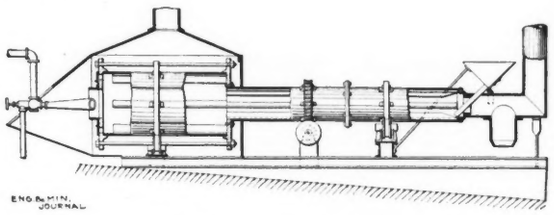
Magnetic Separation of Zinc and Iron, Campbell Process

Magnetic concentration is applied to the separation of pyrite or pyritiferous minerals from other nonmagnetic metals or mixtures, so that iron and iron pyrites may be separated from zinc and copper minerals. All iron-sulphide compounds may be so treated as to acquire magnetic properties. The Campbell process consists in roasting non-magnetic pyrite to a magnetic-iron product. The roasting process is brief and is performed in such a way as to prohibit, as far as possible, the entrance of air or oxygen into the ore mixture, by this means avoiding oxidation of the mineral and consequent loss of some of its constituents.



Roasting Furnace for Iron Ores

The improved furnace used in the Campbell process, a type invented and patented by J. B. Etherington, is shown in the accompanying illustration, and consists essentially of a cylindrical furnace proper, connected to an additional extension of tubular shape, ending at a stack or flue. The material to be put into magnetic condition is introduced near the end of the tubular extension in the vicinity of the flue. In its progress down the tube, the material is dried and warmed so that on its entrance into the larger cylinder comprising the furnace proper, the completion of the process requires only a few minutes. The roasting cylinder is covered, as shown, by a hood which serves to exclude the air, only sufficient being admitted to support the combustion in the oil burner.

Oxidation is objectionable in the process because it results in the volatilization of the zinc and sulphur and consequent loss of these elements. Preservation of sulphur in the ore increases the commercial value of both zinc and iron sulphides after their separation.

A point of importance is the evenness of the roast given the material. If each particle is acted upon in the same way and to the same extent, less roasting will be required, a superficial transformation being enough to magnetize the particle sufficiently for separation purposes, and at the same time a clean separation is secured, much more so than in cases where higher heat is used and only a part of the material effectively acted upon.

The Campbell process, which is said satisfactorily to accomplish these desired results, is in operation at Cuba City, Wis., where a 75-ton plant is in commission, and also at the plant of the Linden Zinc Co., at Linden, Wisconsin.

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22,544—ACCOUNTING—Auditing Mine Accounts. J. Bowie Wilson. (Min. and Eng. Rev., Mar. 5, 1913; 1¼ pp.) 40c.

22,545—BELGIAN CONGO—Mining in the Belgian Congo in 1912. Sydney H. Ball. (Min. and Sci. Press, Apr. 19, 1913; 6 pp., illus.) 20c.

22,546—BELGIUM—Belgiens Berg- und Hüttenwerksproduktion im Jahre 1911. (Oest. Zeit. f. B. u. H., Apr. 5, 1913; 1¼ pp.) 40c.

22,547—BLASTING—Analysis of Fumes from Firing-Sticks ("Chisa" Sticks.) J. Moir. (Journ. Chem., Met. and Min. Soc. of South Africa, Dec., 1912; 1¾ pp.) 60c.

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22,554 — COMPRESSED AIR — Utilisation des Vapeurs d'Echappement Pour la Production de l'Air Comprimé dans les Mines. A. Laponche. (Bull. Soc. de l'Ind. Minerale, Jan., 1913; 37 pp.)

22,555—EDUCATION—Mining Schools in Relation to the Mining Industry. T. H. Palmer. (Proc., Aust. Inst. Min. Engr., Dec. 31, 1912; 10½ pp.)

22,556—EXPLOSIVES—The Selection of Explosives Used in Engineering and Mining Operations. Clarence Hall and Spencer P. Howell. (U. S. Bureau of Mines, Bull. 48, 1913; 50 pp., illus.)

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22,561—LOCOMOTIVE ACCIDENT—Unfall beim Benzollokomotivenbetrieb auf dem Kalisalzbergwerk Rossleben bei Rossleben am 9 März, 1912. Ziebarth. (Preus. Zeit. f. B. H. u. S., Part I, 1913; 7½ pp., illus.) Accident in operating a benzol locomotive at the Rossleben potash mine, Prussian Saxony.

22,562—MADAGASCAR — Notice sur Quelques Produits Miniers de Madagascar. F. Bonnefond. Bull. Soc. Ing. Civ. de France, Jan., 1913; 10 pp., illus.)

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22,576—TASMANIA—Around the Tasmanian Mines—I. The West Coast, an Important Mining Area Largely Undeveloped Owing to the Absence of Capital. Peter G. Tait. (Min. and Eng. Rev., Apr. 5, 1913; 18 pp., illus.)

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MINING AND METALLURGICAL MACHINERY

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22,623—LOW-GRADE FUEL—Ausnutzung minderwertiger Brennstoffe. O. Dobbelstein. (Stahl u. Eisen, May 22, 1913; 2¾ pp., illus.) Utilization of low-grade fuel. 40c.

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22,626—SOLID AND LIQUID FUELS—Die spezifischen Eigenschaften und Unterschiede der festen und flüssigen Brennstoffe und ihre technische Bedeutung. Aufhäuser. (Glückauf, Apr. 19, 1913; 11 pp.) Specific qualities and differences of solid and liquid fuel and their technical importance. 40c.

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SAMPLING AND ASSAYING

22,628—ATOMIC WEIGHTS and a New Theory of Chemical Affinity. James Moir. (Journ. Chem., Met. and Min. Soc. of South Africa, Dec., 1912 and Apr., 1913; 8½ pp.) Original paper and discussion.

22,629—COIN METAL—Die Ausführung von Gehaltsproben des Prägemetalls der Deutschen Reichsmünzen in der Kgl. Münze zu Berlin Trenkner. (Chem. Ztg., Apr. 1, 1913; 1¾ pp.) Method of determining the tenor of coining metal of the German imperial coins at the Royal mint, Berlin. 40c.

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INDUSTRIAL CHEMISTRY

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22,633—SULPHURIC ACID—Chamber Tests in an Acid Plant. E. H. Armstrong. (Am. Fertilizer, May 31, 1913; 3¾ pp., illus.) 20c.

MISCELLANEOUS

22,634—CHINA—Bericht über eine Reise in der chinesischen Provinz Szetschuan. Cremer. (Preus. Zeit. f. B. H. u. S., Part I, 1913; 145½ pp., illus.) Report on a journey in the province of Suchwan, China

22,635—CONSTRUCTION CAMP—Model Construction Camp in Missouri. How 1000 Workers on the White River Hydroelectric Development Are Cared For. (Eng. Rec., Apr. 12, 1913; 1⅓ pp., illus.) 20c.

22,636—DAM—Reinforced Concrete Studies—I: The Hollow Dam of the Buttress Type. J. K. Finch and W. F. Thoman. (School of Mines Quart., Apr., 1913; 22 pp., illus. 60c.

22,637—FLOOD PROTECTION at the Illinois Mines. (Coal Age., May 31, 1913; 2½ pp., illus.) 20c.

22,638—FLUME CONSTRUCTION on the Medina (Texas) Valley Irrigation Project. (Colo. Sch. of Mines Mag., June, 1913; 8 pp., illus.)

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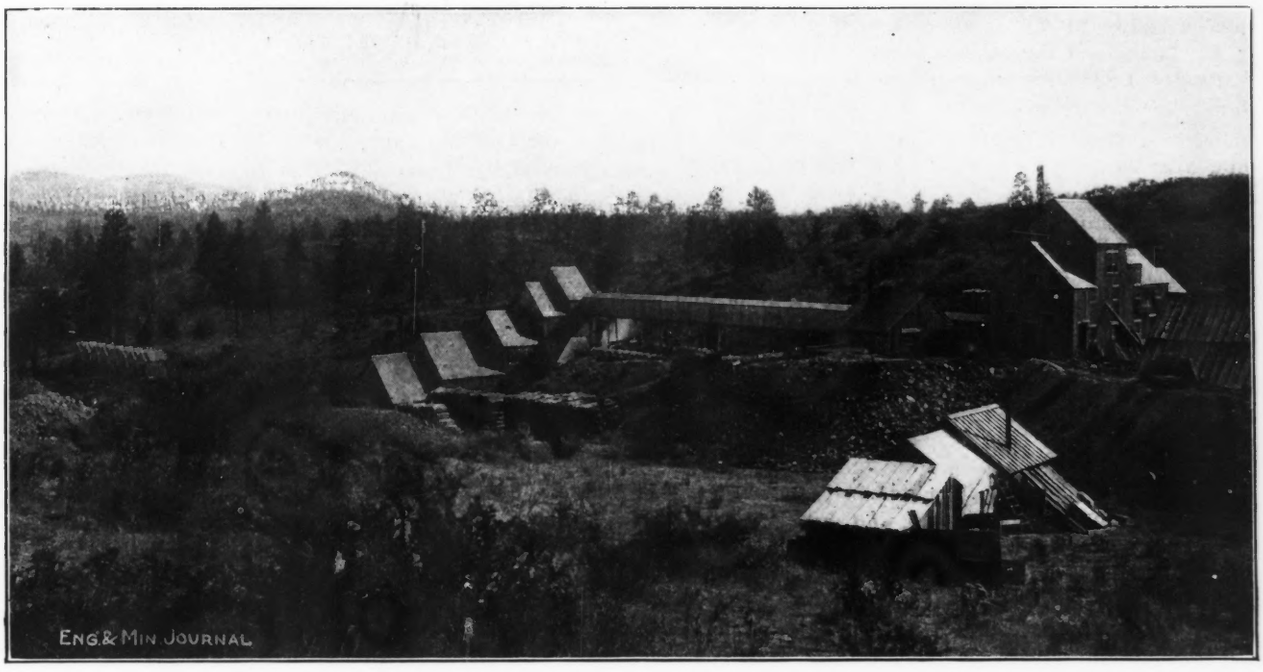
22,643—SMOKE ABATEMENT—The Problem of Smoke Abatement. William A. Hoffman. (Journ. Assn. Eng. Soc., June, 1913; 27 pp., illus.)

22,644—TIMBER PRESERVATION—The Baltimore & Ohio Railroad Timber-Treating Plant. F. J. Angier. (Can. Engr., June 5, 1913; and Eng. Rec., May 24, 1913; 2 pp., illus.) 20c.

22,646—WATER CLARIFICATION and "Mammoth" Dredgers. (Iron and Coal Tr. Rev., Apr. 4, 1913; 1 p., illus. 40c.

PHOTOGRAPHS FROM THE FIELD



THE GEM MINE AND MILL BUILDINGS OF THE CONSOLIDATED GOLD MINING CO. IN BAKER COUNTY, OREGON. THE MINE IS OPENED TO THE 650-FT. LEVEL

A GOLD DREDGE IN BULLER GORGE, NEW ZEALAND

The gold dredge originated in New Zealand from which field it was introduced and brought to perfection in California.

Hollinger Gold Mines, Ltd.

The report of the Hollinger Gold Mines, Ltd., Porcupine, Ont., for the year ended Dec. 31, 1912, shows that the total operating profit during the year amounted to $600,664. This amount was divided into dividends Nos. 1, 2 and 3 of $90,000 each, a total of $270,000; amount written off plants, $106,223; amount written off development, $102,639; and the balance carried forward, $101,801. Profits of $250,000 received from the sale of 50,000 treasury shares were applied to the retirement of indebtedness incurred in completing the mill, this being in keeping with the policy outlined in the manager's report of last year.

Work in the mines included 3280 ft. of drifts, 1381 ft. of crosscuts, 324 ft. of winzes, 150 ft. of raises and 66 ft. of shaft. Stoping produced 30,740 tons of ore, 23,973 tons of which came from the 100-ft. level and the balance from the 200-ft. level. The total advance of workings amounted to 5201 ft., the underground workings now totaling 8918 ft. Some prospecting was done by means of the diamond drill with beneficial results, a total of 1466 ft. having been drilled.

The total ore reserves amount to 644,540 tons, valued at $11,271,400. The value estimated in reserves at the beginning of 1912 was $10,230,000, and during the year there were milled $970,304 worth from those reserves. The presence of ore to a depth of 300 ft. has been assured, and there is no known reason why it should not be found at a considerably greater depth, although no allowance in ore reserve has been made more than 50 ft. below the deepest working already arranged.

The ore hoisted during the year amounted to 36,446 tons. All of this, together with some ore previously placed on the dumps, was milled, the total amounting to 45,195 tons, and containing $970,304 of which $933,681 were recovered. In the total value recovered, silver amounted to $6546 and gold to $927,134. The average value of all ore treated was $21.44 per ton, including low-grade ore sent to the mill at the commencement of milling operations, and that milled during the strike. Cyaniding was begun in July, and up to November a steady progress was made toward increasing both tonnage and value of ore treated. Since that time operation has been made difficult on account of labor conditions.

Mining costs for the four weeks ended Feb. 25, 1913, are for labor, $22,133; for material, $11,014; total, $33,147, making the mining cost per ton $3.58. Milling costs are for labor, $6700; for stores, $7099; total, $13,799; and per ton of ore milled, $1.493. These milling costs do not include expenditures for extraordinary purposes, such as plant alterations, which raised the total cost per ton milled to $1.693.

❋

New Nevada Mining Regulations

Some additions and ammendments have been made to the Nevada law regulating the operation of mines. Chapter 125 provides that all machine-drilling underground must be done with some dust-preventing device such as a water spray and imposes a penalty for non-observance, not only on the mine operator but on the drill-runner himself, a step in the right direction. Chapter 215 requires the sprinkling of dusty ore and rock passing through chutes or ore houses, with the provision that the mine inspector may exempt properties where the installation of such devices would be impracticable.

Chapter 224 amends Section 22 of the previous mining act so as to forbid the use of gasoline underground except in cases of gas engines of 8 hp. or under, operated not more than 100 ft. below the surface and exhausting into a pipe which extends to the surface, or operating not more than 250 ft. below the surface and exhausting into a pipe equipped with a suction fan to discharge into the outer air.

Chapter 285 requires all persons employed underground or handling explosives to be able to speak and read the English language. This is a drastic provision. Its ostensible object is to promote safety by prohibiting the employment of men unable to read printed safety rules. It will be interesting to see whether it is enforced and how it will work out.

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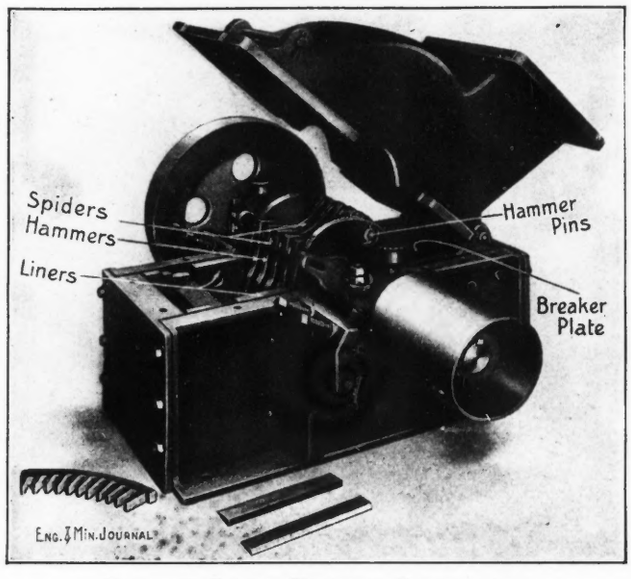
Jeffrey Swing-Hammer Pulverizer

The swing-hammer pulverizer shown in the accompanying engraving is manufactured by the Jeffrey Manufacturing Co., Columbus, Ohio, especially for laboratory use



JEFFREY SWING-HAMMER PULVERIZER

in reducing ore and coal to a fine uniform product. It is particularly useful for sampling purposes since the sample is not only reduced to a comparatively fine powder, but is thoroughly mixed into a homogeneous mass.

The device comprises a set of 20 hammers, which are made of manganese steel, tool steel or carbon steel, as conditions demand. These hammers are pivoted to the arms of the four spiders. The spiders are keyed to the shaft which revolves at about 1200 r.p.m.; the direction of rotation is clockwise in the view shown. The sides of the machine are provided with replaceable liners to take the wear. The ore is kept within the crushing zone until fine enough to pass the grizzly bars which make up the bottom of the pulverizer. An average of 7 hp. is required to operate the machine.

While any high-speed machinery is better for being placed on a solid concrete foundation, it is stated that this machine is built so as to give good service when mounted on timbers on an ordinary wood floor.

CORRESPONDENCE AND DISCUSSION

Milling in Southeastern Missouri

I was interested in Claude T. Rice's article, "Milling in Southeast Missouri," in the JOURNAL of June 21, but there are a few things which I think should be explained. He speaks of coarse crushing as having first been introduced in the Leadwood mill. I think he is mistaken in this, for on my first visit to Mine La Motte, in 1887, I believe crushing to 9 mm. was practiced, and believe that this was always the practice. At the Central Lead Co. mill, which was started in the spring of 1894, 12-mm. screens were used and this was the practice as long as the mill was operated by the Central Lead Co. Is it true that belt weighers cannot be used where there is dust?

ARTHUR THACHER.

St. Louis, Mo., June 24, 1913.

❖

Microscopy in Economic Geology

The valuable article of Professor Beck, translated in the JOURNAL of May 31, 1913, ends as follows: "From this review the conclusion is inevitable that microscopic petrography must have a place in the curriculum of technical schools and especially of mining schools. Such mining and geological engineers as wish to train themselves for consulting work, or such as wish to participate as pioneers in the mining development of new regions, and above all, such as are striving to take an active part in the scientific part of practical geology, must unquestionably familiarize themselves with the fundamental methods of microscopy."

The above remarks of Professor Beck are certainly true, but it is to be feared that the average reader in this country will look upon them as new and strange. As one of the pioneers in microscopical petrography in America, I have used the petrographical microscope for nearly 40 years, hand in hand with other means, in the study of mineralogy, and general and economic or mining geology and have always regarded it as a most efficient aid, particularly in the study of ore deposits. Many other Americans have done the same, like Kemp, of Columbia.

It was my good fortune to teach the first course in microscopical petrography ever taught in this country, so far as known, at Harvard University, in 1877, and to lay the foundations of the present excellent department, which that university enjoys. It was then taught by me mainly for its use in general and mining geology.

