The Engineering and Mining Journal

VOLUME 97 MAY 23, 1914 NUMBER 21

Stockpiling on the Iron Ranges--I

By L. O. Kellogg*

SYNOPSIS—An operation peculiar to the Lake Superior region. Comparison of Michigan and Minnesota systems. Subdivision into seven methods. Short trestle with longitudinal extension by single motor-hauled end-dumping cars; similar method but with the cars descending by gravity and hauled back by hoist; long trestle with lateral extension by trains of motor-hauled, side-dumping cars; these are the three variations of the Minnesota system.

There is no more interesting feature of Lake Superior iron-mining practice than the stockpiling of the winter ore. The operation is probably unique to the region. Certainly, nowhere else in the world do transportation conditions entail an almost complete suspension of shipping during four or five months of the year, so that large tonnages of ore have to be stored after hoisting. While many mining districts are isolated, so far as freight is concerned, during certain seasons of the year, they are in general of a class in which ore reduction is effected close to the mine and from which no tonnages are ever shipped comparable with those of the iron ranges. Stockpiling then is an operation peculiar to this section of the country and the development of the methods followed is to be credited wholly to the various ranges, especially to the Marquette.

Fig. 1. Beginning of Stockpile at Chisholm Mine. Note Branching Trestle and Tail-Track Housing

Fig. 2. The Completed Stockpile of the Whiteside Mine. The Bents near the Headframe Are Steel

Various Methods

Stockpiling consists essentially of storing in a big dump the ore hoisted during the winter, of loading it into railroad cars with a steam shovel when the shipping season begins again and of shipping it along with the current hoisting. Several different methods are in use, but two general systems may be distinguished. In one, the pile is begun with a trestle and extended over a considerable area, tracks eventually being laid on the ore itself; in the other, all the dumping takes place under the trestle, from which the tracks are never moved. These may be known as the Minnesota and the Michigan systems respectively, although both of them probably originated on the Marquette range, and the Minnesota system is not uncommon in Michigan, while the Michigan system is used on the Cuyuna.

The two systems may be further divided to give seven methods, the Minnesota system as follows: (1) Usually motor-haulage is used with end-dumping cars; (2) a variation on this method employs an inclined trestle and stockpile surface, allows the car to run down and dump by gravity and pulls it back with a small hoist at the headframe; (3) recently on the Mesabi, a new method has been introduced with excellent results; it is described in detail by Clarence M. Haight, Jan. 31, 1914; its essential features are the use of a relatively long trestle to start the pile, as in the Michigan system, from which the pile is swung sideways, the tracks being thrown as on a stripping dump, and the use of a train of side-dumping cars instead of a single end-dumper; motor haulage is employed.

In the Michigan system there are four variations: (4) Endless-rope haulage is typically used; (5) motor haulage is not uncommon; (6) single-rope haulage, the car being run down by gravity and pulled back by a hoist, is sometimes seen; (7) at the Negaunee mine, a permanent steel and concrete trestle has been erected, marking, perhaps, the highest development of the stockpiling operation.

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General Description

Practically always the stockpile involves a trestle from the headframe, although occasionally, as at the Republic, a rougher topography permits the tracks to start at or near the surface of the ground. The skips as hoisted are dumped direct into a waiting car which holds just a skip load. The Minnesota system involves a gang of men on the top of the pile to dump the cars and maintain and change the tracks and trolley wires. For practically every pile of either system, there is necessary another gang at the toe of the dump to sort out waste, pieces of timber, etc., and to break up the large lumps. The pile is built up on a large flat area or yard, usually close to the shaft. This frequently needs preparation for stockpile purposes, to the extent of removing trees, stumps and brush and of grading the surface. It is usual, although not universal, to floor the yard with planks 2 or 3 in. in thickness. Such a flooring keeps the ore slightly cleaner and makes a definite mark for the shovels to work to. At one mine, where the loading shovels operated without teeth on the dipper, the life of such a floor was estimated at four to five years. Figs. 1 and 6 show a stockpile yard without flooring. Figs. 3, 7 13 and 14 show the flooring. This floor is often electrically lighted for work at night.

The stockpile trestles are in all but one case temporary, except for a few bents close to the headframe. The bents are torn out when the shovel reaches them in loading, as shown in Figs. 3 and 4. There is, however, a certain space around the shaft kept clear for railroad tracks, etc., and the bents over this interval are permanent from year to year. These few bents may be of either steel or wood, although there is an increasing tendency to use steel. The governing conditions would seem to be the same as those dictating the choice between steel and wood headframes and sheave towers, questions of permanency, first cost and fire risk entering chiefly into the problem. When motor haulage is used, a short tail track is necessary, extending from the shaft in a direction opposite to that of the stocking trestle and usually housed so as to serve as a motor barn. This structure with its bents is also permanent. Figs. 1 and 2 show examples.

The question of the moisture in the ore is one of great importance as bearing on the cost of the operation of stockpiling. An extremely wet ore will freeze solid as piled, and will remain frozen until ready for loading, when it will require blasting. If care be taken in dumping, the difficulties of freezing are largely avoided. If each car, so far as possible, be dumped directly over the load from the car before, its warm ore will tend to keep the other from freezing.

Ore grading introduces an element of confusion in stockpiling. Where two or more grades are to be made, several methods are open to the operator. In the Minnesota system, two distinct piles may be started in two yards, or two piles may be carried along parallel in the same yard. In the Michigan system, two distinct yards may be employed, or parallel trestles may be built in the same yard, or dumping may take place at different points under one long trestle. This last is not always easily effected, but with the adjustable car of the Penn Iron Mining Co., or the hand-actuated car of the Kennedy mine, it is not difficult.

The Two General Systems

It would seem as if between the Minnesota and Michigan systems in general, one should have by this time been found superior, since local conditions apparently do not influence the choice. Local prejudice, however, is extremely potent, and one manager of a company with extensive operations in both states asserts his belief that there is so little difference in the inherent economy of the two systems as to make the choice depend solely on the familiarity of the local management with one or the other. That is, a Minnesota operator using the Minnesota system will stock more cheaply than when using the Michigan method, and *vice versa*. The essential difference is that the Minnesota method uses more labor and the Michigan more timber. The same manager quoted, believes that under present conditions in the labor and timber markets, the Michigan system is perhaps slightly cheaper. A good many minor considerations enter into the problem. The Michigan system is somewhat better adapted to a long, narrow yard, and the Minnesota to one with approximately equal dimensions. The former applied to a wide yard requires several parallel trestles and these in fact are often used, sometimes as many as four, as shown by Fig. 5 of the Caspian mine. The job of the gang that takes care of the tracks in the Minnesota system is far from enviable. On the bitterest winter night, the work becomes intolerable and the impossibility of keeping men on the job may seriously interrupt hoisting. The relative costs of the two systems are obscured by the fact that identical conditions of work are not obtainable. The range in each system is extremely wide, depending on a number of factors, and thus a fair comparison is difficult to obtain.

Method 1—Short Trestle and Motor Tram

Method 1 is perhaps the most important of all in respect to tonnage. It is the prevailing method on the Mesabi and the Vermilion ranges, and is not unknown on the Marquette and around Crystal Falls. Fig. 1 shows a dump just started by this method at the Chisholm mine; Fig. 8 shows one somewhat farther along at the Mary Charlotte mine near Negaunee; Fig. 2 shows the complete pile of the Whiteside mine on the Mesabi. Fig. 1 is perhaps a typical starting trestle. It is branched into three, and consists of perhaps 20 bents. The number of bents may run from 10 to 40, depending on how far from the shaft the pile must be started. It is necessary to be able to dump around several bents at once in order not to put too heavy a lateral stress on one alone. The trestle height will vary from 25 to 50 ft. usually. Various types of bents are used. Fig. 1 shows the common type; sometimes three posts are used instead of four; diagonal bracing, especially at the top is not uncommon. The bents, while temporary, must be strong, as they have to bear the live loads of a rather rapidly moving motor with a loaded car, and are unusually tall. The posts are always round peeled poles, with a big end of 12 to 16 in. in diameter. The spacing is 15 to 20 ft., and longitudinal diagonal bracing is sometimes employed. The decking should be complete over the trestle except for the dumping openings. The trestle does not always branch as shown; in some cases, the tracks are branched on the pile itself. The pile is always carried forward by several parallel tracks.

What may be considered the typical car is probably built of wood and has a turntable mounting. Such cars were shown in the JOURNAL, Jan. 31, 1914 and Feb. 14, 1914. Steel cars are also used, and with them care must be taken in dumping not to touch the trolley wire with the back edge of the car, as this will establish a short-circuit.

The trolley wires, of course, need to be extended with the pile, and this is often an annoyance. Usually, the surplus wire is coiled at the last trolley support. At Ely, Minn., the Oliver Company uses an insulated reel set down on the stockpile floor, as described in the JOURNAL of Dec. 27, 1913, and booms the wire out so as to keep it clear of the car and the ore and prevent a short-circuit. At the Mary Charlotte, the wire is carried out to the top of a mast, shown in Fig. 8, and thus kept clear.

The employment of single cars means the employment of several motors and motormen usually. As many as three may be necessary to keep up capacity when the dump reaches its maximum length. As with the men on track work, the job of the motorman is a hard one in cold weather. In a few cases, notably in the Oliver mines of the Chisholm district, the motors are provided with cabs and the men are well protected against exposure. The labor cost is the highest in this method of stockpiling as compared with the others. In a typical arrangement where two motors are used, there will be employed on the two shifts, four motormen, eight men to change track and dump cars and one man to clean the track and landing around the headframe. This does not include the men on the stockpile floor, the number of whom does not vary particularly with the different methods.

METHOD 2—GRAVITY SYSTEM

The construction of a stockpile by means of a single end-dumping car running down a grade by gravity and hauled back by a hoist, has little to recommend it except under extraordinary conditions. In the first place, stocking room is usually scarce, and is utilized to its full capacity; this requires that the pile be made as high as possible and maintained at this height. With the gravity system and hoist return, a rather steep grade is necessary to insure that the descending car runs freely and rapidly. This, under the best conditions, must be

FIG. 3. STEAM SHOVEL RELOADING STOCKPILE AT WOODBRIDGE MINE. NOTE OLD TIMBERS IN THE ORE

FIG. 4. PARTLY LOADED OLD STOCKPILE OF PENN COMPANY, OLD BENTS STILL SHOWING AND NEW TRESTLE ON RIGHT

FIG. 5. FOUR PARALLEL TRESTLES WITH ENDLESS ROPE HAULAGE, AT CASPIAN MINE

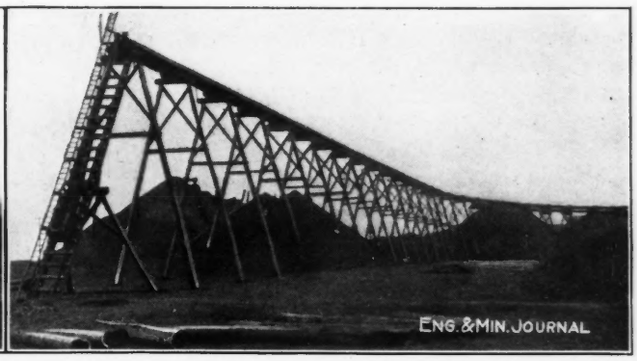


FIG. 6. CURVED TRESTLE AT NORRIE GROUP. ENDLESS ROPE HAULAGE, INCLINED END AND TENSION CARRIAGE

1% and is usually as much as 3%. Evidently this means a large loss of storage capacity on a long pile. If the pile is to be small, however, or if the topography is such as to give a ground surface slope away from the shaft, the method presents a few advantages. One engineer protected by a housing at the headframe can take care of two cars, using a double-drum hoist, and a small hoist is usually cheap. The common type of hoist is a single-cylinder, constant-running, flywheel, steam or air engine to which the rope drum is clutched. Intermittent two-cylinder reversible engines are also used.

Method 3—Long Trestle and Side-Dump Cars

The modification of the Minnesota system first adopted at the Harold mine, near Hibbing, has been, as stated, so admirably described in detail in the Journal as to make further detailed description unnecessary. Its great advantage is that large capacity can be maintained in spite of a long haul. One motor, hauling, say, six cars, can run synchronously with the motor train underground, and is usually equal in capacity to two motors with one car each. The labor cost is cut almost in two. The dumping of the cars and the swinging of the track are more easily done than with the end-dumping system.

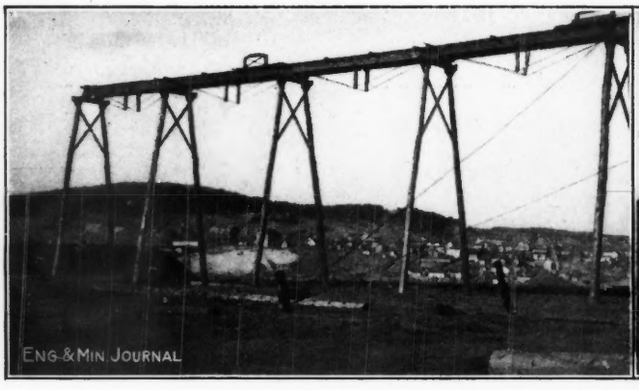


Fig. 7. Brier Hill Trestle. Note Trusses between Bents and Dumping Catches on Top

Two men per shift on the dump can take care of this work and one man per day, as in method 1, can take care of cleaning the track and loading station.

On the other hand, the long initial trestle of about 800 ft. is a large cost item. In the use of this trestle, the method is similar to the Michigan system, but the trestle must be built stronger than for endless-rope haulage, as the stresses are more severe. It must be understood, however, that the loaded train and motors are never all on the trestle together. So long as dumping is still taking place under the trestle, the train is run out ahead of the motor and the end car is dumped first, the train moves up and the next car is dumped, etc. In this way, only the empty cars form the load on the trestle. The trestle is constructed as needed, it being necessary only to keep the structure ahead of the advancing pile. In the manner of dumping, and in fact in general, the method is an adaptation of stripping practice, in which a great dump of overburden is built out from the trestles. In stocking, however, the top of the pile is almost level and is carried its maximum height at one operation, whereas, a stripping dump is generally built up in several terraces and its construction necessitates the overcoming of heavy grades. At the great stockpiles being built on the Mesabi of Leonard ore, however, typical stripping dump methods are followed, the great tonnage and the fact that a large part of the ore comes from the openpit making this necessary.

The system described as installed at the Harold was adopted at the Mississippi, with two modifications. One of these was the use of side-roll dumping-cars of steel, the body being of V-section, instead of the contractors' dump car originally used. This innovation is not satisfactory, the ore not being thrown so well. The other change was the use of trolley supports with only one upright. The Harold trolley support consists of a horizontal sill, two uprights and an upper crosspiece. The Mississippi support has the upright only on the inner side. This is found much more satisfactory and convenient after the dump leaves the trestle and the track has to be kept up along the end of the pile where the outer edge is continually sinking. The car used at the Harold, and that which was to be used at the Scranton, is an ordinary wooden high-set contractors' dump car holding a skip load. When the dumping is all on one side of the pile over a considerable period of time, the tracks at the headframe or the chute can be so arranged that the car is slightly overloaded on one side, and will dump automatically and quickly when the fastenings on the other side are loosened.

Fig. 8. Mary Charlotte Stockpile. Note Guyed Mast to Support the Surplus Trolley Wire

(To be concluded)

Mineral Production of Peru

The mineral production of Peru for 1912 is contained in the *Boletin* del Cuerpo de Ingenieros de Minas de Peru, No. 80, 1914.

PERUVIAN MINERAL OUTPUT, 1912

Minerals	Weight Unit	Weight
Coal	metric ton	278,927
Oil	metric ton	233,600
Gold	kilogram	1,435
Silver	kilogram	324,352
Copper	metric ton	26,970
Lead	metric ton	4,050
Vanadium ore	metric ton	3,048
Bismuth (fine)	kilogram	51,038
Tungsten ore	metric ton	195
Mercury	kilogram	400
Borax	metric ton	1,674
Salt	metric ton	23,292

A Patent to a Placer-mining Claim conveys all the mineral therein, including veins or lodes not known to exist when application for the patent was made. (United States Circuit Court of Appeals, Ninth Circuit; Thomas vs. South Butte Mining Co. 211, "Federal Reporter," 105.)

Diamond Drilling at Miami

By Foster S. Naething*

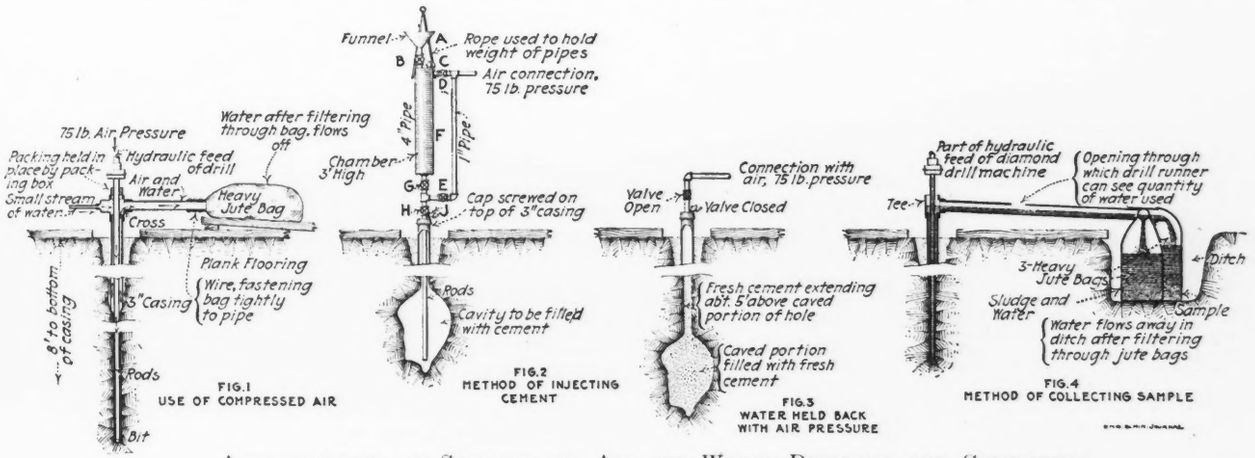
SYNOPSIS—Diamond drilling from underground workings adopted instead of churn drilling from surface, for certain Miami exploration. Rock conditions difficult, drilling slow and expensive, but cheaper than alternatives. Compressed air instead of water eliminated caving of hole so long as rock was dry. Much cementing required. Descriptions of drilling, sampling and recording. Costs.

Like the other companies mining disseminated copper minerals, the Miami Copper Co., in Arizona, has done a large amount of churn drilling, which proved a satisfactory and accurate way of exploring the ground. In the southeast section of this property, a large fault, dipping at an angle of approximately 43° to the southeast, cuts off the ore and the Pinal schist. The hanging wall of the fault is Gila conglomerate and the foot wall is schist. As the lowest workings in the mine were about 570 ft. below the surface, the management decided to explore this portion of the property with diamond drills from the 570 ft. level, thus avoiding the necessity of drilling 300 to 600 ft. through the conglomerate.

After an examination of the rock, the diamond drill operators said that a large percentage of core could be obtained and that there would be no difficulty in putting down the holes. In actual practice it was found impossible to get over 10% of core, and the holes were most difficult to put down. To one familiar with the character of the schist which was drilled, the reason is quite plain. This schist, especially near the great fault which cuts it off on the southeast, is full of a great many small slips and the rock itself is fractured into extremely small pieces. The small pieces in themselves being siliceous, are hard. The result is that a diamond-drill hole put down in the schist caves excessively and little core is recovered. The schist is so hard that it was found impossible to chop down through it and drive casing, and make any speed at all with the diamond drill. On account of the unusual difficulties in putting the hole down and of the lack of core, the ordinary methods of working and sampling were not satisfactory.

Drilling Methods

After a great deal of experimenting the methods to be described were decided on as the most satisfactory. A 5x5-ft. cribbed raise was put up about 30 ft., in order to allow room for handling the rods, and a space 8 ft. high and 10x10 ft. was cut out under the raise to make room for setting up the machine. A Sullivan H 2 diamond drill was used. The hole was chopped down for about 8 ft. and a 3-in. piece of casing cemented into it. This was done to make the hole air-tight around the collar, which was necessary in using compressed air, as will be described later. "E" rods were used with a 5-ft. core barrel and a bit cutting a hole of $1\,^{9}/_{16}$-in. outside diameter and giving a core $\frac{15}{16}$ in. in diameter. For a few shifts the hole generally went down well, averaging around 8 to 10 ft. per shift, but it was found impossible to drill any hole to the depth required without its beginning to cave. Experience in the mine proved that the schist would stand up fairly well when dry, but that, when even slightly wet, it would start to cave badly.



Arrangements at Surface for Air and Water Drilling and Cementing

Compressed Air Instead of Water

To avoid this caving in wet rock and the scouring action of the water on the sides of the hole, Ralph Wilcox, who had charge of the actual drilling, suggested using compressed air instead of water, to keep the bit cool and to blow out the cuttings. This is a practice which I believe was new here. The scheme proved entirely satisfactory until water was encountered in the formation. The hole would then immediately begin to cave almost as rapidly as when wash water was used, and would have to be cemented.

With the air, more care was needed and the advance was not so rapid; so it was found best, therefore, after water was struck to carry the hole down with water only. Although under the conditions, the use of air did not help much, it seems certain that if the holes had been dry for their whole depth that the air method would have greatly reduced the caving.

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Note—This article was prepared with the approval of J. Parke Channing, vice-president of the Miami Copper Co.

A cross-section illustrating the general scheme used is shown in Fig. 1. To avoid loss of dust through the packing around the drill rods and through the meshes of the jute bag used for collecting the sample, it was found necessary to inject the stream of water as shown. The exhaust air prevented any water from entering the hole. The air around the drill was absolutely free from dust and the samples were extremely close to the correct weight for the size of hole drilled, both facts showing that little of the sample was lost. The jute bag was a good indicator for the runner to watch, as it showed plainly by its collapse if the air current was at all reduced. About 50 cu.ft. of air per min. at 75 lb. pressure was used.

Cementing Caved Ground

In the frequent cementing of the hole, several different schemes were used to force the cement down; the best scheme, superior to the ordinary method of pumping the material, is illustrated in Fig. 2. A mixture of the best portland cement and 1% of sodium carbonate, mixed with water to the consistency of a thin gruel, was poured into the funnel *A*, the valves *G* and *D* being closed; the valves *C* and *B* were then opened, and the cement allowed to flow into the large chamber *F*. The cement was poured in, until *F* was nearly full, when the valves *B, C* and *E* were closed and the valves *D, G, H* and *J* opened. This allowed the air to force the cement rapidly down the hole. The process was repeated until the drill foreman thought sufficient cement had been forced down. The rods were then withdrawn and cleaned. When the cement was being poured into the funnel, the valves *E* and *H* were always kept open, and *J* closed, allowing the air pressure to be on the hole. It was found that this would tend to keep back the water and give the cement a much better chance to get fully into the caved portion. The valves *E, G* and *C* were opened when it was necessary to clear the pipes between *E* and the chamber *F*. If possible, the hole was drilled through the caved part before cementing, as shown, in which case the cementing was much more sure; but often it was found impossible to drill through the caving part at all before cementing, and then it was seldom that only one cementing would catch up the hole. The 1% of sodium carbonate was added because it made the cement set much quicker, allowing it to be drilled out in two or three days, instead of a week. When the hole was extremely wet, however, the sodium carbonate did not help much, as it was carried off in solution; it was used because it did no harm and might be of some help.

After the addition of cement, air pressure was kept on the hole, as shown in Fig. 3, for at least 24 hr. This held back the flow of water to a large extent and gave the cement a much better chance to set. As soon as the hole was cemented, the crew moved to another hole where there was a second machine and started drilling. By having two separate rigs and changing from one hole to the other, practically no time was lost by waiting for the cement to harden. About 24 hr. after a hole was cemented, the cement was washed out or partly drilled, depending on how hard it was, to about 5 ft. above the cave. This avoided drilling through more hard cement than was necessary. A point which several times caused great trouble was the fact that the cement after setting would be harder to drill than was the surrounding schist, with the result that the bit would leave the old hole and start a new one parallel to it in the schist. At times a new hole was started even when the bit was advanced very slowly. In this way on a number of holes, several feet were lost and new holes had to be drilled from the points where the bits turned aside. To avoid this trouble as much as possible, the cement was drilled out before it became too hard.

Four carbons of about one carat each were generally set in a bit, and although the wear on the diamonds was not excessive, it was seldom that over 4 ft. could be drilled with a bit, as the broken quartz was hard on the metal. Borts was tried, either alone or set with carbons, in several holes, but it was not tough enough to stand the rough drilling in the quartz. When the wash water was replaced with air the wear on the diamonds did not seem to increase much if any, but the metal of the bit wore down much quicker.

Sampling and Recording

As only enough core was recovered to determine the geology and mineralogy accurately, the sludge alone had to be depended on for the assay samples. The ordinary settling boxes were tried, but as the chalcocite floated off easily it did not prove nearly so easy to manipulate nor so satisfactory as filtering all of the sample through three heavy jute bags. These were arranged as shown in Fig. 4, securely tied to the three branches of the cross. This allowed the entire sample to filter quietly through the jute bags, and tests showed that the amount passing through the bags was of no consequence. The samples were taken every 5 ft., measured from the collar of the hole; a marked copper tag was tied to one of the three sacks and the three were all tied together. They were then dried over steam pipes, and sampled and assayed in the ordinary way. Every sample was weighed when dry, and as the theoretical weight was known, the amount of caving could easily be determined. As soon as the samples ran much over weight, the hole was cemented. Of course the caving tended to salt the sample somewhat, but since the ore was uniform, and since the hole was cemented frequently and the ground could cave for only a few feet away, the results were entirely satisfactory. Only one hole has been checked up so far, this by carefully sampling a large winze, sunk on the hole. The average of the drill hole was practically the same as the average of the winze, showing that the average results of the diamond drill samples were quite dependable. The average of all the ore located by the diamond drills has been within a few hundredths of 1% of the average of all the drifts in ore on the lowest level, which also would seem to indicate that the results were trustworthy.

The drill foreman handed in a daily report, giving the date, name of hole drilled on, hours worked, depth of hole at end of shift, footage drilled, the number of the bits used, the cause and time of delays, and any extra information which he thought might be desirable. He also weighed the stones of each bit before and after using, noting the hole in which used, so that the carbon wear for each hole was accurately watched and determined. A carbon report was handed in every 10 days, giving the number of bits used, the loss of weight of each bit, and the hole in which each bit was used. Every month the drill foreman weighed all the stones, and so corrected any discrepancies in the record of carbon

wear. An engineer was responsible for the drilling and recorded all the data, using the core for the geology and mineralogy, and getting all the other data from the daily reports. These were all entered up in a log book ruled as shown in Fig. 5. The nature of the work, such as drilling, setting up, cementing, etc., was entered under remarks as was also the time used in each operation. The assays were kept on loose-leaf cards and filed away as a hole was finished. The engineer kept a general watch over the holes and especially over the sampling, and visited the holes every day, but he did not spend over half an hour per day on the diamond drilling.

Costs

The costs here given cover a period of 13 months, from May 1, 1912, to June 30, 1913, during which time 2714 ft. of drilling was done at an average rate of about 5½ ft. per shift of 8 hr. The average depth of hole was 208 ft.; the deepest hole was 450 ft.

COSTS OF DIAMOND DRILLING

	Cost per Ft.	Per Cent. of Total Expense
Drill foreman and drill runners	$1.92	35
Drill helpers	0.66	12
Miscellaneous labor	0.10	2
Total labor	$2.68	49
Carbons and borts	0.82	15
Miscellaneous supplies	0.84	15
Total supplies	$1.66	30
Rental and depreciation on drills	1.00	19
Power (estimated)	0.10	2
	$5.44	100

The estimate of the cost of power is based on several tests on the amount of air consumed when running and a rough estimate of the average running time of the drill per shift. It was found that the lowest carbon cost per foot was obtained when the highest grade carbons were used, costing between $60 and $80 per carat. The cheaper grades would wear and chip off too rapidly. But at the best, all of the ground was found to be hard on the diamonds.

The costs per foot of a hole on which air was used entirely for cooling the bit and blowing up the cuttings, are given below.

COST OF A DIAMOND-DRILL HOLE USING COMPRESSED AIR INSTEAD OF WATER

	Cost per Ft.	Per Cent. of Total Expense
Drill foreman and drill runners	$1.64	35
Drill helpers	0.71	15
Miscellaneous labor	0.05	1
Total labor	$2.40	51
Carbons and borts	1.14	24
Miscellaneous supplies	0.15	3
Total supplies	$1.29	27
Rental and depreciation on drills	0.80	18
Power (estimated)	0.20	4
Total cost	$4.69	100

Average speed, 5.7 ft. per shift. Footage drilled, 148.

The costs, while covering only a small footage, show that when air was used the cost per foot was a little

(Location) (Name of Hole) Elevation (Names of Drill Runners)

Date	Shift	Depth End Shift	Advance	No. of Bit	Ft. of Casing Ft. of Cementing Ft. of Reaming	Geology	Minerals	Remarks

FIG. 5. FORM OF LOG

under the average of all the drilling. The carbon cost per foot is a little higher, but part if not all of the increase was due to the fact that the ground drilled was a little harder than the average.

On the whole a great deal more difficulty was experienced in the drilling than was expected. But although the cost per foot was high and the advance per shift was low, the general results were satisfactory, since the ground could not have been prospected for the same money by any other means.

Prospecting in the Tropics

By F. Close*

Two years' prospecting on the west coast of Sumatra, in which time 55,000 acres had to be prospected, nearly all of which was geologically favorable for the occurrence of ores, generally gold, the country rock being chiefly andesite, propylite and basalt, proved the value of the method which I shall here describe, and which will probably be applicable to any property in a similar densely wooded country with deep overburden.

Sumatra has tropical climate, wet but healthful; no malignant fevers. So large an extent of mountainous country could not be prospected in reasonable time or economically by highly paid Europeans, so the local Malays were relied upon to a large extent. Like most natives, the Malays work well when properly treated, and are generally intelligent and reliable. Prospecting had been carried on previously in neighboring districts, so a few natives with a knowledge of what was wanted were occasionally available.

Recruiting Native Malay Prospectors

The first thing to be found out was the extent of knowledge of prospecting of any Malay who offered his services. For this purpose a specimen box was kept at headquarters with samples of auriferous and nonauriferous quartz, copper ore, etc., together with pyritic rock, andesite, propylite, and other rocks likely to be encountered, and a prospective employee was told to pick out the rocks which he thought might contain gold or other minerals of importance. Thus a native who knew nothing of the work, but was looking for an easy job, was easily detected, or intelligent natives discovered and taught what was wanted. Next came a panning test. Some of the natives can pan cleverly in half a cocoanut shell. A skilled native would always show a trace when a trace was to be found with the ordinary gold pan.

Each party of native prospectors consisted of one head prospector, wage, 1s. per day, three laborers and a clerk, wages 8d. per day. Equipment comprised sample bags, prospecting picks, notebook, pencil, loose pieces of strong paper to put in the bags with the samples, numbered plates, knives for cutting through the jungle, and a blanket for each man. They had to cater for themselves, but it was sometimes necessary to give natives from distant villages a small advance payment for purchasing necessities.

The parties were instructed to prospect thoroughly a certain section, generally a small stream from its junction with a larger stream or river, up to its source, including all minor branch streams on each bank. General instructions were given not to take samples of float from the large streams, their origin might be so distant

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that they are of little value when auriferous veins are known to exist, but samples of float from the minor creeks were welcome, as these most probably originated in the immediate vicinity.

At each place where a sample was taken, or at a central place if several samples were taken within a radius of 30 to 40 yd., a numbered plate was nailed to a conspicuous tree. These plates were cut from kerosene tins, one tin making 12, the numbers being cut in the plate with hammer and chisel. The number and position of the plate were described as accurately as possible in his notebook, generally relative to the nearest main stream; the number and location of the sample relative to the plate were also noted carefully both in the notebook and on one of the pieces of strong paper, which was inclosed in the sample bag, wrapped in a green leaf for protection against rain. This was found more satisfactory than a number only in the sample bag, as the natives sometimes mixed numbers; Europeans have been known to do this also.

Preventing Delinquent Tendencies of the Prospectors

All notebooks were carefully filed and a record of the prospecting done in each section of the property thus kept. The numbered plates served a double purpose; first, to enable any sample containing gold to be relocated with certainty; second, as a check on the prospectors who have been known to enjoy life in a distant village for a week or 10 days, then to return to headquarters either with samples easily taken from known veins in other sections, or without samples, saying they could not find quartz in the district they should have been prospecting. The numbered plates afforded evidence that the prospectors had been on the ground, so they were occasionally controlled by Europeans, even though nothing of promise had been found in the samples.

The dishonest native who salted his samples with quartz from known auriferous veins to get the reward given to finders of promising ore, had to be considered. Fortunately this seldom, perhaps never, occurred. When a sample of vein in place of promise was brought in, a European, guided by the prospector, with clerk and notebook, went out to determine what further work had to be done. If nothing of further promise was discovered it pointed to the possibility that the prospector had salted his original sample, and his subsequent career was carefully watched.

When any party had taken 18 or 20 samples they brought them in to headquarters. If the prospector was a new man he was instructed to come in with his samples, but this precaution was not taken in the case of a trained man who had been working several months. The samples were placed in dishes, each with its ticket, and examined; the most promising were assayed. Portions of samples were sometimes crushed and panned, but this test was not considered conclusive, as auriferous quartz containing no free gold may occasionally be found.

The location of each sample, as shown on the ticket, was noted in order to control the direction in which the prospector was working and to see that he was describing the places from which the samples came as clearly as possible. Samples of quartz, rock or other minerals of interest from each district were placed in numbered specimen boxes and proved useful visible records of the nature of the materials found.