In 1887, when in charge of the Michigan College of Mines, microscopical petrography was introduced and was required of all the students from 1889 on. The college was well equipped with about 40 petrographical microscopes and other accessory apparatus, including some 800 microscopic sections. There is but little doubt that the thorough training the students then received in mineralogy, petrography and geology has been an important factor in their success in metal mining throughout the world.

Microscopical petrography was introduced into that technical school and taught at that time for the very reasons given by Professor Beck and because I believed, then as now, that no mining man could thoroughly understand economic (mining) geology without a good knowledge of petrography. For the same reasons I introduced microscopical petrography into the curriculum of the School of Mines of the Pennsylvania State College in 1901 and procured a fair equipment for the work.

For the same reasons when I was reorganizing the School of Mines of the University of Pittsburgh in 1908 and subsequently, some 35 elective courses were made available for undergraduates and some 27 for graduates in microscopical petrography and there was procured one of the best equipments for instruction in that subject ever obtained by any university in this country.

It certainly does not appear that in ideas, efforts or intent that some, at least, of the mining schools of United States have been behind the celebrated Freiberg one. Further, the American petrographers and metallographers have not been lax in the application of the microscope to mining geology or to the generally opaque minerals, as, for instance, Baird Halberstadt, Campbell or Rogers.

M. E. WADSWORTH.

Pittsburgh, Penn., May 31, 1913.

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Calculation of Extraction in Cyanide Plants

An article, by Herbert A. Megraw, in the JOURNAL of Mar. 8, on "Silver Cyanidation at Tonopah—III," has just come to my notice and I am somewhat surprised to learn that the method of calculation of extraction referred to is in use in any of our "up-to-the-minute-inefficiency" milling plants, and I am inclined to at once agree with Mr. Megraw that the question of such method should be discussed. The estimation of mill-head contents by adding bullion content to tailing content and dividing by tonnage, is not a method worthy of a metallurgist, and, as Mr. Megraw so fittingly puts it, is certainly "a method of solving a problem by means of which any answer is the right one."

Such methods are not, I believe, in general use, but are being mostly used by operators for stock companies. There are two classes of mining shareholders; those holding shares as an income-gaining investment, and those holding them for the purpose of speculation. Dividend-receiving shareholders do not exact highest efficiency. They are glad to get a dividend instead of an assessment and seldom question the methods. Those holding shares for stock operating are not interested. If the mine is paying its way, with an occasional dividend, declared at the right time to stimulate a dull market, nothing more is expected or wanted. However, from an engineer's standpoint, or from a business man's standpoint, the system leaves much to be desired.

Not only is the system referred to the source of inaccurate statements and fictitious results, but it is unscientific and unbusinesslike, and tends to show a lack of moral courage on the part of the well paid specialists in charge of operations. Advocates of the system will claim that they are continually watching results and working toward better extractions, and that they get everything possible out of the ore anyway, so why undertake additional work which would result in no benefit and only confuse the records. How do they know they are getting everything possible out of the ore, if they do not know what the ore contains to start with? They tell by the tailing assays; if these are low they assume results to be correct. How do they know that the bullion recovered is the true difference between head and tail content? Tailing content may be low and still the bullion produced may not represent what should have been recovered from the ore, or perhaps what really was extracted. Losses may occur through carelessness, faulty treatment, or dishonesty. These losses, which may amount to much, are entirely unguarded under such a system.

If an operator is afraid of his mill head, why is he not afraid of his mill tailing? He probably is not afraid of either alone, but does not care to meet both together, particularly when he is standing between them with the "brick." There is no reason why the tailing sample or assay should be more reliable than the head sample or assay. In many cases, it is much less reliable. Who ever heard of a correct tailing sample during the time anything was going wrong in the mill, especially when there was no record of heads? How can tonnage represented by tailing samples be as accurately established as tonnage represented by head samples? In cases where sand and slime are treated separately, the calculation of proportionate tonnage increases such inaccuracy.

When the head content is known, an efficient system of solution sampling will check both bullion and tailing, but when the head is unknown, this will only check the bullion. It is true that bullion plus tailing content is equal to the head content if no losses or errors occur, but they do occur, and hence the formula instead of being $B + T = H$, should be written $B + T + L = H$. But H and L being both unknown quantities, "any answer is the right one."

By having the head assay, precipitation record from solution assays, tailing assays and correct tonnage record, results are positive and any discrepancy represents loss or error, the two most important things the metallurgist is paid to guard against. He is not necessarily careless or incompetent when such discrepancies occur, but displays his ability when he finds and removes the causes for such losses or errors. Having no head assay, it requires no ability on the part of the metallurgist to keep his records free from discrepancies except that he must be able to add correctly.

By one method the treatment is controlled or regulated by a knowledge, before treatment, of what is being treated. By the other method the treatment is controlled or regulated by a knowledge, after treatment, of what was treated. By one method the operator is able to arrange his treatment so as to secure the best results, by the other he makes a guess and then, after treatment is finished, he determines how far he was off and makes his answer right by fitting his original problem to it. He never does know what per cent. extraction is being made (a $2 tailing may be the result of better per cent. extraction than a $1 tailing), not that it makes any material difference, as the actual amount of bullion is the main thing, but he reports his percentages just the same; how?

The method is also unfair to the mine. The mill keeps its record clean and all contained values that come to it are accounted for and reported either in bullion or tailing, but the mine must stand its own losses as well as those of the mill. The mine may be sending $20 ore to the mill, but the $B + T$ system may only show $18 as mill head, which is all the mill will acknowledge receiving. What becomes of the $2? Where is it charged? Who loses it? It flutters about unaccounted for, for a time, and then finally settles unowned and unnoticed in the little nest of "shrinkage of previously estimated ore reserves," shown in no report, a most convenient hiding place for inaccuracies, losses and results of the inefficient method of "calculation of extractions." If a careful investigation were made into the cause of discrepancies in mill results, on account of which this "any-answer-is-the-right-one" method has been adopted, it will be found that an incorrect tonnage record is a greater factor in the matter than will be generally conceded.

A. Sidney Additon.

San Francisco, Calif., June 14, 1913.

Rare Minerals at Broken Hill, Rhodesia

By the comment made by George D. Hubbard, in the article in the Journal of June 28, 1913, that deposits of rare minerals, pseudomorphs after bone, may be even now forming, I am reminded that in the Morenci district, Arizona, any old bones left lying on the surface of the ground soon became of a greenish-blue tint, and in some of these bones I found as much as 2% of copper.

Whether the fumes from the furnaces took any part in this change, or whether the surface waters alone were involved, I was never able to satisfy myself.

I suppose the reaction was

$$3\,CuSO_4 + Ca_3(PO_4)_2 = 3\,CaSO_4 + Cu_3(PO_4)_2$$

making two insoluble compounds grow where only one did before.

Donald M. Liddell.

Elizabeth, N. J., June 30, 1913.

Melting Furnace at Rio Plata Mill

In some of the sketches (Figs. 2, 3 and 4) accompanying the article "Melting Furnace at Rio Plata Mill," in the Journal of Mar. 15, 1913, the draftsman made some changes in the design of the doors, representing them all as hinged doors. In my opinion, hinged or swinging doors are not to be recommended if a chain block and overhead traveler are used in handling the crucible, as is done at Rio Plata. It is often necessary to move the crucible in the longitudinal direction of the furnace and counterweight connections on the doors would interfere with such movement. The under-side of furnace doors are extremely hot, and when thrown back, the operator is needlessly subjected to a high heat when pouring.

Alvin R. Kenner.

Guazapares, Chihuahua, Mexico, Apr. 28, 1913.

EDITORIALS

Butte & Superior

If the Butte & Superior company issues to the press the statistics that appear from time to time, as we imagine it does, we suggest to it that it be more specific and conform more strictly to the customs of the zinc business. For example, a recent report read that during the second 10 days of June, its mill treated 5743 tons of ore, averaging 20.3% Zn, and yielded 2,033,281 lb. of zinc, an extraction of 92.05%.

Now this company does not sell zinc directly, but rather blende concentrates, and it is paid per ton of such concentrates. It may be argued that the public knows nothing about the value of that kind of material, but the statement of how many pounds of zinc were produced is no more illuminating in that respect.

In fact, a given quantity of zinc fetches less in the form of a concentrate, assaying 48% zinc than if 50% zinc. Indeed, the difference is rather startling to persons not initiated in the zinc business. We believe that the Butte & Superior concentrates are running about 48% Zn at present. On that assumption, the tonnage of concentrates during the period in question, was about 2118, and the ratio of concentration about 2.7 : 1. In the case of this company the improvement in the grade of its concentrates is more important than a little improvement in mill extraction.

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The Hall Process

Ever since the smoke complaints arose to bother smelters, the obviation of the sulphur nuisance has been a problem engaging the attention of chemists and metallurgists. Of course, they knew that they could make sulphuric acid out of their sulphur as is commonly done in Europe, but in the United States such manufacture has been commercially profitable, i.e., possible, only in a few favored regions, e.g., Tennessee and the zinc-smelting districts of Illinois. The smelter making sulphuric acid at Anaconda, Salt Lake City and in Shasta County, California, would not have known what to do with his product, in spite of the recommendation of a certain government official (of whom the story may be apocryphal), that the Anaconda company should pipe it to the Pacific Ocean and there pour it away.

Recognizing the real conditions, it has long been a dream of metallurgists to isolate the sulphur of sulphide ores in its elemental form, so that it could be shipped to distances barred by freight rates to sulphuric acid; or so that, at the worst, it might be piled up in such a way that it would be no harm to anybody.

Such an isolation of the sulphur is the theme of the ingenious and novel process which its inventor, William A. Hall, has described in this issue of the JOURNAL. We shall not at this time undertake to discuss the chemistry of his process. We shall confine ourselves merely to informing our readers of the auspices under which it has been developed. Mr. Hall himself is a chemist of sound professional training and of distinguished achievement in the field of invention. His present process has been studied by Prof. C. F. Chandler and Prof. A. L. Walker, of Columbia, who have reported favorably about it. Some distinguished engineers have joined in the promotion of it. It has been witnessed in experimental operation by many experienced metallurgists, of whom all that we know have expressed favorable opinions. A great metallurgical company stood ready to spend $150,000 on its further development, but failed to come to terms. It is actually to be tried at the Balaklala works, in California.

It is to be borne in mind that the experimental work done so far has been on a small scale and that there will no doubt be much tedious and costly work in making a commercial process out of it. The great metallurgical company to which we referred estimated that its necessary experimentation would cost $150,000. Process development is almost always costly. In this case, however, it is not unreasonable to hope that we may in the course of a few years see a solution of the sulphur smoke problem. If such a solution does really come to pass, the brimstone market of the world will incidentally be revolutionized.

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Testing Rock Drills

The manager of an ordinary small mine has neither time nor money to test thoroughly the drills he uses underground. He tries usually two or three of the best-known makes and types and selects the one that shows most favorable results after a rather haphazard investigation. Previous experience may often guide him to a choice substantially correct, but in too many cases prejudice is allowed to outweigh obvious defects or advantages. Larger companies, in which the cost of drilling reaches a greater absolute figure, devote much attention to the machines used underground and in addition to a record of the performance of individual machines in the stopes and in the shops, engage in more or less exhaustive preliminary tests before buying any quantity of a certain make. The results of such tests are often as surprising as they are illuminating. The number and the range of the variables contributing to a machine-drill's performance, would open the eyes of the average superintendent.

Probably no other American company pays more attention to this matter than does the New Jersey Zinc Co., at its Franklin Furnace mine. A series of tests begun here some six or seven years ago and still in progress, has resulted in greatly increasing the efficiency of the company's drilling and in bringing out some curious points in the performance of rock drills, intelligible in some cases, and in others largely inexplicable.

Every machine under consideration by the company is taken underground and its air consumption and drilling rate measured, this being done in a certain crosscut where the rock is uniform. The number of perforations in the

back here bears eloqnent testimony to the extent of these tests. The holes are drilled for the most part vertically in calcite, since here, as elsewhere, experience is relegating the piston machine to a secondary position. The rate of drilling is naturally high and the absolute figures would not be instructive to a hard-rock miner. The comparative figures, however, among different makes and types of machines, would prove most instructive if the company were willing to publish them.

The air pressure used is between 95 and 100 lb., and remains fairly constant for any one test. The temperature also is constant. Air consumption is measured by a system involving a pair of displacement tanks, similar to those described in the JOURNAL, July 6, 1912. A certain number of displacements, corresponding to a certain amount of air, are run through, the time noted, and the number of inches drilled, measured. The criterion on which the comparison of machines is made is a figure derived by dividing the number of inches drilled per minuate by the air consumption per inch, thus taking into consideration both the speed and the air consumption. No machine is accepted for further trial nnless it drills at least 7½ in. per min. on 60 cu.ft. of free air or less. A side light on the progress of drill design and manufacture is shown by the fact that for the machines of one manufacturer, the criterion mentioned has increased in some five years from about 0.2 to about 1.5, a remarkable difference.

This test is, so to speak, only an elimination trial. The results are comparable to an engine indicator-card, taken to determine mechanical efficiency. The important factors of convenienee, repair expense, retention of original efficiency under wear, steel breakage, etc., are determind by further tests in the harder formation of the stopes. If a drill is purchased, its probation is not yet over. All machines in use are numbered and a careful record is kept of their performance during their whole life. They are, in effect, on the mine payroll, the number of shifts they work is credited to them and the repairs are charged. It would appear that after a few years of this, the New Jersey Zinc Co. should know something about machine drills.

One anomaly developed in the tests, is the fact that a machine will often drill along as well or better with one wing of the cross bit broken off. More curious still are the contradictory resnlts obtained with the same machine under apparently identical conditions. Thus a hole may be collared and a test run made; then, with no further change than a new piece of steel, a second run continuing the same hole may give a rate of drilling mueh higher. The calcite is too uniform to permit explaining this by a change in the rock quality. Mr. Ca'lin, however, suggests a very plausible theory. He conceives the blow of the hammer and anvil block on the steel to be transmitted through the latter as a wave. Such a wave will be reflected when the bit transmits it to the rock in the hole bottom and in its return may oppose or may coincide with the next blow of the hammer. When conditions are such that these rebonnds reinforce the successive hammer blows, the maximnm drilling effect is attained. If the rebound and new blow oppose each other exactly, then the drilling power is appreciably cut down. The usnal conditions will be a varying degree of interference, giving varying resnlts. An attempt to analyze and control the phenomenon, however, disclosed that too many variables existed, of which the chief are the length of the steel and its resiliency. That great variations of resiliency obtain, is shown by dropping the same steel ball on different pieces of steel and noting the number and height of the rebounds. The differences developed are extensive. Evidently in the field of rock drills, drill steel, rock and their inter-relations, there are more things than our philosophers have yet dreamed of.

Another anomaly concerns not the machine drills, but their manufacturers. One special machine was obtained for test from a certain manufacturer, which drilled at the enormously high speed of 32 in. per min. No other results comparable to this were obtained. The machine was sent back to the factory and was never returned; nor could the company ever get a duplicate made.

Progress in Tariff Making

A remarkable feature of this year has been the complacency with which the coming tariff reductions are regarded in all quarters. Even more remarkable has been the action of the Senate in taking some steps further than the House. In so far as the metal industries are concerned, but few producers took the trouble to file briefs protesting against reductions. The iron and steel people recognized that they could stand them and the lead and zinc people appreciated that prices are made by something besides a tariff. Altogether, it has been a poor year for the tariff calamity howler. Apropos of this it was remarked recently in the *Evening Post*:

> Trade reaction in the United States is progressing slowly. The tariff revising Congress has been in session now for 11 weeks, yet the silent mills and smokeless factory chimneys which were dolefully predicted in April remain to be seen. Reasons have been plentifully supplied; the following illustration gives a new angle to one of them: A New England manufacturer of cheap blankets whose mills are working at capacity in spite of the contemplated changes in wool and cotton tariffs, says that he will not curtail operations until demand for his product falls off. That will come, he says, when labor through the country becomes idle and cannot longer buy. But labor, he feels, will go on buying blankets until it is made idle by the shutting down of other mills and factories. If the manufacturer is typical, and continues waiting upon labor to bring about reaction, and if labor in turn continues waiting upon the manufacturer, it is quite in point to ask under whose auspices the predicted trade reaction can come.

So long as the present conditions prevail in the lead market, it is certain that no lead miner or smelter will have to suspend operations, while as for the zinc business, things probably cannot become much worse than they are anyway, and it is well understood that the present nnsatisfactory state of affairs came about through overproduction, not prospective changes in the tariff.

The arrangement of a foreign loan by the Huerta government in Mexico was thought to provide funds for the inauguration of military activity against the revolutionists in the north. A forward movement was indeed begun. The flotation of the French portion of this loan met, however, with a chilly reception from the French public and it is not certain that the Mexican government will get much more than the money required to relieve the necessities of the National railway. Apparently the bankers attached conditions to their promise of the money which enable them to keep the negotiated loans in a state of snspended animation until events in Mexico take a favorable turn.

The Hall Ore Desulphurizing Process

By William A. Hall*

SYNOPSIS—The Hall ore-desulphurizing process consists in roasting ore in a reducing or neutral atmosphere containing some hydrocarbon gas and steam. All the sulphur distills in etemental form, the metal being left as oxide. The sulphur fumes are then readily collected in water.

The Hall process of desulphurizing sulphide ores with eradication of noxious smeltery fumes, is entirely novel and based upon new principles that have not heretofore been described in any chemistry or metallurgical work or old patents, so far as I have been able to ascertain, as it is based upon the principle of removing the "fixed" sulphur atom of a sulphide by distillation and without permitting any considerable portion of the sulphur thus discharged to pass into any combined forms, such as SO_2 or SO_3.

The Fixed-Sulphur Atom Distilled Directly

The sulphur existing in the ore as a sulphide is removed and discharged from the ore in the elemental condition and when the furnace operation is properly adjusted, there is substantially no discharge from the furnace of combined sulphur, either as SO_2, SO_3, H_2S or COS. Small mechanically rabbled reverberatory furnaces and multiple-hearth furnaces have been operated with the entire fumes discharged into a small room and no odor of these gases was discernible, even when the operation was continued for many hours.