Some of the native prospectors are keen and observant. When auriferous float quartz in a small creek indicated a vein in the vicinity they went over the ground with the utmost care, using ropes cut from creepers tied to trees, to help them along the faces of precipices. Trained Europeans for this work would have been more expensive and frequently no more efficient. Taking into consideration the heavy traveling expenses, a trained white prospector costs at least £1 per day, and also requires more transport and better housing in the bush. A white man's health is apt to break down after long spells of prospecting in the jungle, and for this reason it is generally advisable to let him rest or take other work one week in four. Nine or 10 native prospecting parties can be kept in the field for the cost of one party headed by a European.

In a country where there are numerous small stringers carrying 3 dwt. or more of gold, a promising vein may be hidden under the overburden somewhere near. The question is how much time and money is one justified spending looking for it? No hard and fast rule can be laid down, each case must be taken on its own merits. My opinion is that when a man with the average stock of patience gets tired of carefully prospecting a certain section by pits and adits with indifferent success, the economic limit on that section has been reached, and he had better transfer his attention to more promising fields.

Effect of Foreign Metals on the Rolling of Zinc

Experiments have been conducted in Belgium, says the *Iron and Coal Trades Review*, with a view to discovering the effect of foreign metals on the rolling of zinc. Ingots weighing 40 lb. were prepared by casting together zinc alloys of various metals, with spelter containing lead 1.05 to 1.25, cadmium 0.076 to 0.11, and iron 0.03 to 0.039%. It was found that cadmium is harmful above 0.25%, while with 0.5% rolling is impossible. In regard to arsenic, 0.02% markedly increases the hardness, and with 0.03% the metal is too brittle for practical purposes. Antimony is less objectionable than arsenic as regards hardness, as 0.07% does not increase the hardness; but 0.02% is enough to produce a striated surface on the rolled sheet, which makes it unsalable. Tin is objectionable when above 0.01, and prohibitive at 0.03%. Copper has no hardening effect until it reaches 0.08, and with 0.19% the zinc is unworkable. A permissible maximum of iron is 0.12%, but this is easily reduced in refining. Though 1 to 1.25% of lead does not interfere with the rolling, a slight increase not only seriously affects malleability, but the excess of lead remains unalloyed and forms patches on the sheet. The presence of two or more impurities together results in a combination of the injurious effects of each.

Anticipation of Danger to Employees

A mining company is not liable for injury to an employee who was struck by fall of a timber down a mine shaft, unless the accident could reasonably have been foreseen and guarded against, according to the decision of the Michigan Supreme Court in the case of Kaaro vs. Ahmeek Mining Co., 146 "Northwestern Reporter," 149.

Economic Effect on Certain Ore Deposits of Changes in Depth

By Thayer Lindsley*

SYNOPSIS—A classification of gold-silver siliceous deposits into "Tertiary" and "deep-seated" types; the former decreasing rapidly in value with depth; the latter, persistent. Characteristics of the two types; criteria by which they may be distinguished; methods of formation; factor of structural continuity. Examples and a classification of the world's principal deposits of this nature.

In that group of ore deposits which can be roughly classified as tabular fracture zones containing siliceous or "dry" gold-silver ores, there are two broad types which exhibit certain distinct economic differences. One is associated with Tertiary eruptive activity, and is formed near the surface; the other is formed under deep-seated conditions. The former I designate as Tertiary. Deposits of this type undoubtedly were formed during other epochs, but they have usually been entirely removed by erosion. The second type I call deep-seated; it cannot be designated by a geologic period, as examples occur in rocks of all ages, though rarely later than late Cretaceous.

Characteristics of Two Types

The study of these types shows the Tertiary characterized by a material depreciation of the precious metal content with depth, although vein filling and fracturing continue as strong as ever. The deep-seated type, below the zone of oxidation and surface enrichment or improvement, shows a persistence of precious metal content with depth, provided the structural features persist. This refers to primary ore deposition, including secondary deposition by ascending solutions, but not leaching, oxidation, or secondary enrichment by descending surface waters.

The Tertiary Deposits

The Tertiary deposits usually show marked depreciation and become unpayable at less than 1000 ft. in depth. Some of the greatest examples, however, have been mined down to 2000 ft., and one, the Comstock, has some payable ore at the 3000-ft. level. In the deep-seated type, a depth of 4000 ft. or more down the dip or pitch has been reached in a number of cases.

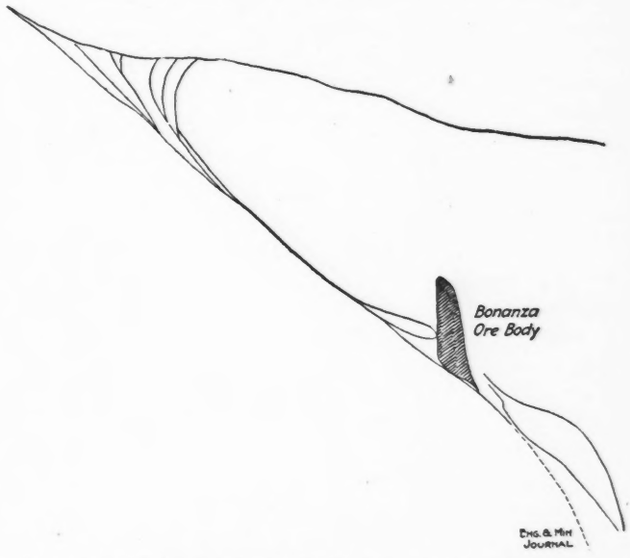
Fracturing in the Tertiary type develops near the surface under light load, and is caused by some sudden strain due to adjustments of cooling rocks, explosive eruptions, or similar local forces. The whole series of possibly repeated movements is completed in a short space of time. Hot ascending mineral-bearing solutions, their periods of activity more or less coincident with the fracturing, rapidly fill the open spaces and replace rock fragments and walls by metasomatic action. The solutions originate in or in connection with some magma, under high temperature and pressure, and in a short distance come under practically atmospheric conditions, with ample opportunity in some cases of commingling on the way with other solutions. This rapid change in temperature and pressure results in a rapid change in the mineralization, and especially in the amount of silver and gold deposited. Where meteoric waters are able to intermingle with these ascending solutions, the maximum precious-metal deposition is, of course, limited to a still narrower vertical range.

The larger the forces causing the solutions to circulate, and the greater their mineralizing strength, the less rapid is the change in the character of the mineralization.

There are many small, isolated eruptive areas in Tertiary belts where the decrease in precious-metal content is extremely rapid. The amount of metasomatism rather than of propylitization indicates the extent of the mineralizing activity. Centers of stronger activity with less rapid decreases of value with depth are found at Pachuca, Guanajuato, Parral, the Comstock, Waihi, etc.

Secondary Enrichment Unimportant

Though secondary enrichment has been effective in the heavily mineralized Tertiary deposits as found at Zacatecas and Taviche, Mexico, and in parts of Colorado, this plays a much less important part in the siliceous gold-silver type of deposit than is generally supposed. The Comstock bonanzas had an indefinite connection with the surface, and could not have been much affected by meteoric waters. At Waihi some of the best veins never came to the surface; the Smuggler-Union vein at Telluride, Colo., practically peters out and disappears in the overlying rhyolite and it is difficult to conceive of meteoric waters, causing much secondary enrichment.



Section through C. & C. Shaft on the Comstock

At the Comstock, secondary magmatic circulation created conditions apparently controverting the general rule of depreciation with depth. The accompanying sketch shows how later periods of fracturing at depth permitted solutions to precipitate their precious-metal contents at the horizon then most favorable.

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The Deep-Seated Type

The deep-seated type is developed in deep fracture zones, which may or may not reach the surface, and which result from orogenic movements, continental uplifts, and batholithic intrusions. Ore deposition seems to be less dependent on temperature than on other conditions. At the depths considered, temperatures are high and with the additional heat from the intrusions with which the deposits are associated, there must exist a wide vertical range, where no sharp temperature changes occur and where the ore solutions will not be subjected to a rapid and complete precipitation of their precious-metal contents.

The chief factor in the introduction and formation of ore is the fracturing; the more intense this is, the greater the ore development.

The exact causes of deposition still remain a matter of doubt. A variety of subtypes existing indicates probably a similar variety in methods of deposition. However, the principal forces at work are as follows: Interaction of the solutions with comminuted rock material; mechanical entanglement of the precious metals and metallic sulphides with the formation of, and deposition of the silica gangue; gradual accretion or impregnation of minerals in a fracture zone by long-continued movements.

Whatever the exact mode of ore deposition, since under deep-seated conditions temperature changes are gradual and ore formation is chiefly a function of intensity of fracturing and movement, and of the degree of chemical interaction with the wall rocks, it is seen that there must occur a wide vertical range where changes in depth have no direct bearing on ore formation.

However, increase of depth may have a minor influence by slightly decreasing the intensity of the fracturing. At these depths, the solutions differ radically from the freely circulating Tertiary-deposit solutions that occur near the surface.

Wherever powerful and concentrated deep-seated fracturing occurs, however, rich ore is not necessarily plentiful. Solutions of different periods vary widely and the period of greatest fracturing may coincide with that of the most barren solutions.

A change in the chemical nature of the wall rocks probably has some bearing on ore deposition, but the universal application of this rule seems unsafe. The strongest fractures also are often confined to a single series of rocks, seldom crossing rocks of different texture and composition, since the rupturing forces find their greatest expression in movements in certain rocks. Examples are the slate belt along the Mother Lode in California, the slate belt near Juneau, albite-diorite dikes at Treadwell, Alaska, hornblende schists at Kolar, India, schists at the Morro Velho mine, Brazil.

Certain features, one or more of which may be present, characterize these types. For the Tertiary type, the following characteristics hold: Occurrence in Tertiary volcanics, association with local centers of action; propylitization of wall rocks; finely divided argentite, stephanite, pyrargyrite, and pronstite in quartz or silicified country; banded vein structure; comb structure, and crystalline development of minerals from rock surfaces; pseudomorphs; wide variety of sulphides without overwhelming predominance of any one; feldspar adularia present, other varieties not; gold finely divided; deposits rarely with flat dips; alunitization and kaolinization; chalcedonic quartz.

Criteria for Deep-Seated Type

The deep-seated type without classification into subtypes is characterized by: Occurrence in schistose rocks; occurrence in slates showing stringers and nodules of quartz; slickensided walls; intercalation with sediments; association with batholiths; coarsely crystallized quartz; lack of comb structure, massive vein-filling, absence of vugs; orebodies usually a series of lenses, continuous horizontal development of ore rarely over 1000 ft.; dips varying from horizontal to vertical, extremely flat dips common; general parallelism and repetition of deposits in a district; vein filling often with ribbon structure, from repeated movements and additional developments of quartz and sulphides with each movement; one sulphide mineral usually overwhelmingly predominant, mixtures of different sulphides not common; gold particles of appreciable size, and development of sulphides and gold along planes of schistosity; increased enrichment at intersections with leaders or small branches; frequently a well defined pitch to the oreshoots; chief valuable content, gold; deposits with silver predominant, unimportant.

These deep-seated deposits furthermore grade from large masses of pure quartz, through mixtures of quartz and calcite, with other carbonates down to deposits with minor quantities of quartz and calcite, the sulphides and the gold seeming to be disseminated through schistose altered belts in the country rock. The gold may be free or closely associated with the sulphides. Free-milling ores may result from long-continued vein movements after the main mineralization, with possibly a circulation of waters of moderate temperature. The more important deposits seldom occur in the batholiths, though minor ones in such rocks are numerous. The deposits often approach pegmatites in origin and appearance, and a somewhat similar phase of mineralization is also found in gold-bearing aplites and alaskites. Deep-seated deposits are usually low grade, those averaging over $20 per ton are rare.

One or more of the features mentioned is usually present in any precious-metal deposit and by careful observation, the two types can be readily differentiated in the field.

A complete unraveling of the geologic history of a district will, of course, give a correct interpretation, but this history is sometimes obscure. A factor likely to create uncertainty, is the occurrence of Tertiary mineralization superimposed on an earlier deep-seated deposit.

Structural Continuity, Tertiary Type

The question of the structural continuity of ore deposits with depth is complex and uncertain and one of economic importance, especially in deep-seated deposits; the speculative features of the mining industry hinge largely on this question.

In the Tertiary type, this question is less vital usually that that of the persistency of the ore value. If the fracturing forces have been of at least moderate strength, the structural features are fairly continuous horizontally and vertically, and persist to greater depths than the precious-metal contents. When the Tertiary deposit crosses from

one rock to another, a structural change may sometimes but not always occur.

Those deposits found in small intrusive stocks are closely confined to the limits of the intrusion, as at Waihi, New Zealand, and at Goldfield, Nev.

Structural Continuity, Deep-Seated Type

In deep-seated deposits it is not always easy to differentiate real from apparent structural continuity; for the structural features of a period of fracturing with mineralization, may not coincide with those of an earlier or later, barren period. Some of the controlling features, however, can at times be recognized. The great variety of forms which the fracturing may assume creates much uncertainty regarding the continuity of structural features, in all except the strongest and largest deposits, such as Kolar or the Morro Velho. At the latter, there occurs a remarkably well defined and continuous oreshoot. Sometimes structural complexity is lessened by examining the broader features of deposits, as in the California Mother Lode, or the Juneau belt, where a zone of related fractures persists in depth, although the individual fractures may not.

In the numerous districts where fracturing has been indefinite or where a series of kidney-shaped bodies are scattered irregularly through the plane of a fracture zone, or where the deposits form as irregular isolated lenses in intrusives, or where local structural features show much irregularity throughout the fracture plane; the mining industry has experienced either a series of ups and downs, or, with the exhaustion of the outcropping kidneys, complete abandonment.

The irregularity of ore occurrence in the minor deep-seated deposits may lead in some cases to fruitless exploration, yet the knowledge that the value of the ore can persist over a wide vertical range, will be an inducement to reopen and study many abandoned mines of this type.

Base-Metal Deposits

This article does not cover contact-metamorphic deposits, limestone, replacements, porphyry disseminations, etc. With respect to those tabular fracture zones whose chief value lies in their baser metals, I am at present uncertain whether economic deductions can be made. In general, however, in the Tertiary type, the base metal contents may gradually decrease with depth, especially in the case of zinc and lead. The deep-seated type would probably show a similar persistence of base metals as of precious.

Summary

In summarizing, I may say that siliceous gold-silver ore deposits in tabular fracture zones can be divided for economic purposes into two broad types: The Tertiary type, formed under surface conditions, showing a marked depreciation of primary precious-metal contents with depth, and the deep-seated type formed at considerable depth, showing a much more gradual decrease. In both cases, the degree of structural continuity is the deciding economic factor. The minor deposits of the Tertiary type show somewhat more structural continuity than the minor deposits of the deep-seated.

Examples and Classification

A few examples will indicate the economic application of the foregoing. The recent collapse in Santa Gertrudis would not have caused such a loss to the Camp Bird if a proper interpretation of the deposit had been arrived at before paying down 4½ millions. An understanding of the Waihi deposits would have prevented running up the shares to $50 some years ago, with a consequent mortifying loss to shareholders and directors. Confidence in the persistence of California Mother Lode deposits has brought about a remarkable resuscitation of this field. Below is a classified list of mining districts belonging to the types under consideration.

CLASSIFICATION OF SILICEOUS GOLD-SILVER DEPOSITS IN FRACTURE ZONES

"A", marked depreciation of primary valuable contents at less than 1000-ft. depth.
"B," marked depreciation between 1000 and 2000 ft.
"C," depreciation between 2000 and 3000 ft.
"P," slow decrease of more or less persisteney.
I, II, III, applied to the deepseated type refer to the degree of structural continuity, I signifying a high degree of continuity, and III extremely irregular structural features.

District	Chief Values		Type
Arizona			
Pearce	Ag Au	A	Tertiary
Tombstone	Ag Au	A	Tertiary
Chloride	Ag Au	A	Tertiary
Gold Road	Au	A	Tertiary
Silver King	Ag	A	Tertiary
Congress	Au	P	Deepseated I
California			
Mother Lode belt	Au	P	Deepseated II
Most important development of deepseated type in the United States.			
Northern Counties	Au	P	Deepseated
Grass Valley, Nevada City	Au	P	Deepseated I
Calico	Ag	A	Tertiary
Randsburg	Au	A	Tertiary
Colorado			
San Juan	Au Ag	B	Tertiary
Cripple Creek	Au Ag	B	Tertiary
Custer County	Au Ag	A	Tertiary
Gilpin County	Au Ag	A and B	Tertiary
	Au Ag	C	Intermediate
Summitville	Au Ag	A	Tertiary
Idaho			
Silver City District	Au Ag	A and B	Tertiary
Atlanta District	Au Ag	Probably B	Tertiary
Custer City	Au Ag	A	Tertiary
Montana			
Boulder County	Au Ag	P	Deepseated III
Butte, Silver Veins	Au Ag	A	Tertiary
Neihart	Ag Au Pb	A	Tertiary
Unionville	Au	P	Deepseated II
Marysville	Au Ag	B	Tertiary
Phillipsburg	Au	B	Tertiary
Nevada			
Fairview and Wonder	Au Ag	A	Tertiary
Tuscarora	Au Ag	A	Tertiary
Aurora	Au	A or B	Tertiary
Goldfield	Au	A	Tertiary
Silver Peak	Au	P	Deepseated II
National	Au	A	Tertiary
Arizona	Ag	P	Deepseated III
Austin	Au	A	Tertiary
Roche	Ag Pb Zn	A	Tertiary
Tonopah	Au Ag	B	Tertiary
Comstock	Au Ag	C	Tertiary
New Mexico			
Pinos Altos	Au Ag	A	Intermediate
Cooney	Au Cu	B	Tertiary
Oregon			
Blue Mountains	Au (Ag)	P	Deepseated I and III
Ben Harrison	Ag	P	Deepseated III
South Dakota			
Homestake	Au	P	Deepseated I
Utah			
Horn Silver	Pb Zn Ag	A	Tertiary
Ontario Park City	Pb Zn Ag	B	Tertiary
Sevier County	Au Ag	A	Tertiary
Alaska			
Treadwell	Au	P	Deepseated I
Juneau	Au	P	Deepseated II
Apollo Cons.	Au Ag	A	Tertiary
Appalachia. Numerous scattered deposits from Maine to Alabama of little importance individually, but in the aggregate producing a fair amount of gold. These all belong to the deepseated type.			

MINES AND DISTRICTS OUTSIDE OF THE UNITED STATES

Canada			
Nova Scotia	Au	P	Deepseated II
Nelson District, B.C.	Au Ag	P	Deepseated II
Nelson District, B.C.	Ag	P	Deepseated III
Porcupine	Au		Deepseated II
Mexico			
Guadalupe y Calvo	Au Ag	B	Tertiary
Lluvia de Oro	Au		Tertiary
Pachuca	Ag	B	Tertiary
Center of active mineralization, stronger orebodies should show slower decrease than usual for the Tertiary type.			
El Oro	Au Ag	B	Tertiary
San Pedro	Au Ag	A	Tertiary
Guanajuato	Ag Au	B	Tertiary
Same qualifications as at Pachuca			
Many other districts		A and B	Tertiary

Central America			
N. Y. & Honduras Rosario	Ag Au		Tertiary
Butters Salvador	Au		Tertiary
Nicaragua Districts Operating at Present	Au		Tertiary
Espirito Santo, Darien	Au		Tertiary
South America			
Frontino and Bolivia, Colombia	Au	P	Deepseated
Tolima, Colombia	Ag	A	Tertiary
El Callao, Venezuela	....	P	Deepseated II
Guianas, Venezuela		P	Deepseated
Zaruma, Ecuador	Au	A	Tertiary
Chuquitambo, Peru	Au	A	Tertiary
Santa Domingo, Carabaya, Peru	Au	P	Deepseated
Cerro Potosi, Bolivia	Ag	A	Tertiary
Morro Velho, Brazil	Au	P	Deepseated I
Guanaco, Chile	Au	A	Tertiary
Europe			
Lagardette, France	Au	P	Deepseated
Schemitz, Hungary	Ag Au	A	Tertiary
Nagybanya, Hungary	Au Ag	A	Tertiary
Verespatak, Hungary	Au Ag	A	Tertiary
Nagyas, Hungary	Au Ag	A	Tertiary
Berezovsk, Russia	Au	P	Deepseated II
Kotchkar, Russia	Au	P	Deepseated II
Asia			
Kolar, India	Au	P	Deepseated I
Annantapur, India	Au	P	Deepseated II
Oriental Con., Chosen	Au	P	Deepseated
Numerous Districts, Japan	Ag Au	A	Tertiary
Redjang Lebong, Sumatra	Au	A	Tertiary
Australasia			
Waihi, New Zealand	Au Ag	B	Tertiary
Reefton, New Zealand	Au	P	Deepseated II
Thames, New Zealand	Au Ag	B	Tertiary
Otago, New Zealand			Deepseated
Croydon, Queensland	Au	P	Deepseated
Charters Towers, Queensland In plutonic batholith	Au	P	Deepseated II
Mount Boppy, New So. Wales	Au	P	Deepseated I
Oaks Rush, Queensland	Au	A	Tertiary
Ballarat, Victoria	Au	P	Deepseated III
Bendigo, Victoria			Deepseated III
Kalgoorlie Dist. West Aust. Structural features developed only in quartz dolerite	Au	P	Deepseated II
Great Fingall Mine Distriet, West Australia	Au	P	Deepseated II
Sons of Gwalia District, W. Aust.	Au	P	Deepseated II
Laneefield Distriet, West Australia.	Au	P	Deepseated
Africa			
West Africa	Au	P	Deepseated II
Rhodesia	Au	P	Deepseated II
Pilgrim's Rest, Transvaal	Au	P	Deepseated I
Practically horizontal quartz reefs in shaly limestones, seem to be associated with diabase sills, extremely persistent.			
Glynn's Lydenburg, Transvaal Similar to above.	Au	P	Deepseated I
Rand	Au	P	Deepseated I

The Steel Corporation and the 12-Hour Day

At the annual meeting of the United States Steel Corporation, on Apr. 20, Chairman Gary presented and read a statement from the Finance Committee on the subject of employment, as follows:

The rate of wages now being paid to our employees is the highest which has been paid in the iron and steel industry since that industry reached anything like its present proportions. There has been no reduction in wages since the advance made on Feb. 1, 1913, which involved an increased expenditure of $12,000,000 a year. During 1913 the average number of employees in the service of the corporation and its subsidiary companies was 228,906. The total salaries and wages paid to such employees was $207,206,176. The average salary or wage per employee per day, exclusive of the general administrative and selling forces, was $2.85; including the general administrative and selling force, it was $2.92. The 12-hour day is now confined almost entirely to those departments such as the blast furnaces and rolling mills, where operations must be continuous throughout the 24 hours, although the hours of labor of the workmen employed in them are intermittent, because of intervals during the operations. The nature of these operations are such that the workmen are acually employed less than two-thirds of the time. Owing to the peculiar conditions controlling these operations, it is the practice in the industry to divide the day into two turns of 12 hours each, and the only change which could be made would be to divide the day into three turns of eight hours each, but in that case the hours of labor would be so much reduced that remuneration to the workmen would necessarily be diminished. The experience in eliminating seven-day labor shows that any plan under which the men earn less, results in the loss of many of the best workmen who seek and find employment where such restrictions are not enforced. From our investigations of the subject, it is believed that the 12-hour day is not physically detrimental to the men, because the work is intermittent, and for the further reason that the introduction of machinery has eliminated most of the ardous physical labor. In fact, those departments in which the eight-hour day prevails are probably more exhausting in their demands upon the men physically than the 12-hour shifts, owing to the continuous nature of the employment.

Steady employment is a matter of vital importance to the workmen in any industry, and is of even greater benefit to him than shorter hours or higher wages. The welfare of the workmen and of the corporation is dependent upon the prosperity of the iron and steel industry in this country, which, in turn, depends upon good general business conditions. The general average of prices for iron and steel products has prevailed for nearly a year past, has been on a low level, and the margin between selling prices and cost of production is much smaller than has prevailed at any time during the past 15 years, with the exception of a short period in 1911, and affords a low rate of return on the actual value of the capital employed. The large tariff reductions have brought many of our largest markets into strong competition with foreign iron and steel makers whose employees work 12 hours a day at wages averaging 50% or less of the rates paid in this country. Under all these circumstances it seems clear to the Committee that such a radical change to the 8-hr. day cannot be made at present.

British Mineral Production

A condensed statement by the Mine Inspection Bureau shows that the coal produced in Great Britain for the calendar year was 260,398,578 long tons in 1912, and 287,411,869 tons in 1913; an increase of 27,013,291 tons, or 10.4%. The production of other minerals from mines included under the Coal Mines Act was as follows, in long tons:

	1912	1913
Iron ore	6,744,258	7,709,624
Iron pyrites	8,964	8,442
Clay and shale	399,033	457,244
Fireclay	2,287,719	2,585,763
Igneous rocks	268	688
Limestone	12,009	7,525
Sandstone and ganister	152,156	144,923
Oil shale	3,184,826	3,280,143
Barium compounds	4,712	4,610

The production of coal given above is practically complete, only a few thousand tons being obtained from open-pit workings classed under the Quarries Act. The output of iron ore will be increased considerably by the reports from metalliferous mines and quarries.

The number of persons employed in these mines in 1913 was: Underground, 909,834; on surface, 218,056; total, 1,127,890, an increase of 38,800 over 1912.

Ray Consolidated Copper Co.

Ray Consolidated Copper Co. produced 17,234,346 lb. of copper in concentrates during first quarter of 1914: January, 5,571,279; February, 5,578,950 lb.; March, 6,084,117 lb. Additional 473,028 lb. were contained in ores shipped direct to smelter, making a total output of 17,707,374 lb. 714,009 dry tons of ore were milled, averaging 1.7978% copper. Mill recovery was 67.13%. Milling costs were 53.15c. per ton treated. Mining and coarse-crushing costs were 68.411c., of which 3.268c. was for crushing.

Average net cost of copper, allowing for smelter losses and crediting dividends of Ray & Gila Valley R.R., but no other miscellaneous income, was 9.211c. Including shipping ore, cost was 9.14c. per lb. If miscellaneous income were all credited, the cost of net copper per pound would be 9.086c. Earnings are based on 14.4117c. per lb. for copper.

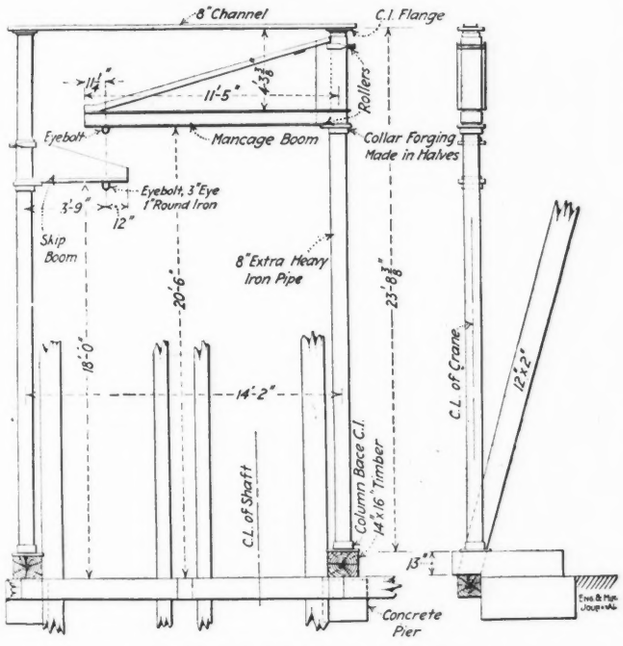
Net operating profit was $913,004; miscellaneous income $9095; total, $922,099. Less interest on bonds, $44,655, total is $877,444. Dividends of $543,964 were paid, leaving net surplus of $333,480.

Details of Practical Mining

Skip and Man-Cage Transfer

By Walter R. Hodge*

The device herein described is in use at the London and Burra Burra shafts of the Tennessee Copper Co., Ducktown, Tenn. At these shafts men are handled in one only of the three compartments. The device is used for swinging skips and man cages in and out of the shafts when it becomes necessary to change them.



Columns and Booms for Cage and Skip Transfer

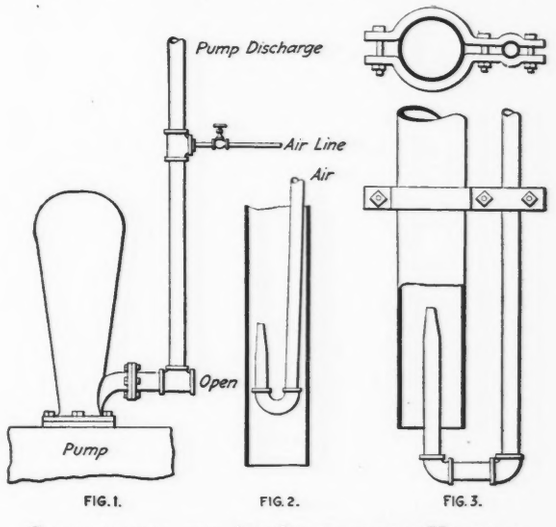
The transfer consists of two vertical columns of extra-heavy 8-in. iron pipe, on each of which swings a boom. These booms are of unequal length and are so arranged that an eye-bolt near the end of each may be swung over the center of the compartment in which the men are handled. In each eye-bolt are hung two chains with hooks at the end. These hooks engage holes in the sides of the man-cage and of the skip, near the top of each. The booms are built of ¼-in. plate and structural steel. They rotate about the columns on vertical rollers placed at the bottom of the boom on the side of the column from which the boom extends, and on the other side at the top of the boom. A collar bolted below each boom prevents it from slipping on the column. About the column at the bottom is shrunk a heavy cast-iron base, which is in turn bolted to a concrete base or pier. Across the top the two columns are joined by an 8-in. channel brace, which is frequently used as an aid in loading material in the skip to be taken underground. The whole structure is stayed by four steel guy-ropes fastened to convenient "dead men."

In operation, when it becomes necessary to exchange skip for man cage, the skip is hoisted into position near the long boom, the bail blocked with a length of drill steel to prevent its dropping down and the chains attached by means of their hooks to the holes in the sides of the skip. The cable is then slacked off so that the skip swings on the short boom. The bolt is removed from the cable clevis and the skip swung out of the shaft by means of a rope reaching the ground and handled by the dumpers. The man cage is swung into position on the rails by means of the long boom on which it is already suspended, the cable is attached to the bail, the cage hoisted and the chains cast off. The whole operation occupies about two minutes.

Applications of Air Lift to Shaft Unwatering

By Arthur O. Christensen*

A shaft can usually be unwatered more quickly and cheaply with an air lift than with pumps. It is, therefore, advisable, before allowing a mine to flood, to connect the air line to the discharge of the pump line as near the bottom of the shaft as possible, preferably a few feet above the pump, as indicated in Fig. 1. If there is a tee where the line joins the pump this should be left



Connections for Air Lifts under Varying Conditions

open. If there is not a tee, the line should be disconnected from the pump.

To start unwatering, compressed air is simply turned into the air line and the pump-discharge line begins to work as an air lift. The diameter of the air line where connected to the water pipe should be about one-fourth the latter.

*Mining engineer, Ducktown, Tenn.

*Mining engineer, Franklin, N. J.

Even if the pump is one which can be started while drowned, so that an air-lift attachment seems unnecessary, still it is desirable to have the connection made as described, for there is no knowing how long the pump may be submerged or whether it will work when the air supply is turned on. In such a case, however, it is not necessary to make any opening in the discharge line, since, if the air lift is to operate without the pump, it can suck water through the pump valves. Both lift and pump can be used, one helping the other. The air lift relieves the pump of a portion of its work by diminishing the head in the discharge, or, looking at it from the opposite standpoint, the pump aids the lift by supplying its suction end with water at a pressure which may be greater and cannot be less than would be the case were the pump not to act. Conversely if it is found that a pump is not able to lift its water to the point of discharge, the suction end being all right, a small amount of air admitted to the discharge line just above the pump will cause it at once to speed up.

In most cases, however, it is too much to expect a retiring management to leave a mine in such shape that it is necessary only to start up the compressor in order to unwater the property. The question is how to unwater the shaft as it stands.

Frequently there is a pipe line running straight down the shaft. Whether the bottom of this be open or closed, and whether there be a pump attached or not, the air lift can be operated, so long as the line is straight enough to allow a pipe to be run down the inside. Fig. 2 represents the lower end of the inner pipe. If no return elbow is at hand, two elbows connected by a close nipple will answer. The nozzle is made by heating one end of a short pipe and forging it down to about three-fourths or one-half its original diameter. This arrangement can suck water through a drowned pump, although, of course, not so readily as if there were no such obstruction.

Where a suitable pipe is in the shaft but is closed by a valve or otherwise, a charge of dynamite can be lowered by a small pipe within the larger, and the charge exploded by electricity—one ordinary dry cell will set off an exploder—thus breaking the pipe. The saving by using an air lift for the job is assumed to be more than the cost of repairs to the pipe line later on.

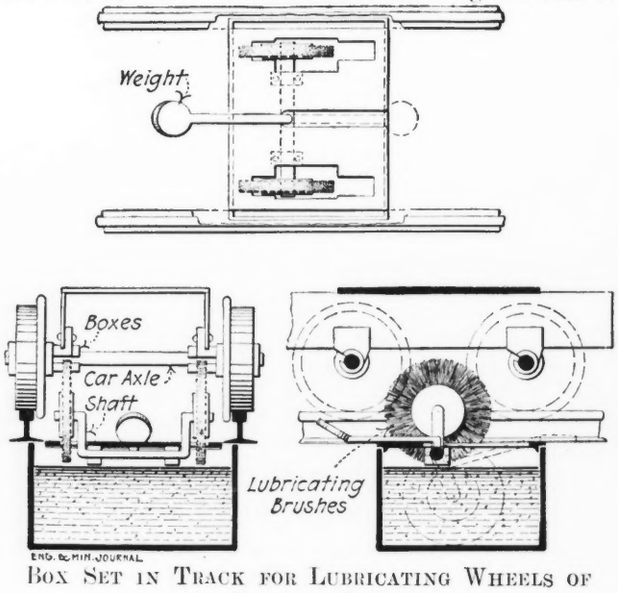
In case no suitable pipe for the water discharge is found in the shaft, a simple air lift can be dropped down a vertical shaft or can be lowered in an inclined shaft either on the truck or simply on a plank laid across the rails.