The distillation of both fixed and free sulphur as such constitutes the advantage this plant has over the other sulphur-recovery processes. Eliminating the sulphur as oxide with subsequent reduction means that a large amount of free oxygen must be taken care of before the sulphur-reduction begins, which requires extra expense for reducing agents, while the fuel expense of removing oxygen combined with sulphur from such association is greater than the fuel expense of direct distillation.

Many tests and demonstrations of the process have been made in France, England and America, and under the direction of several metallurgical engineers and chemists, gas analyses having been made of the fumes discharged. These analyses have been made over continuous runs of several hours, and the total amount of combined sulphurous gas of any condition has been found to average under 0.25% by volume without the admixture of any extraneous air.

A set of careful analyses were made in New York this winter, under the direction of Prof. Arthur L. Walker and Dr. C. F. Chandler, of Columbia University, the analyses showing the following:

Time	SO_2
First hour	0.025%
Second hour	0.028 "
Third hour	0.023 "
Average	0.0253%

and during the entire period the amount of sulphuretted hydrogen evolved was simply a trace; a quantity too small to be analytically determined.

In this demonstration the rate of decomposition was equivalent to that in treating 50 tons of ore per day in an 18-ft. six-hearth McDougall furnace, when roasting said ore down from 40.5% sulphur to 3.5% sulphur. The rate of decomposition in the Hall process when conducted in multiple-hearth furnaces appears to be from 100 to 125 lb. of ore per sq.ft. of hearth area each 24 hours, which makes it compare favorably with the capacity obtained in the best conducted roasting furnace. The action will be even more rapid if the desulphurizing is not carried down to so sweet a roast, and if the operation is stopped at a point where there is some 7 to 9% total sulphur remaining, sufficient for matte formation. The cinder discharged is in excellent condition, comparing favorably with the best obtained in the roasting process.

Sulphur Distillation May Be Complete

Tests have been made abroad to determine how complete a desulphurizing could be produced in this process, and many analyses show percentages of total sulphur remaining in the cinder of less than 1%. The distillation is obtained by the direct application to the ore of a burning-gas flame of slightly reducing or, at least, non-oxidizing character, accompanied by sufficient H_2O, either in the shape of water of formation (from the combustion of hydrogen) or by the addition of small amounts of extraneous water in the shape of steam. This H_2O, whether derived from formation water or from extraneous steam, is decomposed by the hot ore; the nascent oxygen going to the metal and the nascent hydrogen combining with any free oxygen that may enter the furnace through the atomizer through which the gases are admitted, thus creating a sort of cycle of H_2O decomposition and water formation from the combustion of the hydrogen so derived. It appears that nascent hydrogen has more affinity for oxygen than it has for sulphur.

When the burners on the furnace are properly adjusted, the final discharge of hydrogen appears to be all in the shape of water vapor, i.e., complete balances are easily maintained whereby there is substantially neither SO_2 nor H_2S in the discharge, the tests being made on samples taken within a distance of 6 in. from the furnace.

A large variety of ores have been experimented with, including pyrites, various pyrrhotites, copper concentrates, crude blende, zinc concentrates, and even chemically pure FeS, the action appearing to be the same on each and the only difference being in the amount of sulphur discharged, according to the amount contained. In order to prove that the "fixed" atom is removed by distillation, the furnace has been operated on chemically pure FeS, which, of course, contains no feeble or free atom and no SO_2 or H_2S was discernible in the discharge, but only yellow elemental sulphur vapor.

The analyses of the cinder show it to be a mixture of Fe_2O_3 and Fe_3O_4. The oxidation of the metal (after any feeble atom has been removed), is due to the nascent oxygen from the decomposed H_2O, it apparently being proven that nascent O has much greater affinity for the metal that decomposes it, than it has for the S element.

If producer gas is used as a fuel, a larger amount of

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extraneous water is found necessary than when a gas is used that is high in hydrogen, such as water gas and particularly oil gas. Gasified fuel oil appears to be an ideal fuel, containing substantially no N, having extremely high thermal values (gasified oil having a B.t.u. of over 1500 per cu.ft.). When high-grade fuel oil is used, there is a much smaller volume of fumes to be handled in the subsequent sulphur extraction. Where a gas is used that is high in CO, a certain amount of COS is formed, as CO has a greater affinity for S at elevated temperatures, but it has been found that when COS and water vapor pass to a lower temperature, say, less than 400° C., there is a mutual decomposition with a formation of H_2S and CO_2.

Working Temperature Range About 200° C.

The temperature maintained in the furnace must be slightly above 700° C., as that is about the distilling point of the S of a metallic sulphide, and it must be maintained below 900° C., the fusing point, but the latitude of 200° C. gives a large margin of safety in the operation.

Although undoubtedly the reaction is somewhat exothermic, no allowance has been made for the same in the fuel calculations, fuel required being calculated as if the reaction were entirely endothermic; and on such a basis, allowing amply for radiation and for the largest factors of safety, the amount of coal fuel required (gasified) is calculated at less than 10% of the weight of the ore. These fuel requirements have been calculated by numerous engineers.

The process was first demonstrated in France and later in England, extending over a period of a year, during which it was examined there by over 20 foreign and American engineers, and the demonstrations have been observed by more than that number in this country.

A European company, known as the British Sulphur Co., was formed and took over the foreign rights, that company being composed mostly of metallurgical and mining engineers and capitalists largely interested in copper mining. An American company has taken over the American rights.

The calculation of the cost of producing sulphur by this method in American smelting works is placed at from $3 to $5 per ton of the crude sulphur derived. These calculations have been made by some eminent American engineers.

Character of the Fume

The fumes coming from the smelter are of a heavy yellow appearance with no appreciable odor, other than that of hot elemental sulphur vapor. The sulphur is extracted from the fumes by simply washing, it being found that this finely divided elemental sulphur has great physical affinity for water, due, presumably, to surface tension, and when the fumes are agitated with water, the atmosphere is almost instantly clarified, the sulphur settling to the bottom of the apparatus.

Any of the well known gas-washing apparatus, such as the Thiesen or the Feld system, is considered as well adapted for the purpose, and tests have already been made with them. Some of these washers are made with a capacity of 50,000,000 cu.ft. per 24 hours.

The fumes have also been run through the Cottrell electrical dust collector, which completely precipitated the sulphur therefrom. The solids precipitated from the fumes by washing have been analyzed several times and found to run from 98 to 99½% S; the impurities being flue dust or lead or zinc sulphides. The refined sulphur has been found to be over 99½% soluble in CS_2 and is of the octothedral and prismatic types.

So far the process has been developed principally with the view of its attachment to multiple-hearth roasters, but it is understood that experiments have been made in its adaption to blast furnaces, and which appear to be promising.

[It is understood that one or more of the larger Western smelters will shortly install this process on an extensive scale.—Editor.]

California Oil in May

The net production of oil in California in May in all fields was 7,639,144 bbl., an increase in total over April of 126,448 bbl., but a decrease in daily average owing to May having one more day. Total shipments in May were 7,857,406 bbl., an increase over April shipments of 512,426 bbl. The losses in May were 96,088, making the total outgo 7,953,494, an increase over April of 503,630. Stocks on hand at the end of May amounted to 47,905,506 bbl., a decrease of 314,306 bbl. from the April stocks. Field records showed 35 new rigs, 51 completed wells, 365 wells drilling, 384 wells on which drilling was suspended, 6048 wells producing, 946 wells capable of producing but idle, 29 wells abandoned.

Districts	Bbl.
Fresno County:	
Coalinga	1,595,882
Kern County:	
Midway	2,405,170
Kern River	779,048
Lost Hills-Belridge	455,713
Maricopa	450,175
McKittrick	368,968
Total, Kern County	4,459,074
Santa Barbara County:	
Santa Maria-Lompoc-Cat Cañon	427,743
Summerland	4,200
Total, Santa Barbara County	431,943
Southern Fields:	
Olinda-Brea-Puente	526,172
Salt Lake-Sherman	231,251
Coyotes-La Habra	224,896
Ventura	71,910
Whittier	56,704
Los Angeles	31,957
Newhall	9,355
	1,152,245
Total, all fields	7,639,144

Miners' Strike in Upper Silesia

The miners' strike, in Upper Silesia, which commenced on Apr. 25, came to an untimely end on Whit Monday, May 12. It came very near turning out an involuntary "hunger strike." The strike fund must have been at a low ebb, for the weekly allowance to each unmarried man was fixed at $0.75 and that of married men at $1.25. Needless to say, no human being could subsist on such a pittance. The lot of the Upper Silesian miner seems to be a deplorable one to judge by the wages paid them and the cost of living. The average annual wage in 1912 has been $250, and the cost of living modestly, calculated for a family of four, at the towns of Beuthen, Gleiwitz, Kattowitz and Königshütte, respectively, would be $296, $303, $310 and $278, for the same period. It is no wonder that disease and inebriety get the best of these men.

Mining Dividends in June

Mining dividends paid in June by 34 United States companies making public reports, amounted to $7,331,706; by holding and smelting companies and allied industries, $12,956,644; and by 13 Canadian, Mexican and Central American companies, $1,287,645.

With the entrance of Chino and Ray into the dividend-paying stage, all of the big "porphyries" are represented there. As to the rest of the coppers, Quincy, Tennessee and Calumet & Hecla have had to begin reflecting the lower copper market by reduced dividends.

United States Mining Companies	Situation	Per Share	Total
Bunker Hill & Sullivan, l.s.	Ida.	$0.20	$65,400
Bunker Hill Con., g	Calif.	0.05	10,000
Butte-Alex Scott, c	Mont.	0.50	37,000
Calumet & Arizona, c	Ariz.	1.25	745,441
Calumet & Hecla, c	Mich.	10.00	1,000,000
Champion, c	Mich.	1.00	100,000
Chino, c	N. M.	0.75	583,194
Colo. Gold Dredging, g	Colo.	0.25	25,000
Con. Mercur, g	Utah	0.03	30,000
Crawhall, z	Wis.	...	28,500
Daly-Judge, s.l.	Utah	0.15	45,000
Federal Min. & Sm., pfd	Ida.	1.50	179,792
Fremont, g	Calif.	0.02	4,000
Frontier, z	Wis.	2.00	2,500
Golden Cycle, g	Colo.	0.02	36,000
Hecla, l.s.	Ida.	0.05	50,000
Homestake, g	S. D.	0.65	163,254
Nevada Con., c	Nev.	0.37½	749,790
New Idria, q	Calif.	0.10	10,000
North Star, g	Calif.	0.20	50,000
Pittsburgh-Silver Peak, g	Nev.	0.02	55,800
Quincy, c	Mich.	1.25	137,500
Ray Con., c	Ariz.	0.37½	542,757
Stewart, l.s.	Ida.	0.10	123,826
Superior & Pittsburgh, c	Ariz.	0.38	569,922
Tennessee, c	Tenn.	0.75	150,000
Tomboy, g	Colo.	0.48	75,330
Tom Reed, g	Ariz.	0.06	54,573
United, c	Wash.	0.01	10,000
United Verde	Ariz.	0.75	225,000
Utah, c	Utah	0.75	1,186,627
Wasp, g	S. D.	0.02	10,000
Yellow Pine, l.z.s.	Neb.	0.02	19,000
Yukon, g	Alas.	0.07½	262,500
Iron, Industrial and Holding Companies	**Situation**	**Per Share**	**Total**
Amer. Sm. & Ref. Co., com	U. S.	$1.75	$875,000
Amer. Sm. & Ref. Co., pfd	Mex.	1.00	500,000
Crucible Steel, pfd	U. S.	1.75	427,638
General Asphalt, pfd	U. S.	1.25	164,120
General Chemical, com	U. S.	1.50	128,382
General Development	U. S., Mex.	1.50	39,000
International Nickel, com	U. S., Can.	3.00	1,137,760
Lackawanna Steel, pfd	N. Y.	1.75	612,115
National Lead, com	U. S.	0.75	154,915
National Lead, pfd	U. S.	1.75	426,433
Phelps Dodge	U. S., Mex.	4.50	2,025,000
Pittsburgh Steel, pfd	Penn.	1.75	112,500
U. S. Steel, com	U. S.	1.25	6,353,781
Canadian, Mexican and Central American Companies	**Situation**	**Per Share**	**Total**
Chontalpan, g.s.l.z.	Mex.	$0.50	$3,500
Crown Reserve, s	Ont.	0.05	88,441
Dos Estrellas, s	Mex.	1.25	375,000
Granby Con., c.g.s.	B. C.	1.50	222,721
Hedley, g	B. C.	0.50	60,000
Hollinger, g	Ont.	0.15	90,000
Kerr Lake, s	Ont.	0.25	150,000
Lucky Tiger, g	Mex.	0.05	35,767
New York & Hond. Rosario, g	C. A.	0.20	40,000
Peñoles, l.s.	Mex.	1.25	150,000
Seneca-Superior, s	Ont.	0.10	47,683
Temiskaming & Hudson Bay, s	Ont.	3.00	23,173
Victoria	Mex.	0.50	1,250

Five Mexican companies paid in June, but the general tone of the distracted country is distinctly shown in the dividend column.

For the first half year, United States mining companies making public reports have paid $38,216,193; iron-smelting, industrial and holding companies have paid $59,650,232, and Canadian, Mexican and Central American companies, $10,781,767.

Chronology of Mining for June, 1913

June 2—Shaft house at the War Eagle mine, Rossland, B. C., destroyed by fire.—Skidoo Mines stamp mill, in Inyo County, Calif., destroyed by fire.

June 4—First trial trip made under electric power on Butte, Anaconda & Pacific R.R.

June 6—Strike at the smelting plant of the United States Zinc Co., at Blende, near Pueblo, Colo., the men demanding higher wages.—Two men killed by cave-in at the Morris mine of the Giroux company, at Ely, Nevada.

June 7—President John P. White and 18 other officials of the United Mine Workers of America indicted in the federal court under charge of violating the Sherman anti-trust law, by alleged conspiracy with the coal operators of western Pennsylvania, Ohio, Indiana and Illinois, to raise wages in the West Virginia coal fields so as to prevent its competition with the other four states in the western market.

June 10—Senate investigation of miners' conditions in New River coal field of West Virginia begun.

June 12—Strike at Nichols copper refinery, Laurel Hill, N. Y.

June 14—Sintering plant at the smelting works of the St. Joseph Lead Co., at Herculaneum, Mo., destroyed by fire.—Midwest Oil Co. wins suit brought against it by the government, claiming illegal occupancy of public lands.

June 24—American Zinc, Lead and Smelting Co. began milling at Mascot, Tennessee.

June 25—Official call made by the union for a strike of coal miners in the New River field, West Virginia, where about 15,000 miners are employed.

June 28—Settlement of strike at Nichols refinery.

Chontalpan y Anexas

The report of the Compañia Minera Chontalpan y Anexas, S. A., for the year ended Apr. 30, 1913, shows that the total profit of 163,131 pesos was earned by the operations of the year. This profit will be divided as follows: 10% to the reserve fund; 10% to the board of directors; 1% to the commissario; 67,000 pesos for the building of the new mill; 21,000 for dividends; 20,000 for unforeseen expenses; 20,000 for deterioration and 15,375 pesos for surplus.

Ore in reserve is sufficient to supply the mill during four years at the rate of 30 tons daily, at which capacity the new mill will be operated.

Work has been much interrupted by the revolutionary activity, principally by the Zapatistas, who have assaulted the property, carrying off horses, arms and much personal property of the manager and others, and, in addition, destroying most of the assay-office equipment.

Hydraulic Prospecting at Cobalt

The illustration appearing in "Photographs from the Field," in the JOURNAL of June 21, 1913, showing hydraulic prospecting at Cobalt, should have been credited as copyrighted by A. A. Cole. This was inadvertently omitted when the photograph was published and this opportunity is taken to extend the proper credit.

The case of A. Chester Beatty vs. the Guggenheim Exploration Co. and others, in which the plaintiff made claims for a large sum of money on account of the organization of the Yukon Gold Co., has been decided in favor of the Guggenheims.

PERSONALS

D. H. Banks is at Yerington, Nev., on professional business.

Grant H. Tod recently left San Francisco for Juneau, Alaska.

Forest B. Caldwell recently left San Francisco for Candelaria, Mexico.

C. Earl Rodgers has been placed in charge of the refinery at the Dome Mines Co.'s mill at Porcupine.

Dwight E. Woodbridge, of Duluth, Minn., has been at Salt Lake City and Butte on professional business.

D. M. Riordan, who is still in California, had the misfortune to break his leg. It is mending satisfactorily.

President William G. Rice, of the Superior & Boston Co., left Globe, Ariz., June 16, for Houghton, Mich., with the remains of his brother, the late Carl Rice.

E. B. Quigley, for three years past superintendent of the Herman mine at Westville, Calif., has assumed the management of the Black Cañon mine in the same district.

W. S. Thyng has concluded his services as secretary of the Northwest Bureau of Mines, Spokane, Wash., and has opened an office for the general practice of mining engineering.

C. A. Coffin has resigned as president of the General Electric Co., and has been made chairman of the board of directors. E. W. Rice, Jr., former senior vice-president, is president.

E. H. Coxe, general superintendent of mines for the Tennessee Coal, Iron & R.R. Co., has accepted the position of general manager of the LaFollette Coal & Iron Co., of LaFollette, Tennessee.

Harry J. Wolf, of Denver, has completed the investigation of copper prospects in Mineral and Lyon counties, Nev., and has gone West to examine gold properties in Calaveras County, California.

Dr. Lauro Muller, minister of foreign affairs of the Republic of Brazil, who is making an extended visit to the United States, inspected the works of the Bethlehem Steel Co., at South Bethlehem, Penn., recently.

J. B. Carrington has been elected president of the Woodstock Iron Co., Anniston, Ala., to succeed Earnest Williams. Mr. Carrington has been connected with the Woodstock Co. for several years, and only recently organized another large iron and steel company at Anniston, which will begin operations soon. M. H. Maury was elected to succeed F. S. Kirkpatrick as vice-president, and M. B. Wellborn to succeed W. C. Ivey as director.

George H. Abeel, Ironwood, Wis., the oldest of the Gogebic mine managers, has resigned his position with Oglebay, Norton & Co., Cleveland, after 26 years of service. He had supervision of iron-ore mining properties of the Montreal Mining Co. in the Gogebic, Wis., district, mines at Buhl on the Mesabi range and properties of the Castile Mining Co., at Wakefield, Mich. Frank B. Goodman succeeds to the managership of the Montreal company's properties, Percy S. Williams to the Castile mines and A. Angst to the Buhl mines.