A 2-in. and a 1-in. line make a convenient size for such a lift, as is shown in Fig. 3. At intervals of from 15 to 30 ft. the two lines are strapped together as indicated. This arrangement will operate either vertically or on an incline. The discharge can be carried through elbows, but two 45° elbows give better results than a single 90°. As soon as it is noticed that the ratio of water to air being discharged has decreased considerably, the lift must be submerged more, or, if this is not possible, the height of its discharge must be diminished by installing a pump as near the water as possible to throw the water from the lift to the surface.

With 100 lb. of air pressure, such a lift as indicated can raise water 200 ft. with a 20-ft. submergence, or can lift 50 ft. with almost no submergence at all. The air issuing from the nozzle serves as an ejector to suck up and carry the water along with it. Air lifts can be compounded to raise water any heights with any submergence, down to almost nothing, but in general a pump is preferable to such a complicated arrangement.

Lubricating Box for Mine Cars

Joseph Henry Thomas, of Independence, Colo., has invented a device for lubricating the axles of mine cars, when these turn in accessible bearings beneath the truck (U. S. Pat. 1,080,500). It consists of a box set in the ground between the rails and almost completely covered. This is partly filled with lubricant, preferably a heavy oil or a grease. On the under surface of the box cover are two bearings, which carry a shaft. The ends of the shaft are bent to crank form and two brushes mounted on the ends, these being preferably capable of rotation. An arm fastened at right angles to the crank at the center carries a weight on the end. Slots in the box cover permit the brushes and the weighted arm to



Box Set in Track for Lubricating Wheels of Passing Car

project, the brushes being in a position to touch the axle bearings as the car passes over. When not in use, the weighted arm is thrown over so as to submerge the greater portion of the brushes in the lubricant, as is shown by the dotted lines. When thrown up again in order to lubricate a car, the brushes will be filled with lubricant. It is advised that the axle-bearing boxes be slotted on one side, so that the lubricant can more easily enter.

Qualities of Sand Pulp for Mine Filling

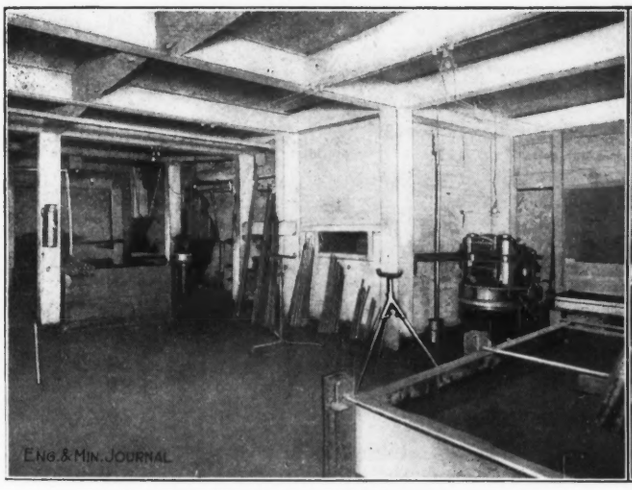
The most desirable sand pulp for mine filling is that which is lowered underground with a minimum of slime and water, and such a sand can be readily obtained by good classification prior to current cyanide treatment. Sand sent underground with much slime tends to undergo a classification similar to that in a tailings dam, with the result that the slime is carried furthest from the point of entry into the stope and by lodging against the barrier interferes with free drainage (*Journ.* Chem., Met.

& Min. Soc. of South Africa). The higher the ratio of water to solids in the pulp entering the stope the more this effect is accentuated, with the result that the deposited sand is liable to form a water-logged mass. The behavior of water as an incompressible fluid under such conditions causes any subsequent vertical rock pressure, which it is the object of sand filling to withstand, to be laterally transmitted against the barriers, frequently resulting in their giving way.

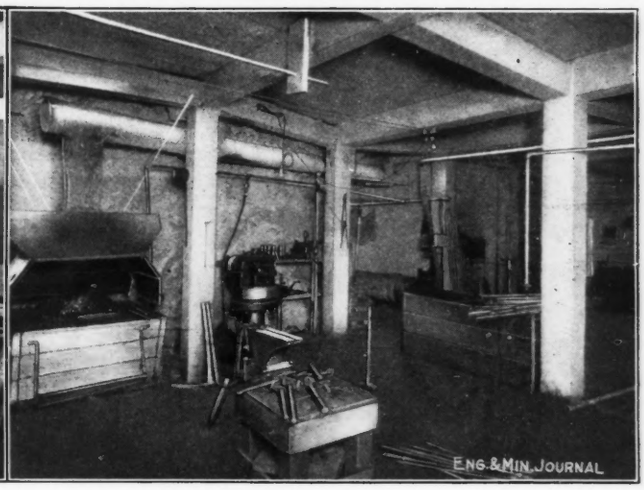
On the other hand, clean sand deposited without being classified in the process behaves like a desirable uniform and permeable charge in a leaching vat, and not only allows to escape readily the water conveying it as a pulp, but also any mine drainage water which may subsequently enter the stope. Well drained sand shows little tendency to transmit vertical into lateral pressure against the barrier, owing to the great friction between the sharp-edged particles, and as shown by previous tests, its compressibility is so slight that even at 6500 ft. depth the contraction of a deposit 6 ft. deep cannot amount to more than 1 foot.

Underground Blacksmith Shop

The Ray Consolidated operates an underground blacksmith shop on its 200-ft. level. The photographs show



One End of Shop. Oil-Burning Forge in Center, Fire Extinguisher on Post



The Other End of the Shop. Coke Forge on Left, Oil Forge at Right

two ends of this shop with the two Leyner drill sharpeners, the coke forge, the oil-burning forge, anvil, quenching tanks, rests, etc. The fire extinguisher on one of the posts is worthy of note.

Packing for Centrifugal Pumps

After installing some high-pressure eight-stage centrifugal pumps the Penn Iron Mining Co. experimented with various types of packing. The original packing in the main stuffing boxes was solid metallic; it was unsatisfactory and soft metallic packing was tried; then several kinds of special packings. A good grade of square braided hemp packing was finally adopted as most satisfactory (*Bull.* A. I. M. E., February, 1914).

Leakage in such a pump is greatest through the stuffing box on the discharge end of the pump, where the full pressure occurs, in this case, 522 lb. Since the shaft has only rotary motion and no longitudinal, there is nothing to distribute the pressure from the outside ring of packing to the other rings where the packing is tightened up Consequently, the outside ring is likely to be pressed too tight and wear a groove in either the shaft or the protecting sleeve on the shaft. No attempt is made to lubricate the packing; the shaft is protected from wear in the stuffing boxes by a removable sleeve which can be changed in about two hours.

Unit Blocks for Mine Model

In constructing a mine model of the Charters Towers property in Queensland, the system which employs wires to represent the workings was decided upon, but an innovation consisted of dividing the block to be represented into unit cubes of wire frames (I. M. M. *Bull.* No. 113). The cubes had 10-in. sides, equivalent to 1000 ft. These were made of ⅛-in. galvanized-iron fencing wire soldered at the angles. By using a template, they could be made true and strong in about 10 to 15 min. each, the wires being already straight and cut to length.

A plan of the workings in each 1000-ft. square section was made to scale and the mine levels reduced to sea-level datum. To represent levels, small crosscuts, winzes, etc., $\frac{1}{16}$-in. copper wire was used, while the main shafts and crosscuts were indicated by ⅛-in. brass wire. For each tube, each level was first made by bending and cutting the wires to fit the plan and soldering on the branches, etc., while held on the plan. Then sections through any shafts and winzes which were important or helped to stiffen the model were plotted on cross-section paper and wires were cut and bent to fit. Notches were cut in the incline shaft wires to accommodate the wires of the levels. The shafts were held at the correct angle in a vise or by other means, while the levels were soldered to them and connected by the winzes, the correct relative orientation of the levels and the inclines being first assured by comparison with the plan.

The soldered network was then suspended in the cubes by fine wires attached by solder to the cube wires and acting as ordinates therefrom, while the wires of the same

workings where they continued from one cube to the next were soldered together. Occasionally an insufficiently supported end which did not reach to the cube surface required support by a fine diagonal wire.

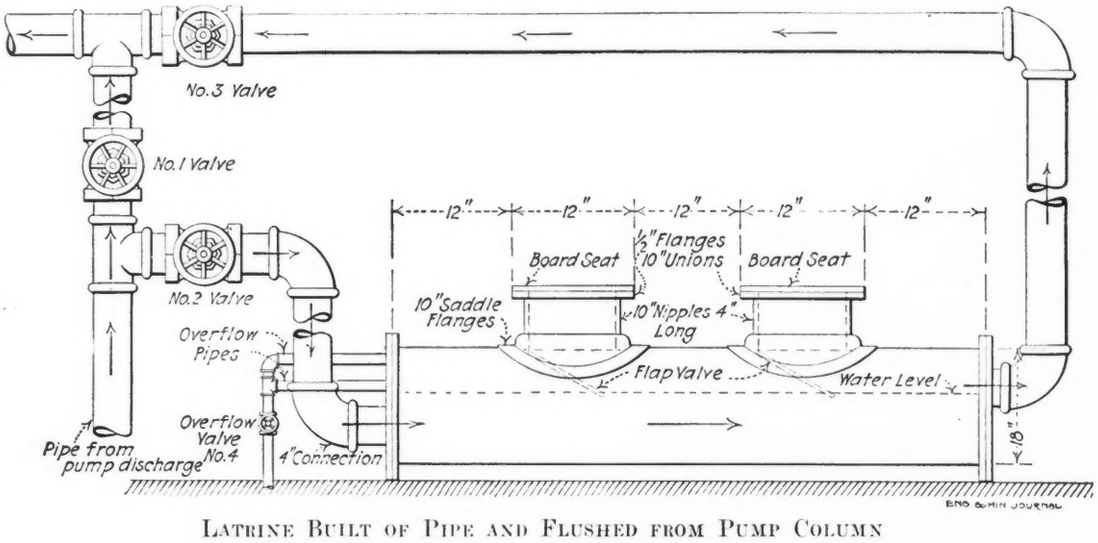
The wires designating workings were painted various colors to differentiate country rock, dikes, unpayable lode and pay ore, the cube forms being painted black to avoid confusion.

Sanitary Underground Latrine

By W. B. Hambly* and A. E. Hall†

At most mines the problem of the underground privy is serious. If the men are allowed to go to the surface excessive time is lost; the portable privies frequently used are generally unsatisfactory; if the waste from the privies is allowed to run into the sump, unless pumping is frequent, there is danger of having the material collecting on the sump bottom. The accompanying sketch shows a design of a privy which keeps the waste materials entirely separate from the sump and it is a unit in itself.

The device is simple. It consists of a piece of 12-in. cast-iron pipe or any sort of pipe with a cap on each end, the caps bored and threaded for a 4-in. pipe. The intake is at the bottom of one end and the discharge at the top of the other. A small auxiliary pipe, inserted at one end to be used as a run-off after flushing, leads to the sump. Two saddle flanges are placed as shown, the 12-in. pipe being cut to match. The saddle flanges should be 10-in. A 10-in. nipple about 4 in. long is placed in the saddle and on the nipple is screwed half of a flange union. A wooden seat is attached to the top by the bolt holes in the union. Flap valves must be placed inside the main pipe at the saddle flanges to prevent overflowing during the process of flushing. A valve is placed in the water column leading from the pump and connections made on either side of this valve, which connections are also provided with valves as shown. The valves are all placed so that they come inside the pump house; only the pump man has access to them and he is responsible for the flushing. When the privy does not need flushing, valve No. 1 is open and No. 2 and No. 3 are closed. The discharge from the pump is then up the shaft direct. Valve No. 3 is a gate valve, but the other two can be globe valves. When it is desired to flush the closet, valve No. 1 is closed and No. 2 and No. 3 are opened. The water then takes the indirect course through the closet, carrying the waste to the surface. When it has been flushed, valves No. 2 and No. 3 are closed and valves No. 1 and No. 4 are opened. As shown, there are only two seats, but any convenient number can be put on.



Latrine Built of Pipe and Flushed from Pump Column

Electric Power Shaft Cables

All power current carried underground in the shafts of the Penn Iron Mining Co. at Vulcan, Mich., is 2200-volt, three-phase, 60-cycle (*Bull.*, A. I. M. E., February, 1914.) At the West Vulcan and East Vulcan No. 4 shafts three separate lines of conduit are carried from the surface substation to the pump rooms. Each conduit incloses three separate transmission wires, two of the conduits having No. 00 stranded wires and one having 500,000 cir.mils stranded cable. Each wire is insulated with rubber for 7500 volts, the wall being of 30% Para rubber $\frac{5}{16}$ in. thick. The conduit is sealed at the upper end around the wires to prevent the entrance of moisture and is open at the lower end to allow the moisture of condensation to get out. The first conduits used at the Penn mines were 3-in. pipe lined with fiber. The inside diameter was so small that it was hard to pull the three wires in, and after being used some time, the moisture caused the fiber to swell so that it was still more difficult to get the wires out. The conduits now used are 3-in. Sheraduet for the No. 00 lines and 5-in. for the large lines. The first 2200-volt underground lines, put down one of the shafts at Republic, were lead-covered cables, three cables in an iron pipe. The alternating current seemed to build up a static charge on the lead covering that punctured the insulation as well as the lead and caused bad short-circuits. While wires in a shaft or mine are underground in the miner's use of that term, they are really aërial lines, for they are not imbedded in the ground, under which latter conditions lead-covered wires are properly used.

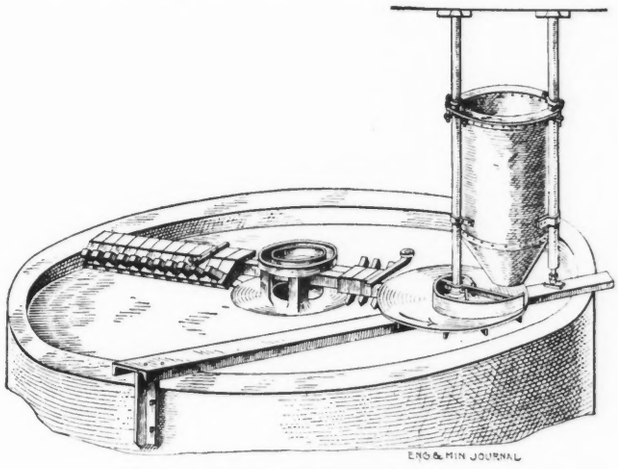
*Superintendent, No. 2 Mine, Canadian Copper Co., Copper Cliff, Ont., Can.

†Mining engineer, Creighton mine, Canadian Copper Co., Creighton Mine, Ont., Can.

Details of Milling and Smelting

Miller Furnace-Feeding Device

With the object of insuring a regular and constant feed to roasting furnaces, particularly of the McDougall type, E. B. Miller, of Baltimore, Md., has invented a mechanical feeder (U. S. pat. No. 1,064,516), which may be set to deliver material at any required rate. A cone-bottomed cylinder forms the hopper of the feeder, the opening at the cam apex delivering onto a movable round table. A spiral scraper is mounted immovably, and as the table revolves, the scraper pushes the material on to the top of the furnace. The underside of the table has pieces of angle iron fastened to it, and the lugs,



Miller Furnace-Feeding Device

shown in the drawing, which are fastened to the rabbles, engage these angle irons and give the table its movement. The rate of feed can be increased or diminished by raising or lowering the hopper on its standards.

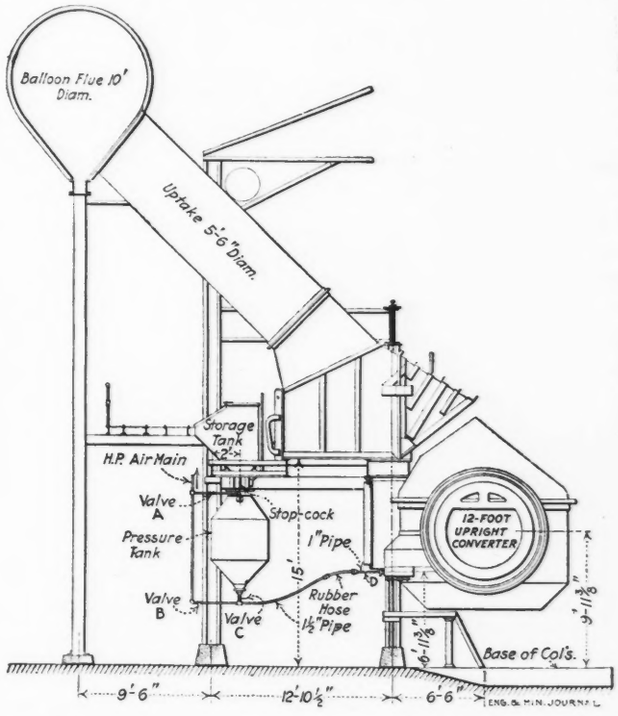
Fracture Samples of Furnace Slags

Many furnace foremen become expert in judging the grade of matte by the fracture of the small sample usually taken at the time of tapping. This principle is sometimes applied in judging the furnace slag as well as the matte. At the Old Dominion smelting works at Globe, Ariz., the components of the furnace charge are exceedingly variable and often result in abrupt changes in the running of the blast furnaces. Slag samples are taken by a small shallow ladle and are approximately the size and shape of the usual matte sample at most smelting works. The slag "buttons" from each furnace are arranged by the sampler in regular order in a small tray and the foreman judges by the microscopic characteristics of the fracture whether a furnace demands attention. It has been found that the old employees become excellent judges of the fractured slag sample and the system is a great convenience on the night shift.