OBITUARY

Howard H. Dickey died at Cumberland, Md., June 25. He was a graduate of the University of Pennsylvania and had been engaged in the iron trade for many years. With his father he organized the Cumberland Steel & Tinplate Co., which built and operated a rolling mill; and later he was president of the Cumberland Rail Co., which had a mill for rerolling rails.

SOCIETIES

Canadian Electrical Association—The 23d annual convention of this association was held at Toronto, Ont., June 25-27, with over 300 members in attendance, President W. L. Bird occupying the chair. A large number of important technical papers were presented, special prominence being given to the increasing use of electricity as a motive power for vehicles. The secretary's report showed a total membership of 619. D. A. Street, of Ottawa, was elected president; A. L. Mudge, Toronto, first vice-president; B. H. McDougall, Toronto, second vice-president; W. Maclachlan, Trenton, Ont., third vice-president; H. T. Martin, Toronto, secretary-treasurer.

American Society for Testing Materials—The sixteenth annual meeting began at Atlantic City, N. J., June 24. At the opening session, Captain Robert W. Hunt delivered the presidential address in which he spoke chiefly of the application of specifications and the necessity of using judgment in carrying them out. He directed attention to the difficulty that necessarily must be experienced in formulating international specifications and stated that for many years to come most countries will demand specifications which will best apply to their own circumstances, either of production or use.

The society was reported in a flourishing condition, having 1574 members. The following officers were chosen: President, Arthur N. Talbot; second vice-president, Richard Moldenke; members of the executive committee, William H. Bixby, John Brunner, F. H. Clark and Albert Sauveur. President-elect Talbot is professor of municipal and sanitary engineering in the University of Illinois, Urbana, Ill. He has made a number of important contributions to the "Proceedings" of the society.

Wednesday was devoted to iron and steel, there being morning and evening sessions, while Wednesday afternoon was reserved for recreation. Cement and concrete tests were subjects for Thursday; ceramics and road materials for Friday morning and nonferrous metals for Friday afternoon. The final session, Saturday morning, was given to papers on testing and miscellaneous subjects.

INDUSTRIAL NEWS

Among recent orders received by the Hardinge Conical Mill Co., 50 Church St., New York, is one from the W. A. Clark interests at Butte, Mont., for five of their largest-size mills.

The chancery court of Rhea County, Tenn., has appointed H. T. Noyes receiver of the Dayton Coal & Iron Co., at Dayton, Tenn. He is directed to continue the operation of the plant, of which he has been superintendent for some time. The stock of the company is nearly all owned by James Watson & Sons, of Glasgow, Scotland, and the present trouble is due to the recent failure of that firm.

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.

AMALGAMATOR. Eugene E. Thibault, Butte, Mont. (U. S. No. 1,065,563; June 24, 1913.)

DRY BLAST—Improvements in the Obtainment of Dry Air for Use in Blast Furnaces and Other Like Furnaces. Chemische Fabrik Griesheim Elktron, Frankfort-on-Maine, Germany. (Brit, No. 13,050 of 1912.)

IRON-ORE REDUCTION—Process of Producing Metals. Sven Emil Sieurin, Höganäs, Sweden. (U. S. No. 1,065.890; June 24, 1913.)

URANIUM, RADIUM AND VANADIUM—Process of Extracting Values from Ores. Warren F. Bleecker, Canonsburg, Penn., assignor to the Standard Chemical Co., Pittsburgh, Penn. (U. S. No. 1,065,581; June 24, 1912.)

VANADIUM—Process of Purifying Vanadium. Warren F. Bleecker, Canonsburg, Penn., assignor to The Standard Chemical Co., Pittsburgh, Penn. (U. S. No. 1,065,581; June 24, 1913.)

CARTRIDGE—Lime Cartridge for Mining Purposes. Herbert Lushington Storey and Joseph Parkinson, Lancaster, England. (U. S. No. 1,065,261; June 17, 1913.)

DRILL STEEL—Pin-Pulling Machine for Use in Forging the Shank Ends of Drill Steel. John Q. Grant, Denver, Colo. (U. S. No. 1,065,125; June 17, 1913.)

MINE-CAR APPLIANCE. William H. Walker, Johnstown, Penn. (U. S. No. 1,064,795; June 17, 1913.)

ROCK DRILL—James A. Thompson and Edwin M. Mackie, Chicago, Ill., assignors to Chicago Pneumatic Tool Co., Chicago, Ill. (U. S. No. 1,065,007; June 17, 1913.)

CONCENTRATOR. William W. Whitton, Goldfield, Nev. (U. S. No. 1,065,288; June 17, 1913.)

SEPARATION—Apparatus for Separation by the Action of Centrifugal Force. William John Gee, Tulse Hill, London, England. (U. S. No. 1,065,519; June 24, 1913.)

SEPARATORS — Improvements in Electro-Magnetic Ore Separators. G. Rietkotterm, Hagen, Germany, and P. Claes, Brussels, Belgium. (Brit. No. 24,435 of 1912.)

SETTLING CONE—William Main, Piermont, N. Y. (U. S. No. 1,065,542; June 24, 1913.)

EDITORIAL CORRESPONDENCE

SAN FRANCISCO—June 26

The Resignation of M'Nab, U. S. district attorney, followed immediately the postponement of the trial of directors of the Western Fuel Co. by the Department of Justice, together with the postponement of a notorious criminal case. The Western Fuel Co. directors were charged, upon grand jury indictments, with selling 60,000 tons of coal more than their books show was shipped by them into this country. They are charged with maintaining fraudulent scales, corrupting the customs officers and bribing engineers of the Japanese fleet. The attorney general had passed on the evidence and declared it sufficient to put all the defendants on trial. The defendants demanded a short continuance on the ground that their attorney had important business in Washington. Five days later Mr. M'Nab was ordered by wire from the attorney-general to refrain from certain prosecutions in these cases. Mr. M'Nab stated that if compelled to postpone these cases, or refrain from prosecutions, such act would be the last that he would perform as district attorney for the northern district of California.

Ownership of the Town of Forbestown, in Butte County, under mineral patent, is claimed by A. J. Batt, a merchant in the town. The claim is made not only of the land occupied by the town, but the buildings as well. Mr. Batt has not attempted to evict any of the householders who are in possession, but has taken formal possession of all vacant houses, and has denied the owners of houses occupied or unoccupied permission to remove them. The town was settled about 50 years ago, but at that time a survey was either deemed unnecessary, or was neglected through carelessness. In the early mining days at Forbestown the placers furnished all the gold, and like many other mining camps in California, the miners considered their occupancy as only temporary. When quartz mining was undertaken, prior to the working out of the placers, Forbestown became one of the most thriving and productive camps in the state; there was serious talk of surveying a townsite and undertaking the establishment of an organized municipality. This was not done. The failure of Hayward, Lane, Ralston, and Stowe, the pioneer quartz miners, to realize the permanency of the orebodies in the Shakespear, Mexican, Gold Bank and Golden Queen, and the cessation of active mining, rather discouraged the idea of the establishment of a permanent town. The topographical situation and climate of the Forbestown district combine to render it attractive for residence, and many of the early householders have retained their residences regardless of the mining possibilities of the camp. During the last two years the quartz mines have been extensively developed, particularly the Gold Bank-Golden Queen and the Burlington mines, and several smaller old properties have been reopened and some new properties have been prospected. In the present year a 20-stamp mill and 75-ton cyanide plant have been built at the Gold Bank, which are now in operation. The future of the camp is at the present encouraging. The mines lie chiefly north and south of the town. There are evidences that the ore-bearing formations strike through and under the town. Evidently Mr. Batt has realized the present importance of the camp and desires to maintain whatever rights he may possess. The householders of the town have organized the Forbestown Townsite Association for the purpose of carrying the matter to the U. S. Land Office, and have recently had a survey made. It is believed that the only rights that Mr. Batt will be able to maintain will be the mineral rights, the right to locate and develop mining claims within the townsite, but that he can take possession of the surface and surface improvements is doubtful.

DENVER—June 27

Hearing of the Colorado Coal Rate Case between the Consumers' League and the Burlington, Union Pacific and Colorado & Southern railways has been postponed until Aug. 25.

Four Cripple Creek Mergers are under way. First, the one that includes the El Paso, of Beacon Hill, and the Golden Cycle, called the Colorado Railways, Mines & Utilities Corporation (this is the company of which Allen Burris is president, who is now in London negotiating the deal); second is the Raven Hill Consolidated, with the Joe Dandy for a nucleus, taking in the acreage between the Elkton and the Cresson mines; the Gold Hill merger, just commenced, takes in the Moon-Anchor, Anchoria-Leland and Conundrum on Gold Hill; the fourth is on Mineral Hill, including the placers and several lode claims, but of this no details are yet at hand.

SALT LAKE CITY—June 27

The U. S. Assay Office has moved from Post Office Place to the fourth floor of the recently enlarged Federal Building. The new quarters are more convenient, and the most uptodate equipment for the assay of gold and silver bullion has been installed. The Salt Lake office receives bullion from Utah, Nevada, Idaho and adjoining states, having averaged about $100,000 per month since its establishment in February 1909.

The Bingham & Garfield R.R. filed an amendment to its articles of incorporation with the secretary of state June 11, increasing the capital stock from $2,500,000 to $6,000,000. The road is said to have cost about $5,500,000, of which $3,000,000 was in bonds. The stock retains its par value of $100 per share. The reasons for the increase in capitalization have not been given, but it is probably for taking up the bonds. Arrangements to attach a special sight-seeing car to the trains between Salt Lake City and Bingham are to be made. The large concentrating mills at Garfield are passed en route, and a fine view of Salt Lake Valley from the Oquirrh to the Wasatch mountains is obtained.

BUTTE—June 25

An Interesting Judicial Decision was that made June 24 in the district court at Helena, by Judge J. Miller Smith, in settling the estate of John D. Allport. He signed a decree of partial distribution by which the Anaconda Copper Mining Co. comes into the possession of an undivided quarter interest in the Minnie Healy quartz lode claim in the Butte district. The administrator of the estate is directed in the decree to collect from the Anaconda company and pay to the county treasurer $908, the inheritance tax.

A New Use for Waste Products from the Anaconda concentrator has been found. A proportion of two parts sand and one of slime is molded into tile in a new machine recently installed in the brickyard. Although still in the experimental stage, it is believed that the material can be successfully used, as good brick has been made from it. The tile is to be used in draining the Norton and Parrott ranches, consisting of about 1000 acres of land, acquired by the company as an addition to the model farm situated near Anaconda, which has been operated by it for several years, primarily for the purposes of demonstrations in the smoke suit. The tile will be made in sections 2 ft. long by 12 in. diameter, and will be laid in parallel rows from 6 to 9 ft. under the surface, east and west across the area, the drainage to flow into an 18-in. cement drain on the eastern border. It is calculated that about 50,000 linear feet of tile will be used, and already 11,500 ft. of other kinds of tile have been laid. If the new composition is found effective, tile made from it will be largely used in the remainder of the work. On parts of the farm where tile has been laid the effect is apparent, the grain being green and luxuriant, in marked contrast to parts where water still lies near the surface, where the growth has a yellow appearance.

HOUGHTON—June 28

Operations at the Onondaga property in Ontonagon County are confined practically to diamond drilling and to general surface geological exploration. This company was organized and financed a year ago and the exploration work now under way is preliminary to a more elaborate development campaign which will follow. Two diamond drills are in use in making a cross-section examination of a formation which has been found to be commercially valuable at property in that immediate vicinity, notably the White Pine, which is now operating under the direction and management of the Calumet & Hecla. That is about all that can be said of the Onondaga. It takes a long time to develop virgin mineral territory in this region, particularly territory concerning which there is little accurate information. The company was cleanly financed, and is capably managed. R. C. Pryor, the president, owned the land and took no cash for it, putting

it in on a stock basis. His record in other properties, particularly in the development of properties formerly of doubtful value, has been without a failure. His geological knowledge brought this section to his attention, and he is convinced that there is good copper ground in the property. It is being explored economically and conservatively. While the management is unwilling to give out any information whatever regarding the results of the drilling so far attained, there is general knowledge that commercial copper has been opened in at least one of the holes.

Important Developments at the Indiana property at present are reported at the 600- and 1150-ft. levels. On the 600-ft. level commercial copper continues to be opened and the results are of a most satisfactory nature in every way. The most peculiar thing about the formation opened at this point, and it is true also of the class of rock which has been opened at the 1150-ft. level, is the large amount of mass copper that has been encountered with practically no fine copper at all. In this the lode differs from the ordinary amygdaloid lode. In one spot in the 600-ft. opening two tons of mass copper was found. The failure of the drills to find again the No. 2 drill-core showing of copper at 1400 ft. is, frankly discouraging to the management. As the old Cornish miner said, "Where she is, there she is, and sometimes not." The No. 2 drill core showing was beyond a doubt the richest ever made in any exploratory work in the Lake Superior district. It caused a great sensation here and in the East Indiana stock was selling at $40 per share. According to the calculations this formation should have been cut by the shaft shortly before reaching a depth of 1400 ft. It was not found in the shaft, and six diamond-drill holes were drilled horizontally from the bottom. Some of these went in 200 ft., and some as far as 500 ft. None has as yet cut the formation. This seems to be conclusive evidence that there was a decided change in dip in the formation in the immediate vicinity of the core as taken from the hole, for the shaft went down parallel with the drill hole. At the same time there is no reason for pessimism as to the inability to locate the rich lode which the drill core showed to be in that vicinity. It will be found eventually, although it is discouraging, that the opening of this formation should be thus prolonged. A winze will be sunk from the 1150-ft. level, and this will give better opportunity for further opening in the closer proximity to the supposed location of the lode. There is no immediate danger of an assessment on Indiana stock. This company has enough money to operate at the present rate for about five months.

DULUTH—June 28

Stripping on the Cuyuna range is being done at low costs. Several weeks ago it was announced that the Tod-Stambaugh company was stripping the Pennington mine at Crosby for 8c. per yd., and this is easily believable when it is announced that two minutes only was required to load a 28-yd. car with a 5-yd. dipper. Not only that, but within the two minutes the next empty car was spotted for loading. A good record is being made also at the Pittsburg Steel Ore Co. mine at Riverton on the Cuyuna range, where sand suckers are used. For stripping on the Mesabi range, 25c. to 40c. per yard has long been commanded, but the difference in cost between the Cuyuna and the Mesabi is found in the material comprising the overburden. On the Cuyuna it is sand and on the Mesabi, clay, boulders and sand. The cheapness of stripping on the Cuyuna is going to be an incentive to deep stripping.

Revenue from Iron Mines to the state of Minnesota is beginning to loom large. It is estimated that the revenue this year will amount to not less than $1,000,000. Minnesota owns 25 mines that have been developed to the shipping stage; 48 of the 165 state mining leases have developed merchantable ore. All of these developed mines are on the Mesabi range except the Thompson (Inland Steel) at Crosby, on the Cuyuna range. The state gets 25c. per ton royalty for its ores. There is one state lease on which the operating company pays $1.25 per ton royalty. The state gets 25c., and two men divide the dollar. One of the biggest properties owned by the state is the Scranton, once known as the Elizabeth, near Hibbing. This mine has a large tonnage, and the state will in the course of time derive several million dollars in royalties from it. Pickands, Mather & Co. control the Scranton.

The Lake Deposits Decision recently made by the courts, holds that the state of Minnesota has no real ownership over the bottoms of meandered lakes except as a sovereign to protect for the common good. It will be interesting to note how many mines and how much ore will be found under such waters. The item was evidently considered a large one for the state made a strong fight to establish its ownership of such ores, but the courts held that the riparian owners control any such ore. Undoubtedly much ore exists under numerous lakes of the Mesabi range. This suggests that the waters of the Embarrass River will some day be temporarily diverted to enable the production of the Syracuse mine ore, and of ore on the other side of the river. The Syracuse has been partially developed by a shaft, but the work has been suspended on account of quicksand and water. This property is controlled by Pickands, Mather & Co., and eventually this orebody will be developed from the east side of the river where the company has other land to be developed. A large engineering problem, to overcome quicksand and water, is involved.

FAIRBANKS, ALASKA—May 22

The Sluicing Season Opened the last of April, a little later than usual. The breakup of the ice in the Tanana River occurred May 11, but there was not the usual heavy run of ice and only an insignificant rise of water. The outlook is for a prosperous season for the placer mines. The banks of Fairbanks estimate the probable output of the entire Tanana Valley at $5,000,000, a falling off of $500,000 from the figures of 1912. About $4,000,000 of this will come from the Fairbanks district proper, the rest from Hot Springs, Tenderfoot and other outlying camps. As has been the case for several years, the bulk of the production from the creeks adjacent to Fairbanks will come from Goldstream, Ester, Cleary, Dome, Engineer, Little Eldorado and Fairbanks Creeks. The most important result of the winter's prospecting was the discovery of rich pay in what appears to be an entirely new channel on the Niggerhead claim at the mouth of Dome Creek. The locating of the continuation of the Crane Gulch pay on Fairbanks Creek, and the discovery by churn-drilling of good pay in the thawed ground of Cripple Creek, were other important events of the winter. Smallwood Creek was prospected, and several small outfits will be at work there during the summer.

On Fairbanks Creek, more men will be at work than last season, and it is thought that the output will be correspondingly swelled. Upper Cleary will not be lively, but the flats at the mouth of the creek will be the scene of great activity. Keys & Rettig, the largest operators will work from two shafts and expect to strip 100,000 sq.ft. of bedrock. On Dome Creek, as on Cleary, the greatest activity will be on the flats where the creek joins the valley of the Chatanika River. Some large cleanups are expected from the Meyer & Paulson pay on the Niggerhead claim, one of $16,000 having already been made. The output of Little Eldorado will probably show a decrease, although several outfits are working near the head of the creek. Goldstream and its tributaries will again take first place in point of production among the creeks of the camp. On upper Goldstream there will be the usual large amount of open-cut work by scrapers. On lower Goldstream the pay has been traced farther downstream than before, and a large output is expected from that section. Engineer Creek, formerly one of the most important, will witness little activity in a mining way. Ester, with its rich tributary, Eva, will probably show a slight increase in production. A cleanup of $30,000 was recently made on the Happy Home association claim on Eva Creek. The latest advices are to the effect that another attempt will be made to operate the dredge of the Alaska Exploration Co. on upper Fairbanks Creek. So far, the dredge has been a failure, partly because it is antiquated and of a type unsuited to the work to be done, and partly because of the limited amount of dredging ground available.