The Day Process of Blowing Fine Material into Converters

When it was decided to accept the contract for handling the Miami concentrates at Cananea, the smelting of this product became a problem. A large proportion of the concentrates is exceedingly fine and it was decided to try the process devised by Arthur Day. This is a development of the old idea of blowing the fine material into the converter through the tuyeres. While this has not been entirely successful in the past, Mr. Day persevered with his experiments until he succeeded in getting this process working on a commercial scale.

At Cananea, the concentrates are dried in a home-made three-hearth McDougal furnace. The dried concentrates are trammed in closed cars to the storage tank shown in the accompanying drawing. The concentrates are then dumped into the pressure tank through a large



Day Apparatus for Feeding Concentrates into Converters

stop-cock, after which the latter is closed, making the drum airtight. When it is desired to blow concentrates into the converters, high-pressure air (75 to 80 lb.) in small quantity is turned on at the valves *A* and *B*. Connection with the converter is made by means of a short piece of pipe *D*, pointed to fit tightly into the converter tuyere, where it is clamped in place. A piece of rubber hose in the feed line gives flexibility to the connection.

A little more high-pressure air is then turned on and the valve *C* at the base of the pressure tank is opened; the

concentrate falls into the stream of compressed air and is injected through the converter tuyere into the molten matte. Ordinarily, about 100 lb. of concentrates are blown through a tuyere per minute; under ordinary conditions, "blowing in" is continued 10 to 15 min. when the valve *C* is closed, the nozzle withdrawn and the high-pressure air shut off.

Between April, 1911, and June, 1913, about 35,000 tons of Miami concentrates were smelted in the converters in this manner. Concentrate storage tanks and pressure tanks have been erected behind each converter stand as shown in the accompany drawing, so that the concentrates may be fed as desired to any converter. When the Day process was installed the grade of the matte was usually between 30 and 35% and about 50 tons of Miami concentrates were smelted daily in the converters, the remaining 75 tons being smelted in reverberatory furnaces. The process is not used at present as a higher-grade matte is now being made and the converter cleanings provide sufficient cold material to keep the converters cool. It is cheaper to use to the cleanings in the converters than to re-treat them in the blast furnaces and continue to blow in Miami concentrates.

Miami concentrates are dropped on the sides of the reverberatory furnaces instead of the usual fettling material. The concentrates carry about 21% sulphur and 17% silica. When they run off the side of the reverberatory furnaces, they, consequently, do not produce the siliceous "floaters" that often result when quartz or highly siliceous ores are used for fettling material. On account of disturbed conditions, however, the Miami concentrates have lately been sent to Douglas.

Jacketed Blast-Furnace Tops

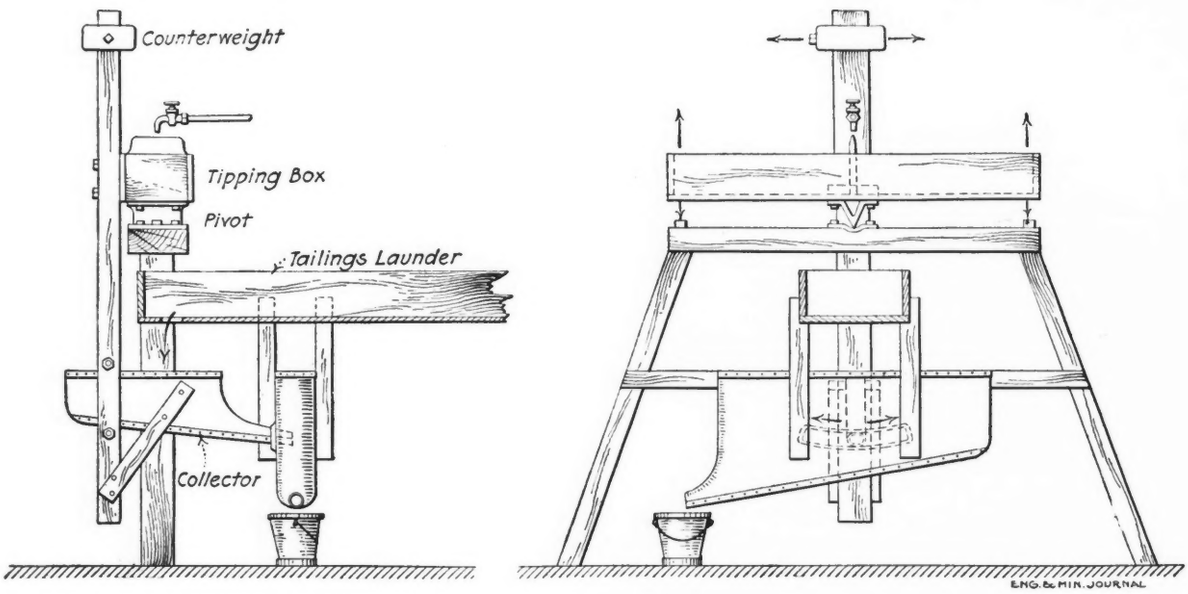
The blast furnaces at the Washoe works, Anaconda, now have water-jacketed tops. Riveted-steel jackets proved unsatisfactory. The best form has been found to be cast-iron jackets, about 2½ in. thick, the iron being cast around a grid of 1¼-in. pipes, connected by U's at the ends, the individual pipes being about 1 in. apart.

A Simple Sampling Device

By L. U. W. Judell*

A few years ago when some adjustments were being made at the concentrating mill of the Stannary Hills Mining Co., North Queensland, it was desired to obtain an accurate average sample of the tailings and a simple and effective automatic sampler was evolved for the purpose. I do not know whether it is altogether original, but have not seen any like it on any mining field. It is very simple and cheap and can be recommended to any mill man.

A galvanized-iron collector with a narrow rectangular orifice on top, is moved across and beneath the tailings stream as it drops from a launder, by means of the tipping action of a long, wooden box pivoted at the center, as shown in the accompanying diagram. The spout of the collector moves in an arc cut in a shaped galvanized-iron receptacle which in turn empties into a 4-gal. bucket which holds the sample for an 8-hr. shift. The alternate tipping is caused by a small stream of water running into the tipping box on alternate sides of a central division. One side fills until the weight of water pulls it over, inclining the bottom to a slit in the end through which the water escapes; while one side is down, the center partition is shifted out of the vertical and thus guides the stream of water into the elevated side. The number of samples taken can readily be adjusted by varying the flow of water with a small valve.



Automatic Pulp Sampler

The tipping box is supported at the center on a steel knife edge resting on a V filed in a plate screwed on a small trestle and the top of the trestle is extended to stop the box when it has moved through the arc required. A couple of small rubber buffers are desirable to prevent jarring. [This sampler is in some respects more simple than the Lamb tailing sampler, which it resembles, but it has the disadvantage of an arc cut. In the Lamb sampler, the track and rollers attached to the tilting box give a nearly right-angle cut of the stream.—Editor.]

*Jamestown, South Australia.

Company Reports

North Lake

The 1913 report of the North Lake Mining Co., Houghton, Mich., states that the company received $100,000 from assessment No. 1 and $956 from other sources; after deducting a deficit of $13,835 from 1912, a balance of $87,121 remained, from which expenses for the year amounting to $37,713 were deducted. The company ended the year with a balance of quick assets of $49,408. Total mine expenses are shown to have been $30,194, the principal item of which was 282 ft. of shaft sinking at $50.94 per ft., made up of: Mining, $20.85; timbering, $20.54; and power, $9.55 per ft. The cost of running 124 ft. of crosscut is given at $13.60 per foot.

No active work has been done on the property since the strike was called in July. All the plant necessary for the development of the property has been completed and presumably work will be resumed when labor conditions permit.

Adventure Consolidated

The 1913 report of the Adventure Consolidated Copper Co., Lake Superior Copper District, Mich., states that at the beginning of 1913 exploratory work was in progress in the drifts from the long crosscut at the bottom of No. 5 shaft. These openings disclosed no ground of a profitable character and work was discontinued in March. Diamond-drill operations were continued on surface and underground until July when, on account of poor results, they were stopped, thus bringing all active work to an end. Machinery and tools were stored and the buildings boarded up. The company began the year with a balance of $22,633, and after paying all expenses, closed with a balance of $12,793 over liabilities. This company was organized in 1898 and produced a little under 9,000,000 lb. of copper during years 1900 to 1907, inclusive. No value is given in the report for the lands owned, which aggregate about 1700 acres.

Rio Tinto

In 1913 the Rio Tinto company, in Huelva, Spain, mined 1,859,571 tons of ore, averaging 2.19% copper. Two-thirds of the ore was treated locally, and 635,900 tons of pyritic ore were sold to consumers for both the copper and sulphur contents. The total quantity of copper sold was 36,320 tons, of which 21,062 tons were produced at the mine.

As compared with 1912 the tonnage mined is reduced by 23%, copper produced at mine by 17.5%, and ore sold by 8%. The dividends are reduced from 90% to 75%. These reductions were chiefly due to labor troubles, though a dry season and consequent shortage of water supply contributed.

Relative to the labor troubles, the chairman at the 41st annual meeting, held in London on Apr. 3, laid the blame wholly on socialists and syndicalists who, for their own political ends, have been trying to stir up strife and selected Rio Tinto as a suitable object for attack. Previous to the strike the directors decided to introduce a workmen's pension scheme, to provide a subsistence for any man who had worked for the company for 25 years.

Utah Consolidated

According to the report of the Utah Consolidated Mining Co., Bingham Cañon, Utah, for the year ended Dec. 31, 1913, profits amounted to $630,829, after charging off expenditures on plant; this is $63,891 greater than in 1912. Dividends amounting to $450,000 were paid. The mine produced 251,966 dry tons of ore, all of which was shipped to the International Smelting & Refining Co. Of this ore 181,077 tons averaged 1.987% Cu, 0.056 oz. Au, and 0.705 oz. Ag, and 70,889 tons averaged 15.053% Pb, 0.060 oz. Au, 3.922 oz. Ag, and 0.968% Cu. Development work totaled 20,510 ft. In the western portion of the upper limestones an important body of lead ore was found, measuring 570 ft. on the dip and 500 ft. at its greatest length, with an average width of 4.8 ft. This ore averages 18.7% lead, 3.07 oz. silver and 0.06 oz. gold. Ore reserves are said to contain 287,038 tons of 1.9% copper ore and 51,409 tons of 15.3% lead ore. Above the porphyry dike on levels Nos. 10, 11 and 12 there has been developed a body of ore containing 190,000 tons of 1.75% copper. Tests by an oil-flotation process are being made to determine if a commercial grade of concentrate can be made from this and other low-grade copper-ore reserves in the mine. So far the tests have not been decisive.

Tonopah Mining Co.

The report of the Tonopah Mining Co., Tonopah, Nev., for year ended Feb. 28, 1914, shows net earnings of $1,363,441 and dividend payments amounting to $1,300,600; dividends to date total $11,600,000. The mine produced 163,411 tons of ore and 38,877 tons of waste; total, 202,288 tons of rock. The mill treated 163,387 dry tons, having an average assay of 0.247 oz. gold and 21.61 oz. silver per ton. Costs were as follows:

	Per Ton
Mining	$3.28
Milling	2.81
Freight on ore milled	0.74
Marketing products	0.58
Total cost per ton	$7.41
Metal losses	1.96
Profit per ton	8.42
Average gross value	$17.79

A segregation of mining costs shows labor, $1.977 per ton; supplies, 72c.; power, 26.9c.; indirect charges, 31.2c.; total, $3.278 perton. The mill operated 95.9% of total time and crushed an average of 4.65 tons per stamp per 24 hours. The combined extraction of gold and silver was 87.52%. Development consisted of 8414 ft. of drifts, 5311 ft. of crosscuts, 3751 ft. of winzes and raises, 461 cu.yd. of excavations and 448 ft. of shaft sink-

ing. Ore reserves are estimated to contain 172,761 tons of ore, averaging $14.33 per ton. Owing to changes to make an all-slime product for cyanidation, the milling tonnage was reduced from 500 to 400 tons on Nov. 1, 1913. The company acquired an interest in a placer deposit at Breckenbridge, Colo., and an option on a mining property in Nicaragua, where development work is being carried to determine the extent of the ore.

Barnes-King

The report of the Barnes-King Development Co., Kendall Mont., shows a net profit of $129,906, from operations beginning Aug. 27, 1912 and ending Dec. 31, 1913. This was the result of treating 49,726 tons of ore yielding $8.34 per ton or a total of $414,594. Miscellaneous earnings totaled $7910. Since the last report, the company has acquired title to the North Moccasin and the Piegan-Gloster properties. Development work performed totaled 7186 ft. of drifts, etc. and 22,650 cu.ft. of stations and pockets.

OPERATING COSTS

Total tons of ore milled	49,726 tons
Operations at North Moccasin Property:	Per Ton
Development	$0.650
Stoping	2.850
Milling	0.600
Maintenance	0.260
Operations at Piegan-Gloster Property:	
Labor and supplies	0.463
Traveling expenses	0.020
General Expenses—Kendall Office:	
Management and office salaries	0.250
Printing and other expenses	0.020
Taxes	0.045
Insurance	0.080
Sundries	0.005
General Expenses—Treasurer's Office:	
Salaries	0.043
Traveling	0.008
Office and miscellaneous	0.011
Mine examinations	0.013
Depreciation	0.212
Total operation cost	$5.630
Yield of ore per ton	8.340
Profit from operations	$2.810
Profit from miscellaneous sources	0.160
Total	$2.970
Less judgment and expenses in suit	0.360
Net profit per ton of ore	$2.610
Miscellaneous data:	
Average extraction in mill	90.58%
Consumption of cyanide per ton	0.317 lb.
Consumption of lime per ton	2.71 lb.
Consumption of zinc per ton	0.343 lb.
Consumption of zinc per oz. of bullion	0.697 lb.

The company ended the year with a balance of $103,474 in quick assets including mine and mill supplies. There is a suit pending in the New York Courts brought by the Assets Collection Co., which involves $89,500.

Beaver Consolidated

The Beaver Consolidated Mines, Cobalt, Can., according to its report for year ended Feb. 28, 1914, shipped 769,699 oz. of silver valued at $438,551. One dividend of $60,000 was paid. Balance of quick assets was $110,299 at the end of the period. The mill operated 293.5 days, treated 25,256 tons of ore and produced 324.13 tons of concentrates containing 379,764 oz. of silver. The heads assayed 18.6 oz. and tails, 3.65 oz., indicating a recovery of 80.85%. Development work totaled 4522 ft. and stoping 4685 sq.yd. No attempt was made to estimate ore in place, which includes some high-grade shipping ore, but an estimate of mill ore broken shows 15,000 tons on dumps and 30,000 tons on stulls. This ore is estimated to contain 1,200,000 oz. of silver, which will yield about $436,879 after payment of treatment and shipment charges.

The only accident during the year was a minor one on surface due to the carelessness of a workman. The mill has been increased from 80 to 100 tons capacity and a new Nordberg hoist with a capacity of lifting 8000 lb. from 2000 ft. at a speed of 1800 ft. per min. is being installed. The old hoist will be shipped to the Beaver Auxiliary property for installation.

Indiana Mining Co.

The Indiana Mining Co., Houghton, Mich., in its 1913 report shows expenses amounting to $46,868 for the year which lowered its surplus from $53,060 to $6730 after crediting $538 received from interest on deposits and assessments. No work was done at the property after the strike was called in July. During the first half of the year, the shaft was completed to a depth of 1415 ft. and a plat cut at the 1400-ft. level. The cost of sinking 211 ft. of this shaft was $50.24 per ft. The cost of driving 270 ft. of drifts and crosscuts was $17.52 per ft. The diamond drill hole No. 2 cut a copper deposit at 1400 ft. and the shaft was located to intersect this hole at this depth. The drill hole, however, was evidently deflected from its vertical course as the shaft is in rock of a different nature. The exact course of the drill hole is yet undetermined. The southeast drift at the 600-ft. level went through good copper ground for 50 ft., and is apparently the same character of ground as shown in No. 2 drill hole.

Ahmeek

According to the annual report of the Ahmeek Mining Co., Calumet, Mich., for 1913, its copper production amounted to 9,220,874 lb. from 383,749 tons of rock stamped. A comparison is made with previous years:

AHMEEK PRODUCTION

Year	Tons Stamped	Pounds of Copper—Per Ton	Pounds of Copper—Total Production
1910	530,365	22.3	11,884,954
1911	598,549	25.4	15,196,127
1912	652,260	25.2	16,455,769
1913	383,749	24.0	9,220,874

Net profits, after including an expenditure of $30,500 for lands, was $166,919. Dividend payments amounted to $850,000, thereby decreasing quick assets $673,081. Receipts over expenditures, dividends and balance of quick assets for the last four years follow:

SUMMARY OF RESULTS, AHMEEK MINE

Year	Receipts Over Expenditures	Dividends Paid	Balance Quick Assets	Cost per Lb. Copper
1910	$229,320	.....	$393,539	11.05c.
1911	870,272	$250,000	1,013,812	7.17c.
1912	1,465,396	1,100,000	1,379,209	7.85c.
1913	166,919	850,000	706,128	13.30c.

Of the rock hoisted, 385,450 tons, 1701 tons or about 0.4% was discarded as waste. Development work consisted of 104 ft., as compared with 1336 ft. in 1912. The Ahmeek, like other companies in the Lake Copper district, suffered from the general strike called in July, 1913. At that date the company employed 830 men, and at Mar. 14, 1914, it had in its employ 579 men. Copper produced cost 13.30c. per lb., compared with 7.85c. in 1912. However, 3.33c. of this increase was due to construction account, otherwise the increase cost over 1912 was 2.12c. per lb. of copper.

Notes from Current Literature

Cheap Production of H_2S

The activity in copper-leaching experiments, and the possibility of using sulphuretted hydrogen as a precipitant for copper, render the following abstract from *Le Phosphate* by the *Chemical Engineer,* on the economic production of sulphuretted hydrogen, a matter of considerable interest. Naturally enough, it has been proposed to combine hydrogen with the sulphur of different sulphides, but hitherto it has not been possible to effect any result with the most commonly occurring and the cheapest sulphide, FeS_2. It is known that pyrites only gives a partial reaction with hydrogen even at high temperatures, and that it is not attacked either in the cold or hot by the acids capable of producing sulphuretted hydrogen. A new process effects a combination of sulphur and iron directly from pyrites, containing all the sulphur of this latter in a form which allows hydrogen to combine with it.

This new compound, which is perfectly stable, is obtained by simply heating pyrites preferably between 500° C. and 800° C. in the presence of a suitable reagent, such as lime, CaO, or other alkalis, alkaline salts or alkaline earths, or even wood charcoal, sawdust, etc. It is sufficient if only a slight proportion, say, 15 to 20% of the weight of pyrites, of the reagent is used. This bringing of the pyrites to a temperature varying between the above limits according to the degree of fineness of the pyrites, in presence of certain bodies, produces a molecular transformation of the iron sulphide difficult to explain, which seems to reduce the affinity existing between the atoms of the sulphur and the iron or to increase the affinity between the sulphur and hydrogen, so that when this new body or compound is submitted to the action of feeble acids or even of steam, the hydrogen evolved combines with the whole of the sulphur. The new product has naturally a different composition according to the reagent employed, but it retains in every case the same sulphur grouping attackable by acids which is the active part, the other elements not entering into the reaction.

Polysulphate Ore Reduction

A process invented by M. Dekker, of Paris, appears to possess economic as well as technical advantages in the treatment of ores containing metals, as oxides, sulphides, or carbonates, says the *Mining Journal,* Jan. 17, 1914. Polysulphates are produced by treating normal sulphates with concentrated sulphuric acid, the best combination in ordinary circumstances being 1 molecule $ZnSO_4$, 1 molecule $MgSO_4$ with four molecules H_2SO_4. With this, or some other suitable polysulphate, the finely ground ores are mixed and heated in a closed iron vessel. After half an hour's heating an extensive reaction sets in, and the the metal particles in the ore, forming sulphates with them. If pyritic ores are treated the sulphur becomes liberated, and, after being distilled off, is condensed in an hour's heating an extensive reaction sets in, and the collecting apparatus to chemically pure sulphur. When no more sulphur is liberated the reaction is completed. The residues can be lixiviated with water and filtered off; any metal sulphates contained in the solution can be precipitated by electrolysis or some other precipitating agent.

The Firedamp Whistle

At the conclusion of a lecture before the Society of Chemical Industry, Prof. Haber gave the following account of his firedamp whistle (ENG. AND MIN. JOURN., Nov. 29, 1913), illustrating his remarks with a practical demonstration of the instrument.

Endeavors have been made for a long time to invent forms of apparatus which will reveal the presence of firedamp in coal mines. Among people who have a practical acquaintance with the subject there exists a consensus of opinion that such instruments can be of real service only when they are of such a small and handy form that the miners can carry them and use them conveniently. Practical people are also unanimous in the opinion that the miner is not in a position to employ a measuring apparatus, but that he must receive from the instrument in question a distinct *signal,* enabling him to recognize the presence of firedamp and approximately estimate its amount. The Davy safety-lamp satisfies these conditions, inasmuch as it yields a direct signal and one which enables the miner to estimate roughly the amount of firedamp present. A Davy's safety-lamp fed with benzine and with its wick turned down exhibits in air containing methane an aureole round the flame, which is visible as soon as the proportion of methane reaches 1½%, and which increases rapidly in size and visibility as the proportion of methane increases. So far as the recognition of methane is concerned this apparatus satisfies all the requirements of the practical miner. It has, however, the serious defect that the indicator employed is a flame, which under certain circumstances can ignite the firedamp. Statistics prove that such a danger is really present, since they show that more than one-half of all the firedamp explosions occurring in coal mines are due to ignition of the firedamp by the lamps. This is the reason why endeavors are being made to obtain another sort of firedamp indicator. So long as the flame of the Davy lamp is employed for the purposes of illumination so long will it naturally be used as an indicator of firedamp. Since, however, the employment of portable electric lamps has become possible the necessity for another form of danger signal has been felt.

The "firedamp whistle" is an instrument for detecting by acoustic means the presence of firedamp. The idea of employing an acoustic apparatus for this purpose was first broached by your fellow-countryman, Professor Forbes, in 1880. His suggestion has been followed by several others, but none of them has met with acceptance by practical miners. The reason for their failure is to be found in the fact that the proposed apparatus did not take the form of small, handy and portable instruments,

and that they were ill-adapted to withstand the rough usage of daily work in coal mines. Recourse was therefore had to other means, but it is very difficult to suggest any principle which possesses such great advantages as the acoustic one. If methane were not at ordinary temperatures so chemically sluggish one might employ its chemical reactions for the purpose in hand. Methane reacts, however, with sufficient rapidity only at high temperatures, and the high temperature involves the possibility of that ignition which one must at all costs avoid.

Led by these considerations Dr. Leiser and I have endeavored to develop the acoustic method. The firedamp whistle which I show you here is the result. As you see, it consists of a brass cylinder 25 cm. long and 6 cm. in diameter. Inside the brass cylinder are two small pipes which are tuned to give the same note in air. They are blown by one and the same current of air, which is provided by a hand pump. This hand pump is simply the outer sleeve of the brass cylinder. Both pipes are provided with membranes, which prevent the operating air current from entering the pipe-tubes (resonators). The space beyond the membrane forms therefore, in the case of each pipe a closed gas chamber, the nature of the gas contained in which determines the pitch of the note given by the pipe. In the case of one pipe the gas chamber is filled with pure air outside the mine, this air remaining unchanged during the sojourn in the mine. Into the closed chamber of the other pipe can be brought the air of the mine, purified from dust, moisture, and carbon dioxide by a cartridge of soda-lime. If the mine air contains methane then on sounding the two pipes by means of the sleeve-pump beats are heard whose frequency increases with the proportion of methane in the air of the mine. The beating of the notes of the two pipes produces a characteristic "trill" when the methane content approximates to the explosion limit.

Nickel-Plating Aluminum

A communication has just been presented to the Académie des Sciences by M. Le Chatelier, in which the author states that he has succeeded in nickel-plating aluminum (*Engineer*, Feb. 6, 1914). Until now it has been impossible to cover aluminum with any kind of metallic layer by the methods in use. This has considerably prevented the extension of employment of this metal, which lends itself to so many purposes, but its dull appearance, especially after prolonged use, has been much against it. The difficulty has been surmounted by a preliminary scouring of the aluminum in a bath of hydrochloric acid containing a certain proportion of iron. The iron precipitated on the surface of the aluminum forms a kind of network, and when the piece of metal is next passed into the nickel bath the nickel gets entangled, as it were, in this network and adheres strongly to the aluminum. This process, which is based upon an action which is purely physical, appears capable of solving a problem hitherto considered insoluble.

Aluminum-Cobalt Alloys

Alloying with 9 to 12% Co improves aluminum, but it is still deficient in mechanical strength, owing to the coarse crystalline structure (A. Neuburger, *Elektrochem. Zeit.*, 1914, p. 295). This defect can be overcome by addition of a small proportion of tungsten or molybdenum, yielding alloys having a tensile strength three times that of pure aluminum. The best results are obtained with: W 0.8 to 1.2 and Co 8 to 10%, or Mo 0.6 to 1, Co 9 to 10%. The forging and rolling qualities diminish and the tensile strength increases with increasing content of tungsten (or molybdenum) and cobalt. The alloys containing tungsten are somewhat harder than those containing molybdenum.

Lead in Bronze

In a paper before the Institute of Metals, John Dewrance draws attention to the desirability of modifying the composition of bronze with the object of preserving its strength when used for high pressure and superheated steam. The paper gives a large number of experiments which go to establish the fact that the addition of ½ of 1% of lead preserves the strength of the bronze up to 500° and that without the lead bronze loses its strength at 350° Fahrenheit.

It is suggested that as lead has this effect it is probable that further investigation might prove that some other ingredient might preserve the strength of bronze at even a higher temperature. It is also shown that oxygen in bronze does not reduce the strength within practical limits.

A New Source of Gallium

Two French chemists, Bardel and Boulanger, have recently found that commercial metallic aluminum, presumably the European product, contains 0.02% of gallium. This is the richest source of the metal thus far found. Boisbaudran, who discovered the element in 1875, obtained only about 2 oz. of it from between 4 and 5 tons of blende, while the same amount of aluminum would contain nearly 2 lb., says the *Brass World*, February, 1914.

It would be interesting to know if American aluminum contains this metal. It is known that gallium is more easily reduced than aluminum, so that it seems probable that a richer product might be obtained by collecting separately the aluminum first produced after adding the oxide to the cryolite bath in the Hall process.

So little gallium has been obtained that it is not known whether it would have any practical uses or not, but there have been so many applications of rare elements of late years, such as tungsten, thorium, vanadium, etc., that the possibility of practical application is fascinating.

Gallium, as far as its properties are known, is a curious metal, resembling aluminum in some respects, as, for example, in its color; but it is heavier and it melts at about ordinary room temperature.

Preparation of Pure Metals

According to the *Journal du Four Electrique* (Mar. 1, 1914), a method has been invented to produce pure metals, free from iron and carbon, which consists in treating the chloride of the metal with sodium hydride under a bath of molten salt. According to our contemporary this reaction takes place, for titanium and vanadium, at about 400° C., and constitutes a notable advance over the old method of heating in a bomb at high temperatures. The method is said to be due to Maurice Billy.

Filtering Slimes in Cyanidation*

By Herbert A. Megraw

SYNOPSIS—Slimes must be filtered both to recover the contained solution and to allow them to be thoroughly washed. Vacuum filters were first to meet the economic requirements, though the plate-and-frame filters filled a special field with high-grade ores. More recent practice favors continuous process, leaning toward drum filters and counter-current decantation, or a combination of both. The last is especially efficacious in treating silver ores.

The dewatering of slimes is one of the desirable objects in cyanidation which has been most difficult to obtain economically. Dating from the time when slimes were separated from sand and given a distinctive treatment, the problem of disposing of slimes residues without throwing away also large quantities of solution containing gold and cyanide, was a problem difficult to solve.

Separation by Settling

The first more or less successful method of dewatering was to allow the slime pulp to settle for a great length of time, decanting all clear solution as it appeared. Many cyanide plants used what they called deep tanks, running as large as 30 ft. in diameter by 20 ft. deep. In these tanks the slimes charges were emptied as soon as the treatment period was over, and settling was allowed for the longest possible time. As the tanks were large enough to hold several slimes charges, the settling period used to run as high as 10 to 12 days. When the tank was full, a bottom-discharge valve was opened and enough settled slimes discharged to allow room for another charge to be put in at the top of the tank. After the settling time the slimes tailings would contain approximately 50% of water, or solution. The difficulty of this sort of treatment was its high cost, due to large expense of tank installation, cost of pumping the slime into the deep tanks and the maintenance of the tanks, together with lack of efficiency because, through this system, the slimes never received a satisfactory washing.

Impossibility of Filtering Colloids

For many years methods of dewatering slimes were tried and many systems of filtering were devised, but few of them reached any degree of practical application. As a matter of fact, with slimes, the material is so finely divided that, in a layer of any appreciable thickness the interstices of the filtering medium will be immediately closed so that further filtering is impossible. This is still a recognized fact, and it should be considered as a basis of all slimes filtering that, with wholly colloid material, it is impossible to make a cake of commercially economical thickness that will permit liquid to pass through it. The success, therefore, of filtering apparatus depends altogether upon the amount of granular material contained in the slimes and upon the thickness, or rather thinness, of the cake or bed to be filtered. It is well recognized that sands may be easily filtered because the grains or separate pieces are of appreciable size and do not lie together or pack so closely that liquid may not pass freely between them. Slimes, on the contrary, have no definite form, and are able to pack themselves together so that there are actually no interstices and, therefore, passage of liquid cannot possibly take place. This is not only a theoretical truth, but a practical one, and it is altogether useless to look for any method of avoiding the law. In order to have a slime which will be filterable, that slime must contain a certain percentage of angular sand, the exact percentage which will permit the mixture to filter depending entirely upon the nature of both sand and slimes.

Plate-and-Frame Filters

Probably the first successful filtering machine was the ordinary plate-and-frame filter press, which is even now used in so many localities. It was early applied in Australia to socalled slimes treatment, and is widely used there at the present day. On high-grade material, it is practical, and there is no great objection to its use, but with material of low grade, the installation expense is too high, and the operation expense is altogether prohibitive. For that reason, it has not been used to any great extent in America. The installation expense of the machine is due to the high manufacturing cost resulting from heavy material, high-class workmanship and small capacity of the units. Its operative expense is principally due to the time and labor required to discharge the press, as each frame must be separated and the cake dropped. The use of the press on high-grade concentrates is justified by the comparatively small quantity of material treated and the necessity of recovering every possible per cent. of valuable metal. The labor requirement in such cases is comparatively small, because discharges are infrequent and the total force can be concentrated temporarily on the work at the required time. On a large scale and on low-grade material, the ordinary filter press is impossible.

Introduction of Vacuum Filtration

With the introduction of vacuum filtration, the system was brought within range of economical working conditions, and constant improvement has been required to bring it to its present state. Vacuum filters are of several classes; in fact, the kinds have been so numerous that it is practically impossible to keep track of them. Many of the filters of the present time which are called pressure machines are really vacuum filters, or *vice versa*, for the essential requisite in either case is a difference of pressure on the two sides of a filtering medium, and whether that condition is obtained by increasing the pressure on one side of the medium or reducing it on the other, is immaterial. The result in either case is the same.

If it were true that by solely dewatering a pulp, the requirements of filtering would be satisfactorily fulfilled, the original search might not have been so difficult, but the idea was to extract the metal-bearing cyanide solution

*This is the tenth of a second series of articles by Mr. Megraw. It deals with the comparative details of cyanide practice, discussing points of possible improvement. Preceding articles of this series appeared in the issues of Sept. 6, Oct. 4, Nov. 1, Nov. 15, Dec. 20, Jan. 31, Mar. 7, Mar. 21 and Apr. 25. The next article will deal with "Precipitation from Cyanide Solutions," and will appear in the issue of June 20, 1914.

and then wash the cake, once, twice or three times, depending upon the nature of the material. It will be realized that the filter enthusiasts had set for themselves a most difficult task, and one which, had theories been capable of translation into practical form, was impossible to solve. As has already been mentioned, a purely colloid slime cannot be percolated. At the first application of pressure or vacuum, the colloids will force themselves into the interstices of the filtering medium, effectually plugging them up. The material acts much like paint, and just as certainly as paint, it will prevent filtering as a commercial possibility.

Efforts to Filter Colloids

Several schemes were tried to make slimes filterable, but none of them amounted to anything. The soap process proposed to coagulate slimes in such form that they would be leachable in thick beds, but it was soon found that although there was apparent coagulation, it was not stable enough to resist heavy pressures or even the passage of solutions. The only way to make slimes leachable or filterable is to add a proportion of sand. Thus the failure of metallurgists to produce a purely colloid material for agitation was the salvation of the filter business. Admitting these statements to be true, there are still filter troubles enough to satisfy the ordinary man, without trying to filter colloids.