SUDBURY—June 26

A Department of Safety in charge of E. Corkill; formerly Chief Inspector of Mines for Ontario, has been established by the Canadian Copper Co. at Copper Cliff. This company has experienced a large number of accidents lately and this step is considered in its best interests. Mr. Corkill has had extensive experience in this class of work and in his new position, will be given full power to introduce measures that are conducive to the safety of the workers.

TORONTO—June 28

Silver Thefts in Cobalt have caused the police to endeavor to unearth the people engaged in the manufacture of silver rings, crosses, charms and other articles from silver supposed to have been stolen. On June 21 they arrested two Polish miners, John Borock and Joseph Matiazuik, and seized about 10 lb. of silver, some of which had been manufactured into various trinkets. Later a house was raided and three women arrested, several pounds of silver being found, together with a furnace and tools used in the manufacture. The women were afterward discharged. The men are under arrest, and other suspected persons are being looked for.

THE MINING NEWS

The items in this department are classified by states and counties. Whenever it can be done conveniently the post office address of each company or mine that is mentioned is given in brackets immediately after the name of the mine or company.

ALASKA

IN THE CIRCLE DISTRICT several dredges and several hydraulic outfits are being operated, as well as a large number of small quartz claims. The output, it is thought, will be about the same as last year. The many dumps taken out during the winter have been sluiced, but no accurate estimate is possible as to the amount of gold recovered. It is reported that Deadwood Creek will be unusually active during the summer, as there are many men at work from 50 Below to 50 Above.

GOOD PAY HAS BEEN DISCOVERED in several places on Bear Creek, in the Tuluksak district. On 3A, upper discovery, Sanderson & Thorns are said to have found good prospects with their drill. Discovery claims have been purchased by Manley & Co., of the Iditarod district. A 40-hp. boiler, a three-drum hoist, and a Baggerly scraper have been freighted to the claims, and will be used in opencut work. Several smaller outfits are at work on Bear Creek and its tributaries. All the creeks are shallow, and are said to be dredgible.

FREQUENT RAINS in the Fairbanks district during the last two weeks of May have prevented the water famine that often follows the floods from the melting of the winter snow. All of the placer operators, according to report, are doing well. Nearly all of the dumps taken out during the winter have been sluiced, with results that have, in the main, been satisfactory. With the exception of opencut work, where the ground is left for the sun to thaw, the season's operations are in full swing. O. B. Mallison, on No. 4, Goldstream, who plans to strip about 100,000 sq.ft. of bedrock by scrapers, expected to start sluicing about June 15, and it is probable that the other operators using scrapers will not be far behind.

RHOADS-HALL (Fairbanks)—It is reported that the vein has been picked up at a depth of 315 ft. It was lost at a fault between the 240- and 315-ft. levels and has only been recovered after several months of diligent prospecting.

ALASKA EXPLORATION CO. (Fairbanks)—It is reported from London that the dredge of this company, on upper Fairbanks Creek, will resume operations as soon as a mining engineer can reach Fairbanks from London to take charge.

NEWSBOY (Fairbanks)—It is reported that the vein has been picked up in the east drift of the 215-ft. level, beyond the fault. The vein there is 30 in. wide, and careful panning tests have shown the ore to carry about $40 per ton in free gold. As soon as sufficient ore is blocked out the mill on upper Cleary Creek will be started.

AMERICAN EAGLE No. 2 (Fairbanks)—This property is in litigation between William McDonough and Frederick Fey. A lease has been let for a period of five years, the royalties to be held by the American Bank of Alaska pending the settlement of the litigation. A working shaft has been started on good ore, and it is planned to install the boiler, hoist and the headframe formerly in use on the Pennsylvania claim.

SILVER KING (Koyukuk, via Fairbanks)—This company owns a group of silver-lead claims on which development work will be done this summer. A small boat of the side-wheel type has been built at Fairbanks for transporting supplies to the mine and for delivering the ore to the larger freighters of the Yukon. The boat is equipped with a removable boiler, a steam engine, and an auxiliary gasoline engine. The boiler will be removed when desired for use in mining work.

KEYES & RETTIG (Fairbanks)—The first cleanup of the season from this lease on the Doctor bench claim, lying in the Chatanika flats at the mouth of Cleary Creek, yielded $9000, being a satisfactory figure, as it shows the ground to average about 25c. per wheelbarrow-load. The operators have over 100,000 sq.ft. of pay blocked out by the tunnels, and have not yet reached the limits of the paystreak. It is thought that the ground as a whole will average better than $1 per square foot.

ARIZONA

Gila County

GIBSON (Globe)—Sultan & Wayne, who recently leased this mine, are contemplating treating all the ores left in the old stopes and in the dumps by flotation. This introduction of the flotation method into the district is looked upon with much interest.

Mohave County

BOUNDARY CONE (Oatman)—Plans are being made for a 10-stamp mill and cyanide plant.

BIG EYE (Yuma)—On account of a breakdown in the gasoline engine the mill has been shut down for a few days. Work continues in the mine and good ore is being opened up.

RAINBOW (Chloride)—It is said that this mine is shipping three carloads of ore per week to the Needles smelting works, the average value of which, in gold, silver and lead, is more than $40 per ton.

WHITE ELEPHANT (Cerbat)—A 5-ft. vein of ore of good grade has recently been opened up in this mine and two carloads have already been shipped to the Needles plant. The property is in charge of W. E. Dunlap.

NEVADA-ARIZONA (Kingman)—H. L. Stewart and John Phillips, directors, have been in Kingman making arrangements for the resumption of work on the company's property in the Music Mountains.

GOLCONDA (Golconda)—The hoisting equipment on this property is being overhauled and the shaft straightened and repaired. It is said to be the intention of the management to install a skip and hoist of greater capacity.

WILLIAM'S TUNGSTEN—A road has almost been completed from the Big Sandy road to this Aquarius Range mine and it is expected that a mill will be built. Much development work has been done on the property during the last year and there is a large tonnage of tungsten ore in sight.

COPPER GIANT (Hackberry)—This property has recently been taken under bond and lease for W. A. Clark. A force of men has been working on the mine for the last two weeks and this force will probably soon be increased to 30 or 50. The old shaft has already been sunk to a depth of 200 ft. It is stated that the siliceous ore of the mine was originally intended to be used for converter lining, the copper content being about 4%. At 200 ft. in depth, however, ore containing about 8% copper has been encountered, and is now rapidly being developed.

Pinal County

MOHAWK (Mammoth)—More than two carloads of high-grade zinc ore have been taken out of the large opencut on the crest of the hill. As soon as the wagon road to the mine can be completed the ore will be shipped.

Pima County

ISABELLE (Casa Grande)—The new owners are continuing shipments at the rate of a carload per week. Hoist, pumps and other mining equipment is soon to be installed.

SPOKANE-ARIZONA (Tucson)—Work on the new shaft has been suspended temporarily. The property was examined recently by A. L. Flagg, of Tucson, who is preparing a geological report on the district.

Santa Cruz County

GROSS—The shaft is 100 ft. deep, and drifting has been begun. Good ore is opened up. The company is negotiating for the Kohler claims, which adjoin its property with a view of developing the two groups simultaneously.

RED MOUNTAIN—The new camp is well established, several new buildings including a larger store and assay office having been built. A well has been sunk and equipped with a pump to supply the camp with all the water needed. The lowest tunnel has reached the orebody, and it is now proposed to drive still another crosscut 140 ft. lower than the new tunnel.

Yavapai County

GRUBSTAKE (Walker)—This property was sold recently by Jasper Scrivens to Pittsburgh men, who have started two shafts, one to be 300 ft., the other 500 ft. deep.

GOLD KING (Crown King)—The new management has started a long crosscut to the Swastika vein from the Muldoon gulch. A large oreshoot has already been developed on the Swastika above the 500-ft. level and the new crosscut will cut it at a depth of 600 feet.

SARATOGA—The five-stamp mill on the Lucky Star mine near Yeager Siding has been purchased for the Saratoga and is being moved to its new site. Alters & Kohlen, who have recently leased the Saratoga estimate that they have about 250,000 tons of mill ore available in the mine and on the dumps.

CALIFORNIA

Amador County

DEFENDER—Rolls will be installed to increase the capacity of the 10-stamp mill.

Calaveras County

FOUR METALS MINING CO. (Keeler)—It is reported that the bondholders have accepted the decision of the referee appointed by the superior court at San José, and will accept $17 on the $100 of value of the bonds for the $250,000 worth. The property is being worked by Louis D. Gordon, who agrees to resell to the company upon the payment of $200,000 debts.

UTICA MINING CO. (Angels Camp)—A miner sustained a broken leg and other injuries while riding on a skip loaded with drills, going down the Cross shaft, June 12. At the 900-ft. level some of the drills caught in the side of the shaft, and the signal to stop was evidently not given in time. Three other men were riding in the skip, but were only slightly injured.

Eldorado County

CARPENDAR (Placerville)—The tunnel has been advanced to the 1100-ft. point east from the shaft and has reached the gravel.

SUNSHINE (Placerville)—A tunnel will be driven to cut the main channel at an estimated distance of about 2000 ft. Scarcity of water has hampered sluicing.

FORT JIM (Placerville)—The tunnel is in 1100 ft., the last 950 ft. being in the gravel. No water has been encountered. Dr. J. W. Hyatt is operating the property on a bond and lease.

Humboldt County

HORSE MOUNTAIN (Eureka)—Preparations are being made for hauling the concentrates and sorted ore with a Knox tractor.

HUMBOLDT PLACER MINING CO.—Notice has been published that an assessment of 3c. per share was levied upon the capital stock payable on or before June 16, 1913.

Inyo County

SKIDOO (Skidoo)—The greater part of the 15-stamp mill was destroyed by fire of unknown origin June 2. One battery of five stamps was saved. The mill had been idle since last January on account of repairs on the 21-mile pipe line, and was ready to begin crushing when the fire occurred. The loss is reported at $50,000. The mill had not been idle since its installation in May, 1908, until the pipe line was damaged by the cold weather of last winter. Several hundred tons of ore had been mined ready for milling and cyaniding.

Kern County

KING SOLOMON (Havilah)—The headframe for the new 20-hp. hoist at the King Solomon shaft is completed. The shaft is down 250 ft. A crosscut will be driven south to connect with the large orebody in the ground worked by Teagle-Lamberson and Walton-Wickard-Jensen, whose leases expired June 15. The vein has been developed to a depth of 180 ft. There are three veins in the mine.

Lassen County

CALIFORNIA-DENVER MINING CO. (Doyle)—A small stamp mill has been installed and high-grade ore is being crushed. A larger mill is contemplated.

CALIFORNIA-UTAH MINING CO. (Doyle)—High-grade copper ore has been developed in the shaft at a depth of 13 ft. During the last 30 days several claims have been located in the vicinity of this mine in the belief that the copper-bearing formation is extensive.

Mariposa County

DUSEL (Whitlock)—This mine, which has been idle for a long time, has been bonded to George R. Dalton. The five-stamp mill is being put in order.

COPPER CLAIMS a few miles east of Mariposa have been bonded by Thomas Rodgers and W. M. Eubanks, and several claims have been located. The presence of copper east and southeast of Mariposa has long been known. Some development has been done. The vein lies east of the Mother Lode and strikes northwest and southeast. The ore is a green carbonate on top and blue sulphide below; there is some native copper. The country has not been sufficiently developed to decide if there is copper in commercial quantity.

Modoc County

SUNSHINE-HIGHGRADE (Highgrade)—Nine sacks of ore shipped to San Francisco last season for exhibition purposes have been treated by the Selby smeltery, and reported to have yielded $417 per ton. The sacks contained 664 lb. of ore.

HESS (Alturas)—This mine, 30 miles southwest of Alturas, has been sold to Harvey & Keegle and others. It has been worked for several months under a purchase bond and lease. The mine is equipped with a 10-stamp mill and cyanide plant. The mine is developed by a 200-ft. shaft and drifts at three levels. In the last season's run of about seven months $18,000 was recovered.

Nevada County

GOLDEN CENTER (Grass Valley)—Development work on this mine in the center of the town was begun June 20. There are nearly 100 acres of mineral rights in the holding.

GOLDEN ORIOLE (North Columbia)—The operation of this drift gravel mine at the head of Shady Creek has been undertaken on a bond and lease by Frank Phillips, of San Francisco. A tunnel will be driven to tap the gravel. The channel is believed to be an extension of the North Bloomfield channel.

Placer County

BELLEVUE (Newcastle)—This is an old producing mine being reopened. A crosscut is being run from the shaft at the 400-ft. point to cut the vein disclosed in the Bullion claim adjoining. The drift at the 100-ft. level in the Bullion encountered water 80 ft. from the shaft, which flooded the mine to a point 40 ft. below the collar and threatened three miners. The Bullion will be unwatered with an air-driven pump. Electric power will be substituted for steam for drills and hoist. The lessees contemplate the installation of a modern stamp mill. The dump of the old workings will be milled.

Plumas County

JAMISON (Johnsville)—Work has been resumed after a shutdown during the winter on account of shortage of water for power and milling. Forty men are employed and all 20 stamps are dropping. This was the first stop in the operation of the mine in the last 20 years. The mine is in the Plumas-Eureka district.

Shasta County

ASBESTOS CLAIMS have been located on Mears Creek near the Trinity County line by L. V. Stevens and H. E. Stock, of Hazel Creek.

STRODE (Stella)—A new stamp mill is to be built at this mine. The mill will be erected on Mad Ox Creek near the site of the old Mad Ox mill. A road has been built from the mine to the millsite and the Mad Ox road has been improved. John S. Strode is manager.

DELTA CONSOLIDATED GOLD MINES CO. (Bayles)—The following directors were elected at the annual meeting at Redding recently. E. Sanders, Dr. S. T. White, Frederick Grotefend, W. D. Tillotson, S. D. Furber, Carlos Furber, T. D. Otto, Adolph Bystle and E. E. Morris. The company owns 32 claims on Dog Creek, west of Delta, which are being surveyed for patent.

COLORADO

Eagle County

AT EAGLE the mining boom is still on with new discoveries being reported daily. B. M. White has leased the Dakota to a Colorado mining company. The Dakota Extension and the North Dakota Extension have been leased to John Harvey, of Leadville. The North Dakota has been leased to Marion Henry and Charles Cravens. Oscar Kempf the discoverer of the Lady Belle, has given a lease on the Little Mary to Mr. Hoffman, who is said to be backed by the American National Bank interests of Leadville. The Lady Belle is now working 30 men. Leadville appears to be specially interested in this new silver district.

Lake County—Leadville

NEW MONARCH (Leadville)—Two electric hoists have been ordered for this mine from the Colorado Power Co.

EMMET (Leadville)—The lessees of the Emmet shaft on Carbonate Hill, are about to install a 112-hp. electric hoist.

LITTLE JONNY (Leadville)—Ore that assays 3 oz. gold per ton was opened in No. 4 shaft by Bertonilla, lessee, and shipments will be commenced.

DINERO (Leadville)—This mine has the largest body of ore yet found in the Sugar Loaf section and of good grade. The monthly shipments are to be increased.

FAIRPLAY (Leadville)—A large body of low-grade ore has been opened, the manager stating that he has enough ore blocked out to keep a mill running for several years; he is contemplating the erection of a cyanide plant.

DISCOVERY (Leadville)—In this mine on Fryer Hill, lessees on the Doublecheck shaft have opened oreshoots in two drifts, one being 3 ft. wide and the ore assays 51% lead and 10 oz. silver per ton. The other is 3 ft. wide assaying 33% iron, 17% manganese, 1.6% lead and 5 oz. silver per ton.

ADELAIDE (Leadville)—Ore said to contain 20% lead and 22 oz. silver per ton has been opened in a shaft 150 ft. west of the old Adelaide shaft by George Ward & Co. lessees. The first carload has already been shipped to a smelter and others will follow. H. S. Beaner & Co., sublessees, are also shipping ore from the 300-ft. level.

Park County—Alma

MORNING STAR (Alma)—A 50-ton cyanide plant, the first in the district, is being built by this company.

Summit County

WELLINGTON MINES CO. (Breckenridge)—About 65 tons of excellent grade lead-silver concentrates have been shipped to the local branch sampler of the Chamberlain-Dillingham Ore Co. The concentrates were made in the new magnetic separator mill. All needed repair work will be made while the wet-process, 100-ton capacity concentrator is idle, pending a better price for blende or a reasonable freight rate from the railroad company, which arbitrarily increased the freight rate to $3 per ton from a former rate of $1.75 per ton.

ST. JOHNS MINES, LTD. (Montezuma)—This company was formed in February, 1913, and commenced operations about one month ago. The mine produced substantially within the last two years under another company, shipping about $10,000 worth of concentrate in that period. All the proceeds went into development and, possibly, ill-advised, mill construction, but only internal dissentions brought the company's operations to an end. There are about two miles of workings in the mine, and approximately 500,000 tons of ore is in sight, a considerable proportion of which is already mined. This was back filled in stopes in the early days after hand-sorting the high-grade silver ore, the only material then shipped, and local official records show that ore worth about $6,500,000 was shipped under such conditions.

Teller County

SCHOOL SECTION (Cameron)—Ore is being shipped chiefly from the 650-ft. level where the stope is 250 ft. long by 6 ft. wide; screenings only are shipped.

EL ORO MINING & MILLING CO. (Elkton)—The company has installed a hoist and is running its own compressor. Crushing and cyanide machinery is to be purchased.

PIKES PEAK PLACER (Cripple Creek)—Two dredges are to be installed on this Mineral Hill placer ground. It is stated that in the early days of the district about $80,000 was taken from this ground in nuggets, the water for washing the gold being hauled from Anaconda in barrels.

PORTLAND (Independence)—A new system is being tried with the lessees. They are to receive half of the amount of the check and the company will furnish air and explosives and hoist the ore. It is estimated that the company in this way will receive about 20% net royalty, 30% covering costs. It is stated that the 1600-ft. level is in rich ore and that the mine is in better physical condition than it has been for several years.

IDAHO

Idaho County

DEL RIO (Elk City)—This property, consisting of the Mascot, St. Lawrence, and Del Rio claims, is under lease to Massam Bros.

NATIONAL COPPER MINING CO. (Mullan)—Official announcement has been made of the company's intention to build a 500-ton mill at the mouth of Deadham Gulch, 1½ miles east of Mullan. Men have already been put to work clearing the site for the concentrator and other buildings. The plant will be so built that additional units can be added as required. Electric power will be used, and water for milling will be obtained from the South Fork and Deadman Creeks. A mile-long aërial tram, with a capacity of 70 tons of ore per hour, will connect the mill and the mine. Mill and tram are to be ready for operation Mar. 1, 1914. A contract is soon to be let for a 600-ft. raise on the oreshoot from the tunnel level.

MICHIGAN

Copper

LAKE (Lake Mine)—In a recent shareholders' meeting the president stated that the company was in no immediate need of additional funds, but that a little later, possibly in two or three months, an assessment of $1 would be levied, making the first assessment the stockholders have been called upon to pay.

WYANDOT (Winona)—Drifting from the bottom of the winze, which was sunk on the lode cut by the crosscut from the exploratory shaft, continues opening ground that is satisfactory. A distance of about 225 ft. has been driven and the formation is well charged, carrying large quantities of heavy copper.

LA SALLE (Calumet)—Railroad connections will soon be completed into this property so that rock shipments will be started in the near future. The two shafts have been fitted out with new surface equipment and the underground openings are sufficient to maintain regular shipments as soon as the railroad is connected.

VICTORIA (Victoria)—Operations at this property are concentrated at No. 2 shaft, which is being sunk below the 24th level. Drifts, east from eight levels are developing ground that is very encouraging, and improvement has been noted with depth. Drifting is also going on at the 13th level west, in commercial ground.

AHMEEK (Kearsarge)—The equipment at the new shafts Nos. 3 and 4 will be ready to go into commission about Sept. 1. Ground has been broken for the erection of the addition to the stamp mill and the steel will be delivered about Aug. 1. Contracts for most of the machinery have been let. The order includes a 2000-kw., low-pressure, turbine, generating set, which will utilize the exhaust steam from the stamps and will furnish the electrical power to operate the mill machinery.

Iron

OLIVER IRON MINING CO.—Lake Superior officials of this subsidiary of the U. S. Steel Corporation have been inspecting safety devices and methods at the Gary steel plant and at the South Chicago furnaces of the Illinois Steel Co.

IMPERIAL (Michigamme)—The Cleveland-Cliffs Iron Co. has completed a new steel headframe and crushing plant at this limonite mine. Active mining operations are being delayed until more orders are received for this class of ore.

MINERAL MINING CO. (Iron River)—Both the James and Konwinski mines, sometimes called the Osana and Wauseca, are active; the new steam shovel recently purchased is used at the stockpile. A new concrete brick change house is nearly completed.

OHIO (Michigamme)—The new crushing and hand-picking plant being erected by the Rogers-Brown interests to treat Portland and Ohio limonite ores is nearly completed. It is expected that a good-sized shipment of Portland ore will be made this season.

CASCADE MINING CO. (Palmer)—This company is installing steel ladders with angle-iron sides in the new Isabella shaft that is now being sunk. The ladders are made by W. T. Cole, of Ishpeming. Shaft sinking and equipping of surface plant continue at the Isabella.

PICKANDS, MATHER & CO.—It is announced that after the overburden is stripped from the new Alpha mine, at Mastodon, in the Crystal Falls district, the ore will be mined by "milling." Sinking of shafts and driving of haulage drifts will soon be started. The stripping contract is to be let and the work hurried.

MINNESOTA

STATE IRON LANDS WILL PRODUCE, according to state auditor S. G. Iverson, of Minnesota, in a recent address at Crookston, Minn., 3,000,000 tons of iron ore and $1,000,000 in royalties will be received therefrom. He estimates that existing leases on the state's lands will eventually produce $150,000,000 in royalties.

CUYUNA-DULUTH (Ironton)—The new shaft entered the orebody June 23.

IRON MOUNTAIN MINING CO. (Manganese)—The new three-compartment shaft is within 15 ft. of the orebody. The shaft will be ready for hoisting within a month.

CUYUNA-MILLE LACS (Crosby)—Shipments amount to 5 to 7 cars of manganiferous iron ore daily. This ore is going forward all-rail to consumers, some going as far as Chicago, a distance of about 700 miles. The high-manganese content of this ore permits this long all-rail haul at a profit to the producers. After Aug. 15 this tonnage will go to the Northern Pacific dock at Allouez, Wis.

CUYUNA DOCK CO.—This subsidiary of its Northern Pacific Ry. Co. reports that the new dock at Allouez, Wis., will be ready by Aug. 15. Ore shipments from the Barrows mine (Barrows) and the Cuyuna-Mille Lacs mine (Ironton) will go over this dock. This will mark the Northern Pacific's entry into the ore-carrying trade between mines and upper lake ports.

ROGERS-BROWN ORE CO.—This company has shipped 150,000 tons from its Cuyuna Range properties so far this season. It controls the Kennedy mine (Cuyuna), Armour No. 1 and Armour No. 2 (Crosby). The Kennedy is hoisting 1000 tons daily, the Armour No. 1, 650 tons and No. 2 about 800. In addition, some ore is being loaded from stockpile, making a total of about 100 cars per day, all going to dock at Superior, Wis., via the Soo Line.

DELL DEVELOPMENT CO. (Duluth)—This company was recently organized and is now preparing to move the Jones step-process furnace from Republic, Mich., to some place on the Cuyuna Range, probably Crosby. The Jones furnace was but a partial success on low-grade iron ores, and it is hoped to make a better showing on the low-iron, high-manganese ores of the Cuyuna north range. Officers of the Dell Development Co. are: E. M. Hatton, Neenah, Wis., president; A. G. Jones, Iron Mountain, Mich., vice-president, and Albert Parent, Duluth, secretary and treasurer.

PITTSBURGH STEEL ORE CO. (Riverton)—This company is hydraulicking the overburden from its manganiferous iron-ore deposit and removed 2000 cu.yd. of surface in 12 hr., June 19. The surface is ideal for hydraulic operations, being fine sand, some gravel and few small boulders. Similar surface is being removed by steamshovel at the Pennington pit (Crosby) near-by, at a cost of 8c. per yard. The Pittsburgh Steel Ore Co. has not announced any costs, as its operation is just now getting down to normal. The Soo Line Ry. is constructing a spur toward the property and the new town of Riverton close by.

MONTANA

Deer Lodge County

HIDDEN LAKE (Cable)—Arrangements were made at a recently held meeting to increase the force now employed at the mine. An examination of the property was recently made by an engineer for G. A. Donald, of New York, who has an option on the mine until Sept. 1.

ORO FINO (Georgetown)—State Senator W. H. Dunningan and Charles Bostrom have secured a lease and bond on this property and will begin work at once. A new 15-hp. electric hoist, capable of sinking to a depth of 400 ft. will be installed The mine has been idle for the last eight months, but during the 18 months prior was operated on a lease by Mr. Bostrom.

Fergus County

NORTH MOCCASIN (Kendall)—During May the Barnes-King Development Co., which is operating this mine, mined and milled 3895 tons of ore having an average value of $8.38 per ton. Mining and milling costs were $3.50 per ton, leaving a net profit of $19,002. Of this amount $14,252 was paid on the purchase price of the mine, the remaining $4750 being retained in the treasury. From the beginning of milling operations, Dec. 14, 1912, to May 31, 1913, the company has mined and milled 18,897 tons of ore averaging $8.70 per ton, from which a net profit of $98,278 has been received. Of this amount $73,709 has been paid toward purchasing the property, and $24,569 kept in the treasury. Including the original cash payment of $5000, a total of $78,709 has been paid for the property, leaving a balance of $71,291 yet to be paid.

Lincoln County

PETERSON-BERGSTROM (Libby)—J. J. Hibbard and P. S. Rose, who recently leased this gold property about 25 miles south of Libby, have received returns from a mill test of the ore, which they say is very satisfactory. The test showed that 90% of the gold could be saved. The ore assays about $20 per ton. It is the intention of the lessees to build a stamp mill and concentrator on the property.

KALISPELL-LINCOLN MINING CO. (Libby)—S. F. Ralston, manager, reports that the mill on the company's property in the West Fisher district has been running since June 13. There is a five-stamp mill on the property, to which five additional stamps and a concentrator are to be added this summer. This new equipment was shipped several weeks ago, but has been delayed in arriving here. The road from Libby to the mine has been put in good condition by the county commissioners, including the building of a bridge across West Fisher Creek.

Park County

KIMBERLY-MONTANA GOLD MINING CO. (Jardine)—This company's property was recently sold at a sheriff's sale to William Hutchins, of Chicago. This was one of the richest gold mines in the state, but was closed years ago on the report that it was not paying expenses. Mr. Hutchins, who believes the shutdown was due to poor management, will begin operations shortly.

NEVADA

Clark County

ELDORADO CANYON produced several million dollars worth of gold and silver from surface ores about 30 years ago. Seven years ago G. A. Duncan, a mining engineer of Nelson, found it practically abandoned. Its geological and vein conditions pleased him, and he bought a large group of prospects. Since that time he has been developing these claims, and advising other seekers to exploit this region. Now four mining companies are developing as many groups of claims and all are encouraged in the belief that "The Cañon" is to become a mining center of importance.

Humboldt County

TOTAL SHIPMENTS TO DATE from the camp of Rochester are estimated at about $85,000.

ROCHESTER QUEEN MINING CO. (Rochester)—This company, leasing Block No. 2 of the Elda Finas, made a discovery in surface stripping, of a 4-ft. vein assaying $20. A shaft has been sunk 60 ft. and a drift is being driven on the vein.

EASTERN STAR (Gold Circle)—At this property development work is being done and excellent results are being obtained. The developments have proved up ore beyond expectations, but while the company expects to build a mill eventually, no plans have thus far been made.

Lyon County

COPPER BELT—A 3-ft. vein of good grade copper ore was struck recently in a 10-ft. shaft.

McDONALD-BOULTER—The shaft is now down 160 ft. Some good-grade copper ore is exposed at the bottom.

McCONNELL (Mason)—This mine is shipping 50 tons of good-grade copper ore to the Thompson smelting plant daily. The drift from the shaft at the 200-ft. level is being driven. When completed a larger tonnage of ore will be mined.

BLACK COPPER (Yerington)—This property, which is situated north of the Montana-Yerington, is being developed rapidly. The tunnel is now in 260 ft., and it is estimated that it will have to be driven 60 or 80 ft. farther to cut the vein.

Nye County

SHIPMENTS in tons from Tonopah mines for the week ended June 21 were as follows:

Tonopah Mining	3050	North Star	300
Tonopah Belmont	3553	Mizpah Extension	....
Montana-Tonopah	997	Jim Butler	400
Tonopah Extension	1113	Tonopah Merger	100
West End	965		
Midway	50	Total	11,111
MacNamara	583	Estimated value	$243,290

White Pine County

NEVADA CONSOLIDATED (McGill)—The first of a series of four large Dorr thickeners recently went into service at the Steptoe concentrator. The thickeners are 50 ft. in diameter by 18 ft. in height. The clear water is pumped back for use again in the mill.

OREGON

Baker County

UNDERWOOD PLACERS (Cornucopia)—The manager states that the results of the cleanups are good this season.

MORNING—This mine is being developed under the management of Frank Pierce, for Portland people, owners.

Coos County

WASSON BEACH PLACERS (Empire)—Wasson Bros., owners, state that they have had satisfactory results from work on their mines on Coos Bay. They have saved considerable platinum.

Curry County

RED RIVER GOLD MINING & MILLING Co.—At this property on the lower Rogue River there are two 6-in. and two 4-in. giants in operation on the placer mines, and the quartz property is being developed. More than 800 ft. of tunnels has been driven on the property during the last winter.

Josephine County

HUMDINGER (Grants Pass)—This mine, which has only been opened up a short time, is owned by Mascall & Scroggin. A bar of gold worth about $750, was recently made after seven wagonloads of ore had been treated in a mill three miles away. The mine is in the Williams district, and the owners will install machinery so that the ore can be treated at the mine.

UTAH

Beaver County

MOSCOW (Moscow)—The monthly output is about 600 tons, the ore being mined from four or five different faces. The drift on the 700, which is being driven for the Moscow vein is approaching its objective point. Much of the ore recently mined has come from above this ground, on the 500- and 600-ft. levels; 80 men are employed.

MAJESTIC (Milford)—This company is shipping copper ore from the Harrington and Hickory properties at the rate of about 40 cars per month. Shipments of ore of this character have been made for about 14 months, during which time most of the output has come from surface workings. More recently the 100-ft. level has been supplying a good share of the ore.

Juab County

TINTIC SHIPMENTS for the week ended June 20 were 157 cars.

EAGLE & BLUE BELL (Eureka)—The new high-grade gold-silver orebody opened on the lower levels has been found to extend from the 1200- to the 1350-ft. level.

CHIEF (Eureka)—Connections at depth have been completed between this property and the Gemini. This will afford good ventilation in both mines, as well as another exit. In the Chief, the shaft has hitherto been the only outlet from the lower workings.

UNITED TINTIC (Silver City)—Preparations are being made for resuming operations below the water level, the work to be financed from the recently levied assessment of ½c. per share. The shaft will be unwatered, and the north crosscut between the 200- and 300-ft. levels continued to the Bullock vein, along which drifting will be started. Conditions are more promising here than near the surface, as the vein grows wider as it approaches the water level. About 20 cars of ore have been mined from this vein in the past, but operations have always been arrested by water coming in.

Summit County

PARK CITY SHIPMENTS for the week ended June 20 were 1425 tons.

AMERICAN FLAG (Park City)—High-grade ore carrying gold, silver and lead is being mined from the new vein, recently opened.

THOMPSON-QUINCY (Park City)—At a special meeting of stockholders held June 21, the question of a bond issue was voted on affirmatively. This will provide funds for development and for immediate obligations. Ore is being mined from the recent find.

C. C. CONSOLIDATED (Park City)—The upper part of the shaft, rotted from disuse, has been retimbered, and sinking below the 450 level will be begun. Prospecting has recently been done in old workings on the 250-ft. level, and some ore has been opened.

WASHINGTON

Ferry County

NORTH WASHINGTON POWER CO. (Republic)—Extensive improvements are being made in the mill. The old engine is being torn out, and an excavation for a 40x32-ft. addition to the power house is being dug. A 700-hp. corliss engine, an air compressor, and an additional electric generator will be immediately installed, and a 150-hp. boiler will be added later. The cyanide plant is undergoing general overhauling, the work at present being the setting of the second 5x22-ft. tube mill. Later two additional tube mills will complete the equipment.

CANADA

British Columbia

NOBLE FIVE (Sandon)—Men are being put to work at this mine and the regular force will be engaged in development work within a week.

SILVERTON MINES, LTD. (New Denver)—The new mill to treat the ore from the Hewitt group is working satisfactorily; a few improvements are now being made.

CONSOLIDATED MINING & SMELTING (Rossland)—Following the announcement of the extension of the lead bounties for five years, the directors have placed the stock on a regular 8% basis.

BRITISH COLUMBIA COPPER CO. (Greenwood)—A concentrator is to be built at the Voight properties, near Princeton, according to a report. The action is prompted by results obtained from diamond drilling, and other investigations during the last two years.

CAPELLA (New Denver)—W. R. Will is clearing the trail to this mine on Goat Mountain, and work will probably be commenced this month. Some of the highest-grade ore mined in the district was taken out of the Capella some time ago, one car of ore giving smelter returns of $10,000.

DIVIDEND LAKEVIEW (Oroville, Wash.)—Recent developments in the Dividend, Lakeview and Gold Dust properties, in the Hedley district, are most satisfactory. Dividend Lakeview resumed shipments last week as the properties have blocked out and on the dump approximately 10,000 tons of $15 to $25 ore. Jacob L. Greatsinger, formerly president of the Brooklyn Rapid Transit Co., and who has been interested in the Mesabi iron mines, is in Oroville directing operations. Frank Sweeny, who is associated with the Guggenheims, is actively interested in the management of the Gold Dust properties.

Ontario

RIGHT OF WAY (Cobalt)—This company, capitalized at $2,000,000, of which 1,635,500 shares were issued, has surrendered its charter and will dissolve July 7.

SAVAGE (Cobalt)—A discovery of high-grade ore has been made on this property south of Cart Lake. Where intersected, the vein showed 3 in. of 5000-oz. ore.

HUGHES-PORCUPINE (Porcupine)—The shaft is 260 ft. deep and is being continued to the 300-ft. level. A 10-ft. vein has been cut at the 200-ft. level 60 ft. from the shaft. The 2-stamp mill is again in operation after having been hung up for several weeks.

SHIPMENTS of ore and concentrates in tons, from Cobalt for the week ended June 27 were as follows:

Bailey	.....	La Rose	98.14
Beaver	.....	Lost and Found	.....
Buffalo	.....	McKinley-Darragh	32.60
Casey Cobalt	.....	Nipissing	.....
Chambers-Ferland	64.57	Nipissing Reduction	.....
City of Cobalt	.....	O'Brien	41.95
Cobalt Lake	32 28	Penn.-Canadian	.....
Cobalt Townsite	42.00	Provincial	.....
Colonial	.....	Right of Way	.....
Coniagas	.....	Seneca Superior	.....
Crown Reserve	.....	Silver Bar	.....
Dominion Reduction Co.	43.18	Silver Cliff	.....
Drummond	.....	Timiskaming	.....
General Mines	.....	Trethewey	.....
Green Meehan	.....	Wettlaufer	.....
Hargraves	.....	York	.....
Hudson Bay	.....		
Kerr Lake	.....	Total	354.72

MEXICO

Durango

BACIS (Bacis via Gavilanes)—This company has been obliged to suspend operations. The foreign force is in Mazatlan awaiting more settled conditions.

CINCO DE MAYO (La Descubridora)—The last carload of ore shipped to Douglas sold for over $8000. The property was owned by Col. Francisco H. Garcia, but was seized by the state government on account of Garcia being a Huertista.

Sonora

EXPORTS OF METAL AND ORE through the port of Agua Prieta in the month of May amounted to 1,724,800 pesos as compared with 2,326,100 pesos in April. The decrease is due in part to the cessation of operations at the Nacozari plant during the strike.

IN THE OPUTA DISTRICT there seems to be a slight recovery from the unsettled conditions caused by the revolution. For the greater part of two years the properties have been idle. Among those opened up again recently are La Caridad, Good Enough, La Maria, San Ignacio, El Saffo, El Alico, La Marageza and Agua Maga.

SOUTH AMERICA

Venezuela

CANADIAN VENEZUELAN ORE CO.—This company has authorized a new issue of $500,000 bonds, the proceeds to be used for additional machinery at the Imataca mines, and for improving shipping facilities. The company has been hampered by the difficulty in securing steamers to carry ore, but has now been able to make additional charters, so that by late fall it will be able to ship 30,000 tons a month.

AUSTRALIA

Tasmania

THE EXISTENCE OF NICKEL ORE near Mt. Leehan has been known for a number of years, but nothing has been done until recently. Prospecting has been carried on by the Mt. Leehan Mining Co., and it has been decided to carry on explorations on a large scale through a subsidiary called the Cuni Mines, Ltd. The small quantity of ore so far found is chiefly pyrrhotite, carrying 4 to 14% nickel and 4.3 to 6% copper. The extent of the deposits is uncertain.

THE MARKET REPORT

METAL MARKETS

NEW YORK—July 2

The holiday week and the midsummer season have combined to make the metal markets quiet. Prices have not been strong, though fluctuations have been small.

By a misprint in part of the edition of the "Journal" last week the upper range of the price of Lake copper, June 19-25 was printed 15.75 instead of 14.75, as it should have been. The mistake was discovered and corrected on the press, so that it appears only in about 1150 copies; in the rest the figures are correct.

COPPER, TIN, LEAD AND ZINC

Copper—The market has been rather featureless throughout the week. Leading sellers have not changed their limits, but an appreciable amount of copper is being offered by the smaller producers and dealers at the last prices, at which small transactions are taking place from day to day, principally for shipment to Europe. The close is undecided at 14.50@14.75c. for Lake, and 14.40@14.45c. for electrolytic copper in cakes, wirebars and ingots, while casting copper is quoted nominally at 14.15@14.20c. as an average for the week.

The London market has fluctuated within narrow limits, and the close is quiet at £63 15s. for spot, and £64 for three months.

Base price of copper sheets is now 20c. per lb. for hot rolled and 21c. for cold rolled. Full extras are charged, and higher prices for small quantities. Copper wire is quoted at 16c. per lb., for carload lots at mill.

Exports of copper from New York for the week were 6174 long tons. Our special correspondent gives the exports from Baltimore at 1560 tons for the week.

Brass Prices—Base prices, dating from July 1 are as follows: Sheets, high brass, 18c. net per lb.; low brass, 17⅞c. Wire, high brass, 15¾c.; low brass, 17⅞c. Rods, high brass, 15¾c.; low brass, 18⅝c. Tubes, brazed, 20½c.; open seam, 20½c. Brass angles and channels, 20½c. Scrap allowances, 10½c. net per lb. for high brass; 11⅞c. for low brass.

Tin—Under further onslaughts by the bear group, the London market broke very badly. There seemed to be no supoort forthcoming from any side, and even the excellent statistics which were published at the beginning of this month failed to arouse interest in the metal. Reports were current in London of a considerable falling-off of consumption in this country, but these rumors alone could not have brought about the severe decline.

Very little interest is shown by consumers in this market, and the continuous decline scares off buyers rather than attracts them. The little business which is done is confined to spot material, which is still closely held. The market closes weak at £188 10s. for spot, and £189 for three months, and at about 41¼c. for July tin here.

Visible stocks of tin on June 30, including tin afloat were: London, 6511; Holland, 929; United States, excluding Pacific ports, 3661; total, 11,101 long tons, a decrease of 2609 tons from May 31, and of 1819 tons from June 30 last year.

Lead—The market is unchanged at 4.17½@4.20c. St. Louis, and 4.30@4.35c. New York.

The London market is still in a very unsettled state. This week there has been a sharp decline, and the close is active at £19 7s. 6d. for Spanish lead and 7s. 6d. more for English.

Spelter—The improvement in the market for this metal has continued throughout the week. It is reported from the smelting centers that a curtailment has taken place in practically all plants, largely due to the fact that the smelting works find it impossible to secure an adequate supply of ore, the production of which has suffered considerably on account of unremunerative prices. On this account there is not much inclination to sell and the market is sensitive upward. The developments in Europe will probably determine in a large measure how much further the improvement can go. The close is strong at 5.05@5.15c. St. Louis, and 5.20@5.30c. New York.

The London market is very much depressed, due to the large accumulation of spelter in the hands of the Zinc Convention. The close is unchanged at £20 15s. for good ordinaries, and £23 7s. 6d. for specials.

The price of zinc sheets was reduced ¼c. per lb. on June 25, and is now $7 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

Silver has been very steady, with no pronounced tendency in either direction. Buyers for the future are watching the India crop prospects; these in turn are dependent on the Monsoon rains, which up to the present are understood to be moderately good.

JUNE AVERAGE PRICES

Average prices of metals for the month of June were as follows:

Silver, 58.99c. per oz., New York; 27.199d. London.

Copper, 14.672c. per lb. electrolytic; 4.871c. Lake; £67.14 per ton London standard

Tin, 44.82c. New York; £204.208 London.

Lead, 4.325c. New York; 4.190c. St. Louis; £20.226 London.

Zinc, 5.124c. New York; 4.974c. St. Louis; £22.143 London.

DAILY PRICES OF METALS

NEW YORK

June-July	Sterling Exchange	Silver	Copper		Tin	Lead		Zinc	
			Lake, Cts. per lb.	Electrolytic, Cts. per lb.	Cts. per lb.	New York, Cts. per lb	St. Louis, Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.
26	4.8665	58⅛	14.50 @14.75	14.40 @14.45	43¼	4.30 @4.35	4.17½ @4.20	5.15 @5.20	5.00 @5.05
27	4.8665	58⅛	14.50 @14.75	14.40 @14.45	42⅝	4.30 @4.35	4.17½ @4.20	5.15 @5.25	5.00 @5.10
28	4.8665	58⅜	14.50 @14.75	14.40 @14.45	42⅜	4.30 @4.35	4.17½ @4.20	5.15 @5.25	5.00 @5.10
30	4.8665	58⅜	14.50 @14.75	14.40 @14.45	42⅜	4.30 @4.35	4.17½ @4.20	5 20 @5.25	5.05 @5.10
1	4.8675	58⅛	14.50 @14.75	14.40 @14.45	41⅛	4.30 @4.35	4.17½ @4.20	5.20 @5.30	5 05 @5.15
2	4.8660	58⅛	14.50 @14.75	14.40 @14.45	41¼	4.30 @4.35	4.17½ @4.20	5.20 @5.30	5 05 @5.15

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. below that of electrolytic. We quote casting copper at 0.15c. below the price for electrolytic. The quotations for lead represent wholesale transactions in open market for good ordinary brands, both desilverized and non-desilverized; the specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium. Silver quotations are in cents per troy ounce of fine silver.

LONDON

June July	Silver	Copper			Tin		Lead, Spanish	Zinc, Ordinaries
		Spot	3 Mos	Best Sel'td	Spot	3 Mos		
25	26 11/16	64	64⅛	69½	198½	199½	20	21
27	26 13/16	63 15/16	63 13/16	69	194	195	19¾	21
28	26 13/16	....	....	....	....	....	....	....
30	26 11/16	64½	64⅜	69½	193¾	194½	19⅜	21
1	26 13/16	63½	63½	69	189½	190	19⅜	20¾
2	26 13/16	63¾	64	69¼	188½	189	19⅜	20¾

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 = 0.21¾c.

Other Metals

Aluminum—Business has been rather light and unsettled. Quotations are variable, and some low prices are reported. A fair range appears to be about 23¼@24c. per lb. for No. 1 ingots, New York. Foreign is quoted at 19@19½c., in bond.

Antimony—Business is of a retail order only, and prices are unchanged. Cookson's is 8.65@8.75c. per lb.; Hallett's, 8@8.25c.; while 7.50@7.75c. is asked for Chinese, Hungarian and other outside brands.

Quicksilver—The market has been quiet and prices are unchanged here at $40 per flask of 75 lb., with 60c. per lb. for small orders. San Francisco, $39.50 for domestic orders and 37 for export. London, £7 10s. per flask, with †7 2s. 6d. asked from second hands.

Bismuth—The syndicate which controls the European production quotes 7s. 6d.—equal to $1.80—per lb. in London. In New York a quotation of $1.72 per lb. is made for metal produced from American ores.

Cadmium—The latest quotation from Germany is 725@750 marks per 100 kg. f.o.b. works in Silesia. This is equal to 78.27@80.97c. per lb. at works.

Magnesium—The price of pure metal is $1.50 per lb. for 100-lb. lots f.o.b. New York.

Nickel—Shot, block and plaquettes are quoted at 40@45c. per lb., according to quality and size of order. Electrolytic nickel is 5c. per lb. higher.

Selenium—Producers of this metal quote large lots at $2.75@3.50 per lb., according to size of order; while as high as $4.50@5.50 is paid for retail lots.

Included in the exports from Baltimore last week were 1323 lb. selenium to Hamburg.

Exports and Imports of Metals, other than iron and steel, in the United States, four months ended Apr. 30, are reported as follows:

	Exports		Imports	
Metals:	1912	1913	1912	1913
Copper, long tons	118,280	143,196	61,604	63,082
Tin, long tons	101	226	18,857	18,114
Lead, short tons	25,400	17,290	34,403	30,726
Zinc, short tons	5,060	1,754	1,038	383
Zinc in ore, lb.	9,867,834	7,637,649	9,936,295	15,839,388
Nickel, lb.	8,927,931	10,465,730	13,024,663	15,628,264
Antimony, lb.	40,320	30,413	5,355,172	8,196,494
Aluminum, lb.	9,656	10,907	9,353,082	10,637,493
Quicksilver, lb.	9,594	28,099	.....	.....
Platinum, oz.	.....	629	32,732	45,330
Ores, etc.				
Zinc oxide, lb.	12,464,255	10,289,802	.....	.....
Zinc dross, lb.	364,695	56,786	.....	.....
Zinc dust, lb.	.....	76,097	.....	1,436,595
Zinc ores, tons	9,182	4,453	14,786	15,664

Copper, lead, nickel and antimony included the quantities of metal in ores, matte, bullion, etc. Quantity of antimony ore is not given. Zinc dust was not given separately last year. The exports include reëxports of foreign material.

Exports of metals and minerals from Spain three months ended Mar. 31, reported by "Revista Minera," in metric tons:

	Metals		Ores	
	1912	1913	1912	1913
Pig and mfd. iron	18,702	2,983	2,204,240	2,540,326
Copper	5,725	4,837	37,653	43,344
Copper precipitate	2,712	1,424	.....	.....
Lead	43,695	51,010	850	439
Zinc	549	22	.....	.....
Quicksilver	624	419	.....	.....
Manganese	....	....	10,563	5,346
Pyrites	....	....	716,326	783,876

Pyritic ores carrying 2.5% or over in copper are classed as copper ores; below that point they are included in pyrites. Exports of salt were 137,675 tons in 1912, and 141,352 tons this year.

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. Germany continues to take some gold, but there was less pressure for supplies than for some weeks past.

Imports of gold in Great Britain five months ended May 31 were £21,528,115; exports, £14,818,064; excess of imports, £6,710,051, an increase of £1,770,271 over last year.

Platinum—The market is quiet and not specially active, but prices are steady and unchanged. Current quotations here are $45@46 per oz. for refined platinum and $49@52 for hard metal.

Iridium—Supplies are not increasing, and with a steady demand prices do not decline. Dealers continue to ask about $85 per oz. for pure metal.

Gold and silver movement in the United States five months ended May 31, as reported by the Department of Commerce and Labor:

	Gold		Silver	
	1912	1913	1912	1913
Exports	$26,225,801	$63,165,301	$28,623,018	$28,590,221
Imports	19,653,285	24,522,621	30,384,764	15,766,510
Excess, exp.	$6,572,516	$38,642,680	$8,238,254	$12,823,729

For the five months this year exports of merchandise were valued at $1,002,853,092; imports at $748,083,165; excess of exports, $219,779,927. Adding gold and silver gives a total of $271,246,319 as the export balance.

Imports of silver in Great Britain five months ended May 31 were £6,866,468; exports, £5,795,883; excess of imports, £1,070,585, an increase of £951,840 over last year.

Exports of silver from London to the East, Jan. 1, to June 19, reported by Messrs. Pixley & Abell:

	1912	1913	Changes
India	£3,270,300	£3,437,000	I. £166,700
China	873,500	344,500	D. 529,000
Total	£4,143,800	£3,781,500	D. £362,300

Imports of silver at New York for the week were $136,144, chiefly from Central America; exports were $847,000 to London and Paris. Imports of gold for the week were $781,446, mainly from Mexico.

Zinc and Lead Ore Markets

JOPLIN, MO.—June 28

The high price of zinc blende is $45.50, the base per ton of 60% zinc ranging from $40@43.50. Calamine sold on a base of $20@24 per ton of 40% zinc. The average of all grades is $40.46 per ton. Unchanged lead prices prevailed again; the base is $52.50 per ton of 80% metal contents, and the average of all grades is $52.20 per ton.

SHIPMENTS WEEK ENDED JUNE 28

	Blende	Calamine	Lead ore	Value
Totals this week.	10,614,280	465,800	1,429,300	$261,588
Totals six months	283,292,680	18,886,690	47,261,360	7,903,280

Blende value, the week, $218,884; six months, $6,414,887.
Calamine value, the week, $5,331; six months, $246,171.
Lead value, the week, $37,426; six months, $1,242,222.

OTHER ORES

Manganese Ore is quoted in London as follows, c.i.f. United Kingdom port: Indian or Brazilian, 50% manganese, 22@22½ per unit; 48%, 21@22c. Caucasian, 50%, 18½@19c.; 48%, 18¼@18½c. per unit.

IRON TRADE REVIEW

NEW YORK—July 2

There seems little doubt that the iron and steel markets are in an improving condition. It is not so much that there has been any actual improvement as shown by a definite increase in orders; but there is a decided easier tone and the pessimistic feeling which has held possession of buyers is passing away.

The strong features are the maintenance of full production of finished steel and the almost complete absence of cancellations or postponements on contracts; the general maintenance of steel prices, and the growing stiffness of pig-iron prices. There are no signs of any letting down in activity, or of more than the absolutely necessary holiday stops. The mills have enough work to carry them on for some time, and the gradual increase in orders looks as if there would be little or no cessation of work between the present time and the end of the year. Buyers have been holding out of the market until their stocks of material have run down to a low point, and it is the belief of many that August, at latest, will see active purchases to meet orders that must be filled.

Pig iron has shown no further recessions. There has been some quiet buying, which has strengthened the market. All indications are that there have been transactions which have been kept quiet by both buyers and sellers, but which have decidedly strengthened the situation. Steel scrap has shown a good deal of firmness, and an advance is expected.

PITTSBURGH—July 2

The only change in the market this week appears in the talk of a probable readjustment of wire prices. Actual sales

and prices of wire products have been under the nominal quotations. The talk is that a reduction from those nominal figures of about $3 per ton will be made, putting plain wire on a basis of 1.45@1.50c., and nails at $1.65. It is about time for such a readjustment.

Pig Iron—Pig iron is firm. On the surface the market is dull, but there are many reports of quiet buying. At any rate there is apparent a strong resistance to any further concessions and none have been made. We continue to quote: Bessemer, $16; basic, $14.50; malleable, $14.25; No. 2 foundry, $14; forge, $13.75, f.o.b. Valley furnaces, 90c. higher delivered Pittsburgh.

Ferromanganese—Small sales are still reported at a cut from former quotations. It is now generally believed that the Senate Amendment will prevail, letting ferromanganese in free. We quote prompt at $59, and contract nominal at $61, Baltimore, freight to Pittsburgh being $2.16 per ton.

Steel—There is no change in the situation. Mills are firm in their views, and might ask a premium for prompt lots, but just at present there is no urgency to buy. We quote forward unchanged at $26.50@27 for billets and $27@27.50 for sheet bars, maker's mill, Pittsburgh or Youngstown. Rods remain at $29, Pittsburgh.

German Pig Iron Production in May is reported at 1,641,600 metric tons by the German Iron & Steel Union. For the five months ended May 31 the total make was, in metric tons:

	1912	1913	Changes 9
Foundry iron	1,318,752	1,500,235	I. 181,463
Forge iron	230,118	221,620	D. 8,458
Steel pig	848,749	1,055,211	I. 206,492
Bessemer pig	163,274	145,317	D. 17,97
Thomas (basic) pig	4,551,438	5,036,935	I. 485,178
Total	7,112,331	7,959,318	I. 846,987

The total increase this year was 11.9%. Steel pig includes spiegeleisen, ferromanganese and all similar alloys.

Foreign Trade of the German Empire in iron and steel and in machinery four months ended Apr. 30, in metric tons:

	Exports		Imports	
	1912	1913	1912	1913
Iron and steel	1,926,473	2,171,745	213,596	208,917
Machinery	161,766	178,846	26,448	27,988
Totals	2,088,239	2,350,591	240,044	236,905

Increase in exports this year was 262,352 tons; decrease in imports, 3139 tons.

IRON ORE

Shipments of Lake Superior ore continue large and steady, though they are hardly coming up to early expectations. Shipments from Lake Erie docks to furnaces have been on a good scale.

COKE

The coke market is unchanged. Production and shipments of Connellsville coke continue about as they have been for several weeks past. No second-half furnace contracts have been closed, but some July contracts are reported at $2.50 per ton.

The Pennsylvania legislature has passed and the Governor has signed the bill imposing a tax of 2½% ad valorem on antnracite mined. It took effect July 1. It is said that the anthracite companies will contest the law on the ground that it is unconstitutional.

Exports of Fuel from Great Britain five months ended May 31 were: Coal, 29,519,825; coke, 424,334; briquettes, 837,070; coal sent abroad for use of steamships in foreign trade, 8,366,021; total, 39,147,250 long tons. This is an increase of 11,302,886 tons, or 40.8%, over last year, when the trade was cut down by the miners' strike.

CHEMICALS

NEW YORK—July 2

The general market is dull and quiet, as might be expected at this season. There is not much business forward.

Arsenic—The market is dull, and there is very little buying, although consumers are carrying no stocks of any account. The situation is weak and prices are again lower at $3.12½@3.25 per 100 lb. There are no signs of improvement.

Copper Sulphate—Trade is only moderate, but prices are steady at $5.25 per 100 lb. for carload lots and $5.50 per 100 lb. for smaller parcels.

Nitrate of Soda—The market is dull, as is usual at this time of year. Prices are off a little, 2.35c. per lb. being asked for both spot and futures.

PETROLEUM

Production of oil in California in May is reported at 8,098,138 bbl.; deliveries, 9,566,079 bbl. The stocks reported were 46,367,329 bbl. at the end of the month.

NEW CALEDONIA ORES

Exports of ores from New Caledonia four months ended Apr. 30, as reported by the "Bulletin du Commerce" of Noumea, were 19,179 metric tons nickel ore and 2854 tons chrome ore. Exports of metals were 2213 tons nickel matte.

COPPER SMELTER'S REPORTS

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

	Feb.	March	April	May	June
Alaska shipments	660,250	472,293	1,730,252	1,771,508	.....
Anaconda	21,250,000	22,900,000	23,800,000	25,600,000	.....
Arizona, Ltd	3,000,000	3,200,000	3,100,000	3,200,000	.....
Copper Queen	6,810,706	7,558,709	8,210,166	8,301,605	.....
Claumet & Ariz	4,050,000	4,250,000	4,500,000	4,300,000	.....
Chino	3,898,998	4,464,723	3,925,409	3,883,611	.....
Detroit	1,689,277	1,640,671	1,856,517	2,001,633	.....
East Butte	1,325,000	1,400,000	1,400,000	1,268,595	.....
Mammoth	1,661,150	1,641,091	1,450,000	1,700,000	.....
Giroux*	600,000	625,000	600,000	625,000	.....
Mason Valley	1,348,070	1,608,492	1,264,304	1,186,560	.....
Miami	.....	.....	.....	1,943,900	.....
Nevada Con	4,798,537	5,555,320	5,650,000	5,933,275	.....
Ohio	380,849	591,651	690,001	650,071	.....
Old Dominion	2,381,000	2,853,000	3,040,000	2,749,000	.....
Ray	3,610,000	4,287,000	4,379,128	4,384,400	.....
Shannon	1,152,000	1,260,000	1,238,000	1,080,000	.....
Sontz, Utah	*nil*	62,224	132,267	200,000	.....
Tennessee	1,600,151	1,796,394	1,718,188	.....	.....
United Verde*	2,750,000	3,000,000	3,000,000	3,000,000	.....
Utah Copper Co	7,585,303	8,248,880	9,539,847	10,003,227	.....
Lake Superior*	19,000,000	19,000,000	17,000,000	18,705,000	.....
Non-rep. mines*	5,399,849	6,203,606	6,000,000	6,300,000	.....
Total prod	94,951,140	102,619,054	104,224,079	.....	.....
Imports, bars, etc.	21,372,292	24,215,480	25,578,297	.....	.....
Total blister	116,323,432	126,834,434	129,802,076	.....	.....
Imp. ore & matte	9,459,432	11,911,041	7,177,363	.....	.....
Total Amer	125,782,864	138,745,475	136,989,439	.....	.....
Miami	2,817,200	3,102,200	2,312,900	.....	.....
Shattuck-Arizona	1,136,480	1,234,450	1,158,326	1,026,170	.....
Brit. Col. Cos:					
British Col. Cop	688,312	844,735	794,000	.....	.....
Granby	1,740,000	1,967,962	1,857,452	1,782,570	.....
Mexican Cos.:					
Boleo†	2,535,680	2,204,720	2,811,200	2,424,800	.....
Cananea	4,880,000	4,772,000	3,581,690	272,0002,	.....
Moctezuma	2,730,914	3,062,159	2,753,240	2,695,881	.....
Other Foreign:					
Braden, Chile	1,178,000	1,472,000.	1,512,000	1,150,000	.....
Cape Cop., S. Af	712,320	732,480	586,880	387,520	.....
Kyshtim, Russia	1,352,960	1,478,400	2,544,640	.....	.....
Spassky, Russia	1,003,520	974,400	974,400	721,280	.....
Exports from					
Chile	5,824,000	7,840,000	7,616,000	3,584,000	.....
Australia	5,512,000	6,944,000	6,608,000	7,840,000	.....
Arrivals—Europe ‡	8,509,760	15,585,920	10,545,920	13,661,760	.....

† Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister. From May 1, Miami copper is refined in the U. S. and apperas under American mines.

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

STATISTICS OF COPPER

	United States			Visible Stocks.		
Month	U.S.Refin'y Production	Deliveries, Domestic	Deliveries, for Export	United States	Europe	Total
VI, '12.	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	105,312,589	78,491,840	183,904,422
II.	130,948,881	59,676,492	72,168,523	123 198,332	77,504,000	200,702,332
III.	136,251,849	76,585,471	77,699,306	122,302,890	81,244,800	203,547,690
IV.	135,353,402	78,158,837	85,894,727	104,269,270	87,180,800	191,450,070
V.	141,319,416	81,108,321	68,285,978	75,549,108	85,948,800	161,497,908
VI.	.....	.....	.....	67,474,225	77,235,200	144,709,425
VII.	.....	.....	.....	.....	.....	.....

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

Assessments

Company	Delinq	Sale	Amt.
Arlington, Ida	July 3	Aug. 4	$0.302
Aurora-Sampson, Ida	June 16	July 16	0.002
Big Elk, Ida	June 10	July 10	0.001
Black Pine, Utah	June 30	July 21	0.005
Caledonia, Nev	June 3	July 25	0.05
Con. Virginia, Nev	July 9	July 30	0.10
East Hecla, Ida	June 18	July 25	0.003
Etna King, Calif			0.01
Giant M. & D. Co	June 17	July 17	0.001
Gould & Curry	July 14	Aug. 5	0.03
Houghton Copper, Mich		July 15	1.00
Hypotheek, Ida	June 20	July 14	0.004
ImperialM. & M., Ida	June 2	July 21	0.002½
Imperial Mg., Ida	June 10	July 15	0.002½
Mineral Farm, Ida	June 7	July 7	0.002
Old Evergreen, Utah	June 17	July 17	0.01
Oreano, Ida	June 9	July 9	0.001
Savage, Nev	July 14	Aug. 5	0.05
Sierra Nevada, Nev	June 24	July 5	0.10
Silver Flat, Utah	June 23	July 7	0.001
Silver Moon, Ida	June 2	July 26	0.005
Silver Pick, Nev	June 23	July 28	0.011
Sunset Dev., Ida	June 16	July 10	0.00
Tintic Standard, Utah	June 21	July 19	0.005
Tuscumbia, Ida	Apr. 26	July 10	0.001
Union Chief, Utah	July 10	July 31	0.01
Wonderful, Ida	June 10	July 10	0.001

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1911	1912	1913	1911	1912	1913
January	53.795	56.260	62.938	24.865	25.887	28.983
February	52.222	59.043	61.642	24.081	27.190	28.357
March	52.745	58.375	57.870	24.324	26.875	26.669
April	53.325	59.207	59.490	24.595	27.284	27.416
May	53.308	60.880	60.361	24.583	28.038	27.825
June	53.043	61.290	.....	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	.....	24.200	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

	New York				London, Standard	
	Electrolytic		Lake			
	1912	1913	1912	1913	1912	1913
January	14.094	16.488	14.337	16.767	62.760	71.741
February	14.084	14.971	14.329	15.253	62.893	65.519
March	14.698	14.713	14.868	14.930	65.884	65.329
April	15.741	15.291	15.930	15.565	70.294	68.111
May	16.031	15.436	16.245	15.738	72.352	68.807
June	17.234	.....	17.443	.....	78.259	.....
July	17.190	.....	17.353	.....	76.636	.....
August	17.498	.....	17.644	.....	78.670	.....
September	17.508	.....	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	42.962	48.766	195.036	220.150
March	42.577	46.832	192.619	213.645
April	43.923	49.115	200.513	224.119
May	46.063	49.038	208.830	224.143
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	49.831	.....	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	4.327	4.046	4.177	15.997	15.977
April	4.200	4.381	4.118	4.242	16.331	17.597
May	4.194	4.342	4.072	4.226	16.509	18.923
June	4.392	.....	4.321	.....	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		Loudon	
	1912	1913	1912	1913	1912	1913
January	6.442	6.931	6.292	6.854	26.642	26.114
February	6.499	6.239	6.349	6.089	26.661	25.338
March	6.626	6.078	6.476	5.926	26.048	24.605
April	6.633	5.641	6.483	5.491	25.644	25.313
May	6.679	5.406	6.529	5.256	25.790	24.583
June	6.877	.....	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	18.15	13.66	16.96	14.10	17.53
April	15.13	17.90	13.90	16.71	14.15	16.40
May	15.14	17.68	13.90	15.80	14.12	15.40
June	15.15	17.20	14.11	15.40	14.22	15.10
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 June 30

Name of Comp.	Bid.
Acacia	.02⅜
Cripple Cr'k Con.	.01
C. K. & N.	.12
Doctor Jack Pot.	.06
Elkton Con.	.51
El Paso	3.20
Findlay	.02
Gold Dollar	.09
Gold Sovereign	.02⅜
Isabella	.10
Jack Pot	.04½
Jennie Sample	.05⅜
Lexington	‡.008
Moon Anchor	.0095
Old Gold	.01⅛
Mary McKinney	.55⅜
Pharmacist	.01
Portland	.94
Vindicator	.88
Work	‡.004

SALT LAKE June 30

Name of Comp.	Bid.
Beck Tunnel	.05½
Black Jack	.09
Cedar Talisman	.01
Colorado Mining	.16½
Columbus Con.	‡.07½
Crown Point	.01½
Daly-Judge	6.30
Grand Central	.50
Iron Blossom	1.27½
Little Bell	‡.10
Lower Mammoth	.01¾
Mason Valley	‡5.00
May Day	.05½
Nevada Hills	.85
New York	‡.02
Prince Con	.35½
Silver King Coal'n	3.35
Sioux Con	.02½
Uncle Sam	.04
Yankee	.07½

TORONTO June 28

Name of Comp.	Bid	Name of Comp.	Bid
Bailey	‡.08	Foley O'Brien	‡.26
Coniagas	‡7.25	Hollinger	16.50
T. & Hudson Bay	66.00	Imperial	‡.03
Timiskaming	.32	Jupiter	.39
Wettlaufer-Lor.	.10	Pearl Lake	.32
Apex	.01	Porcu. Gold	.10¾
Crown Chartered	‡.00½	Preston E. D.	‡.03
Dobie	‡.25	Rea	‡.12
Dome	14.00	Swastika	.05½
Dome Exten	.09	West Dome	‡.15

SAN FRANCISCO June 30

Name of Comp.	Bid
COMSTOCK STOCKS	
Alta	.05
Belcher	.15
Best & Belcher	.05
Caledonia	1.17½
Challenge Con	.02
Chollar	.01
Confidence	.21
Con. Virginia	.05
Crown Point	.20
Gould & Curry	.01
Hale & Norcross	.07
Mexican	.62
Occidental	.70
Ophir	.17
Overman	.31
Potosi	.01
Savage	.06
Sierra Nevada	.12
Union Con	.06
Yellow Jacket	.19

Name of Comp.	Bid
MISC. NEV. & CAL.	
Belmont	5.05
Jim Butler	.70
MacNamara	.16
Midway	.42
Mont.-Tonopah	1.10
North Star	.89
West End Con.	1.20
Atlanta	.15
Booth	.02
C.O.D. Con	.04
Comb. Frac	.03
Jumbo Extension	.12
Pitts.-Silver Peak	.47
Silver Pick	.02
St. Ives	‡.30
Tramp Con	‡.01
Argonaut	‡1.60
Bunker Hill	‡1.90
Central Eureka	.12
So. Eureka	‡2.75

N. Y. EXCH. June 30

Name of Comp.	Clg.
Amalgamated	64
Am. Agri. Chem	44½
Am.Sm.&Ref.,com	61⅛
Am. Sm. & Ref., pf.	100
Am. Sm. Sec., pf. B	80¾
Anaconda	33⅛
Batopilas Min	1
BethlehemSteelpf	66¼
Chino	33¾
Federal M. & S., pf.	33½
GreatNor.,ore.,ctf.	32¾
Guggen. Exp	41½
Homestake	100⅜
Inspiration Con.	14½
Miami Copper	20⅞
Nat'nalLead,com.	45½
National Lead, pf.	105½
Nev. Consol	14⅜
Phelps Dodge	195
Pittsburg Coal. pf.	76½
Quicksilver, pf.	4½
Ray Con	16¾
RepublicI&S,com.	18
Republic I & S, pf.	74⅞
SlossSheffl'd,com.	24
Sloss Sheffield, pf.	86
Tennessee Copper	28
Utah Copper	41⅞
U. S. Steel, com	52¼
U. S. Steel, pf.	103
Va.Car. Chem., pf.	93

N. Y. CURB June 30

Name of Comp.	Clg.
Barnes King	1.43
Beaver Con	.31
Big Four	.45
Braden Copper	6¾
B. C. Copper	2¾
Buffalo Mines	2⅛
Can. G. & S.	.21
Cou. Ariz. Sm.	⅝
Davis-Daly	1⅞
Diam'field-Daisy	.02
Ely Con	.09
Florence	.34
Giroux	1⅛
Gold Hill Con.	‡1¼
Goldfield Con.	1¾
Greene Cananea	5⅞
Greenwater	.04½
Internat. S. & R.	‡109
Kerr Lake	3¼
Keystone	‡2
La Rose	2¼
McKinley-Dar-Sa.	1⅛
Min. Co. of A. new	2¾
Motherlode Gold.	‡.60
Nipissing Mines	8½
Ohio Copper	⅝
Pacific Sm. & M.	⅛
Puebla S. & R.	2
South Live Oak	‡2
South Utah M. & S.	¼
Stand'd Oil of N.J.	355
Stewart	1½
Tonopah	4½
Tonopah Ex	2
Tonopah Mergor	.56
Tri-Bullion	⅛
Tularosa	¼
Union Mines	1
United Cop., pfd.	3
Yukon Gold	2¼

Name of Comp.	Bid
Adventure	1⅛
Ahmeek	265
Alaska Gold M.	10⅝
Algomah	1⅛
Allouez	30
Am. Zinc	17¼
Ariz. Com., ctfs.	2½
Bonanza	.32
Boston Corbin	⅛
Butte & Balak	1½
Calumet & Ariz	59
Calumet & Hecla	410
Centennial	10
Cliff	1¼
Copper Range	39½
Daly West	2 1/16
East Butte	10
Franklin	5⅛
Granby	54
Hancock	14½
Hedley Gold	30
Hejvetia	.30
Indiana	3⅞
Island Cr'k, com.	48
Island Cr'k, pfd.	79
Isle Royale	18
Keweenaw	1¾
Lake	7¼
La Salle	3½
Mass	2⅜
Michigan	1
Mohawk	44¼
New Arcadian	1¼
New Idria Quick.	‡3⅞
North Butte	24¼
North Lake	1½
Ojibway	.65
Old Dominion	43
Osceola	76
Quincy	57
Shannon	7¼
Shattuck-Ariz.	22½
Superior	23
Superior & Bost.	2
Tamarack	22
Trinity	3¼
Tuolumne	1⅝
U. S. Smelting	35½
U. S. Smelt'g, pf.	46⅜
Utah Apex	1½
Utah Con	8
Victoria	.99
Winona	1¼
Wolverine	43
Wyandot	.60

LONDON June 14

Name of Com.	Clg.
Camp Bird	£0 16s 9d
El Oro	0 14 9
Esperanza	0 17 6
Mexico Mines	5 12 6
Oroville	0 5 6
Santa Gert'dis	1 2 6
Stratton's	0 1 9
Tomboy	1 7 6

BOSTON EXCH. June 30

Name of Comp.	Clg.
Adventure	1⅛
Ahmeek	265
Alaska Gold M.	10⅝
Algomah	1⅛
Allouez	30
Am. Zinc	17¼
Ariz. Com., ctfs.	2½
Bonanza	.32
Boston Corbin	⅛
Butte & Balak	1½
Calumet & Ariz	59
Calumet & Hecla	410
Centennial	10
Cliff	1¼
Copper Range	39½
Daly West	2 1/16
East Butte	10
Franklin	5⅛
Granby	54
Hancock	14½
Hedley Gold	30
Hejvetia	.30
Indiana	3⅞
Island Cr'k, com.	48
Island Cr'k, pfd.	79
Isle Royale	18
Keweenaw	1¾
Lake	7¼
La Salle	3½
Mass	2⅜
Michigan	1
Mohawk	44¼
New Arcadian	1¼
New Idria Quick.	‡3⅞
North Butte	24¼
North Lake	1½
Ojibway	.65
Old Dominion	43
Osceola	76
Quincy	57
Shannon	7¼
Shattuck-Ariz.	22½
Superior	23
Superior & Bost.	2
Tamarack	22
Trinity	3¼
Tuolumne	1⅝
U. S. Smelting	35½
U. S. Smelt'g, pf.	46⅜
Utah Apex	1½
Utah Con	8
Victoria	.99
Winona	1¼
Wolverine	43
Wyandot	.60

BOSTON CURB June 30

Name of Comp.	Bid
Bingham Mines	2¼
Boston Ely	⅜
Boswyocolo	‡.01
Butte Central	.15
Cactus	.02
Calaveras	1⅞
Chief Cons	1⅜
Corbin	95
Cortez	‡.30
Crown Reserve	3½
Eagle & Blue Bell	.75
First Nat. Cop.	1⅜
Houghton Copper	1¾
Majestic	.35
Mexican Metals	.59
Moneta Porc	‡.06
Nevada-Douglas	1⅛
New Baltic	.70
Onoco	.90
Ravon Copper	.01½
Rhode Island Coal	.02
Smokey Dev	¾
S. W. Miami	2
South Lake	4½
Trethewey	.30
United Verde Ext.	.63

‡Last quotation.