Washing Is an Important Object

Slime filtering is undertaken, as has been mentioned, for the purpose of removing moisture from the material to be discharged, and to recover the greatest possible amount of precious metal and cyanide in solutions. In order to carry this object to a reasonable point, the cake once formed must be washed several times. Washing then becomes really the most important part of filtration, because faulty washing may make a process too costly, by leaving large quantities of dissolved metal in the cake.

At the present time some of the best known and most widely used filtering processes are those which use the leaf which was proposed for the first successful Moore installation. The principal leaf filters may be divided into three classes, the first of which uses a movable leaf, that is, one which is put into the tank, the cake made upon it, and then the leaf removed for washing and discharged in other tanks. The second form uses the stationary leaf, in which the leaf remains in one tank during the entire process, the contents of the tank being changed to suit the operation to be performed. In the third form, the leaf, or set of leaves, is inclosed within a drum, or cylinder, and the cake formed by pressure, the solution discharge through the leaves being led outside the drum. For cake discharge, the drum or cylinder is opened and the set of leaves run out, so that the cake may be discharged in an appropriate place. Of these types the stationary- and removable-leaf systems are the most used, although the pressure-leaf system is in use and is successful in a number of plants.

Leaf Vacuum Filters

In considering the work of the leaf filters, whether removable or stationary, it is best to typify the process with the use of a slime which is more or less readily filterable. A tube mill product which is called all-slime, and, in fact consists of 80 to 85% of material that will pass a 200-mesh screen, most of it will be granular. Fortunately, with quartz ores, true colloid slime is conspicuous for its rarity. It will not amount to more than 3 to 5%, although sometimes running up to 20 to 30%. When more colloid material than this is present, the slime becomes difficult to filter. With iron ore which consists of oxidized materials, such as hematite, or alumina, or clay materials, the process becomes more or less difficult, varying with the percentage of colloids present, and at last, when the colloids are in a large preponderance, the material is not susceptible to economical filtering.

Typical Vacuum-Filter Results

Using as a type the 80 to 85% minus 200-mesh material, consisting largely of granular tube-mill products, as a type, the work of the stationary- and removable-leaf type can be summarized. On the average, with the stationary type the cycle of filtering will be about as shown in Table 1.

TABLE 1—STATIONARY-LEAF FILTER CYCLE

	Minutes
Making cake	30
Discharging pulp	8
Filling with solution	5
Solution washing	45
Discharging solution	8
Filling with water	5
Water washing	5
Discharging water	8
Discharging cake	10
Filling with pulp	5
Total	129

When using the removable-leaf type of filter, the cycle is somewhat shortened, being approximately as in Table 2.

TABLE 2—MOVABLE-LEAF FILTER CYCLE

	Minutes
Making cake	30
Solution wash	30
Water wash	5
Changing and discharging the leaves	10
Total	75

It may be taken for granted that on slime of the class now under consideration, a 1-in. cake often has the most advantages, taking into consideration the time of formation, permeability, etc. When the leaves are new, or in first-class condition, the 1-in. cake may be formed in about 20 minutes, but due to the fact that the leaves may be, and usually are partly in good condition and partly clogged, and slow working, the full 30 to 40 minutes must generally be allowed in order that the slower leaves be permitted to acquire the full load.

The pumping out and filling operations in the stationary type filter consume about 39 or 40 minutes in each cycle, as shown in Table 1, or 30% of the working time of the filter. While the delay is not a distinct disadvantage to the filter itself, provided the installation is large enough to take care of the tonnage in the allotted time, it is somewhat of a metallurgical disadvantage because during the pumping out and filling operations the cake is wholly or partly out of contact with pulp or solution for such a long time that cracking and loosening are facilitated.

In the schedule already shown by the table, the cake is exposed to the air partly or wholly for nearly 13 minutes while the pulp is being displaced by the washing solution. During this exposed time, the vacuum is lowered as much as possible, just leaving sufficient to keep the cake attached to the leaf. It is a delicate and difficult operation to regulate the vacuum to such nicety that it will not be too low and allow the cake to drop off, or too high and fill the cake with cracks. The latter horn of the dilemma is

usually the preferred one. In the effort to keep the cake attached to the leaf, it is a common fault to use too much vacuum and open cracks in it, and it is a natural consequence that with the cracks open directly through to the canvas of the leaf, there is a short-circuit of the washing solution which passes through the cracks and does not thoroughly and completely wash the cake, the object of the operation. In addition, the slow withdrawal and as slow addition of pulp and solution allow the top of the cake to remain out of contact with the liquor for a much longer time than the bottom of it. This is conducive to cracking of the cake, the usual effect being to open cracks in the top, which short-circuits the vacuum, causing air and solution to be readily drawn through the cracks in the top, and consequently reducing the effect of vacuum so much that pieces drop off the bottom of the leaf, leaving bare spaces through which solution or air may pass without affecting other parts of the cake. This effect is naturally increased with each succeeding transfer of solution, so that the final or water wash is not likely to have great efficiency.

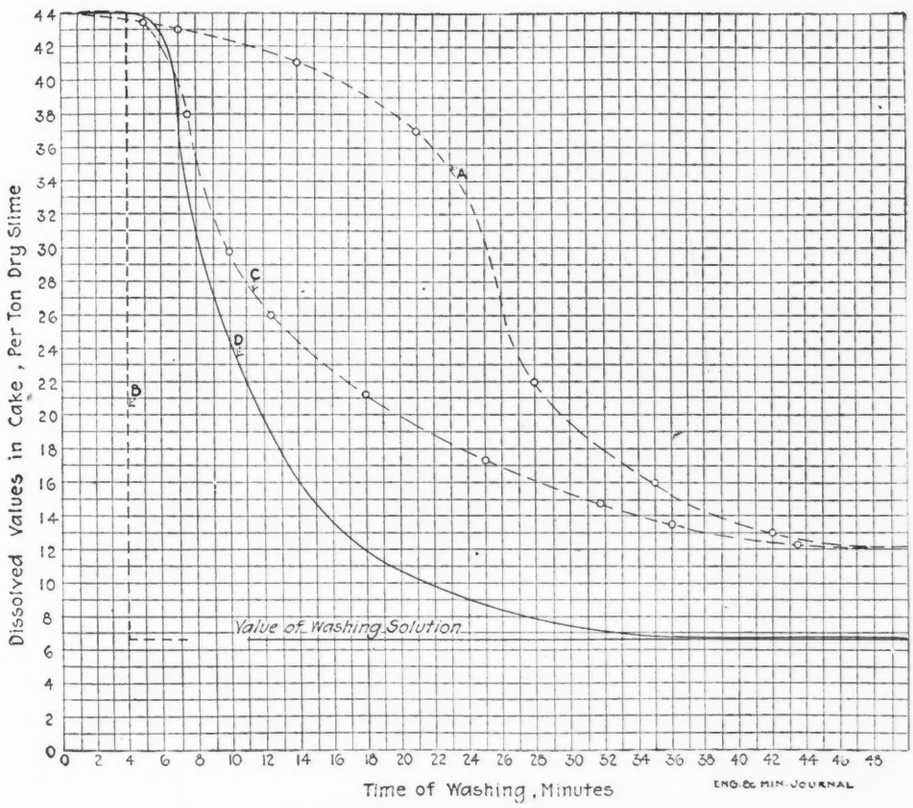


FIG. 1. COMPARISON OF WASHING EFFICIENCIES

REMOVABLE-LEAF FILTERS

In considering the removable-leaf type of filter, the time that the cake is out of contact with the liquor is much reduced, because the basket of leaves can be lifted out of the cake-forming tank and put into the washing-solution tank very much quicker than the whole tank full of pulp could be pumped out and the washing solution run in. This has a tendency to keep the cake in the homogeneous condition in which it was formed rather better than the other type. The same process is gone through when discharging the cake from the leaves. The disadvantage of the movable-leaf type is that when the slime is heavily charged with colloid material, and consequently much more likely to slip off the leaf, the slight jarring of lifting the cake and the basket of leaves is likely to dislodge pieces, in which case the result is exactly the same as in the stationary-leaf type of filter. The power required to lift the basket, compared with that required to pump out the tank, is very likely to be less in the former case, although this difference would not have a finally deciding effect on the merits of the approved type. One difficulty which has often been found with the movable-basket type is that the mechanical arrangements of it are not always perfect, and the basket is subject to drops. If the whole basket of leaves drops from the crane which hoists it, the result is disastrous both to the basket and to the tank upon which it falls. A number of rather serious wrecks have occurred from this cause, and while it cannot be blamed upon the type of filter, it seems that there is an almost irresistible temptation to mechanical inefficiency on the part of those who install the machines.

The washing of the filter cake being, as we have already mentioned, an item of the utmost importance, may be studied in somewhat greater detail. Referring to the diagram, Fig. 1, there are shown four different curves, representing the washing of the filter cake. The curve *A* represents faulty washing and is the one actually established in a plant upon which experiments were made with washing. It is based on solution samples. The curve *B*, which is a series of straight lines, illustrates the theoretical ideal of cake washing. In a homogeneous cake, washed by a solution of known value, the ideal result would be a simple displacement of the contained solution by the impoverished washing solution. That is, the entry of the washing solution would completely displace or push out the rich solution contained in the cake. In this case, immediately the rich solutions were displaced, the dissolved values in the cake would instantly drop to the value of the washing solution. The curve *B* represents this condition. It is a theoretical ideal and cannot be accomplished in practice, but it may be approximated, and the nearer practical results approach this ideal the better they are. Upon this it may be stated that an efficient filtering curve will be one which approaches this result.

Due to diffusion or mixing of the weak solutions contained in the cake with the impoverished washing solution, which occurs to more or less extent in any practical process, there is a more or less rounded point at the head

of the curve where the drop begins, just after the displacement of the major part of the rich solution. This is unavoidable in practice. The drop after that is rapid, losing gradually in efficiency as the contained value becomes less and less, until it finally reaches the value of the washing solution. This is expressed in the curve *C*, which represents the actual performance of a well regulated filter with clean and properly cared-for leaves, the points being based on cake assays. In many cases a curve better than this may be obtained, but it will serve as a type of satisfactory performance. The curve *A* is unsatisfactory and is due to improperly cleaned leaves, together with cracks and bare places in the cake. This condition may obtain with any type of leaf filter, but is most likely to be true with the one in which the cake is exposed to the air, out of solution or pulp for the greatest length of time. Curve *D* represents as near the ideal result as it is usually possible to reach in practice.

Features of Removable Leaves

One of the objections to the leaf-basket type is that unless the leaves are equal in condition the results will be erratic, because the cake formed on one leaf will be better than that formed on another, the dirty or clogged leaf containing the latter cake. The cracking or dropping of these cakes will be unequal, according to the thickness of the cake itself, and it will be difficult or impossible to get them to work exactly alike. It is much more satisfactory to maintain the leaves in each basket in identically the same condition, then results are likely to be consistent and all the leaves will work alike. When bad results are obtained, the whole basket of leaves can be removed for cleaning.

Determination of Cake Condition

The method of determining the condition of a washed cake, to show whether or not it has been sufficiently washed, varies at different points. In some plants the method is to assay the solution coming through the cake, and at others the method is to take samples of the cake itself for assay. When considering the conditions obtaining with cracked cakes, or cakes imperfect in any other way, it seems that the solution method must be altogether erroneous. It will be readily seen that if the cake is entirely homogeneous and the washing solution passes through every part of it, the solution may be reasonably expected to inform one of the condition of the interior of the cake; but, on the other hand, if the cake is imperfect, contains cracks and bare places through which the solution is short-circuited, the solutions coming out from the cake will show only the value of the solution itself, altogether irrespective of the condition of the cake on the leaf. The only satisfactory way, then, to know whether or not the cake has been washed, is to sample the cake itself before and after washing. The solution method is defective and not to be depended upon in ordinary cases.

Comparison of Fixed- and Movable-Leaf Systems

In summarizing the comparative values of the stationary and movable-leaf type of vacuum filters, it must be understood that the advantages of either type may be nullified by improper manipulation, and that their disadvantages may be removed by proper construction and improvement. For instance, the time necessary for filling and emptying the tanks in the stationary-leaf process may be reduced by using pumps of great size with appropriate pipes, so as to empty and fill the tanks in approximately the same time that the leaf basket is handled in the movable-leaf type. As to convenience in discharging and washing there have recently been invented filter leaves of different forms which greatly facilitate discharging and allow of important economies in leaf cleaning. The inclosed-leaf and pressure type of filter is subject to the same advantages and disadvantages as the exposed-leaf type already mentioned, depending upon the character of slime washed and the skill with which manipulation is carried on.

The Sluicing Plate-and-Frame Press

The type of filter which differs radically from any of those mentioned is the Merrill plate-and-frame press. This is more or less similar to the old-style pressure filters which were used in Australia and which were mentioned at the beginning of this article. The improvement, upon which the greatest efficiency of the Merrill type rests, consists of an arrangement by means of which it does not have to be opened and the frame separated in order to discharge the cake. Instead, there is a sluicing bar through the bottom of each frame, through which a high-pressure stream of water may be delivered through a nozzle into the cake itself, after it has been made and washed, and the cake sluiced out through an opening in the bottom of the frame. This puts the plate and frame filter, with its decided cake-making and washing advantages, into the same economically operated class as the vacuum filter. In fact, it may be, in many cases, more economical than any of the others. It will be readily realized that the cake in a pressure filter of this kind is made quickly under high pressure, and is, therefore, quite homogeneous. The type is especially advantageous where a more or less dilute pulp containing mixed heavy and light particles is to be filtered. In the ordinary box or filter tank of the vacuum-filter systems, this material would separate, the heavier parts settling, and the lighter parts only being filtered. In this case, air lifts or other methods of agitation would be required to keep the sandy or granular portions in suspension. With the Merrill system this is not necessary, as the cake is formed under high pressure and quickly, so that there is no time for settling out, and the pressures are so great that settling cannot readily occur. This almost necessitates the forming of a homogeneous and perfect cake, which may be subjected to successful washing. In these filters, as the cake is made in two halves, the washing current has only to pass through half the thickness of the cake, therefore making washing easier and more efficient. The Merrill presses are installed at the Homestake mine, one of the largest filter installations in the country. A filter which is said to combine the advantages of the leaf and pressure types is the Sweetland, which uses leaves in a chamber which can be opened to discharge the cake.

Revolving Drum Type

A still different type of vacuum filter is the Oliver type, which is simply a revolving drum with the filtering medium on the face. The drum revolves in a tank which contains the pulp, vacuum being constantly applied, and the cake forms on the surface. The drum revolves slowly in its tank of solution, but the revolution rate is just so speeded that the cake formed

is very thin. As the cake emerges from the tank of pulp, it is dewatered by the vacuum and immediately after the wash is applied by spraying it on through nozzles suspended above the face of the drum. This wash may be divided into the required number of parts, and when the drum reaches a point about opposite to where it emerges from the pump tank, a reverse current of air is applied and the cake is loosened. It then meets a scraper, which scrapes the cake from the face of the drum. The details of the filter are well enough known so as not to require explanation here.

The advantages of the type are its extreme simplicity, the thinness of the cake, which renders dewatering rather easy and its continuous operation requiring a minimum of attendants. Its disadvantages are that it has never been able to demonstrate a thorough degree of washing on material which contains more than a very small percentage of colloid. It is, however, exceedingly efficient as a dewatering machine, and has been used and is being used with great success where the pulp is previously washed to the required degree.

Continuous Decantation

At this point we come to the process, which while not filtering, is a modern development of filtering and is intimately connected with it. This is continuous decantation. The invention of this process was made practicable by the success of Dorr thickeners. In this system the pulp is thoroughly washed in a series of thickeners before going to final filter. In such cases where the solution itself is low in cyanide and contains small metal values, it may be washed so thoroughly by counter-current decantation that the final filter is not required at all; in fact, in many mills at the present time it is being omitted. This is almost exclusively true of gold mills, but does not apply to those which treat silver, because in such cases a solution of much higher cyanide content is required, and the quantity of metal in the solution is much higher than when gold is being treated. Counter-current decantation means simply the passing of a slime pulp through a series of thickeners, the thickened pulp being thinned in each case with washing solution and sent to another thickener, where the pulp is again thinned, the thickened portion again diluted with washing solution, and again thickened. The series may be continued through as many tanks as is required to bring the cyanide and precious metal content of the solution down to the required minimum. In silver mills where this process cannot be continued to so great an extent, a good practice, and one which is being more or less followed at the present time, is to use thickeners until the solution content is appreciably lowered, and then filter the pulp through a filter of the continuous-drum type. In this way the remaining pulp is quickly dewatered, and a spray wash may be applied, which will reduce it somewhat further. In this way a highly efficient filtering process is obtained at a very low cost.

Columbia School of Mines Exhibition

On the occasion of the fiftieth anniversary of the founding of the School of Mines of Columbia University, an exhibition will be held relating to the history and development of the school, in the University Library exhibition room in the Library building, on the campus, 116th St. and Broadway. The exhibition will be largely personal in character, consisting of group pictures of the various classes and individual pictures of members of the faculty from the beginning of the school to the present. There will also be pictures of the old School of Mines buildings and of the new school. The original "Plan for a School of Mines and Metallurgy in New York City," prepared by Prof. Thomas Egleston, in March, 1863, will be exhibited. Also a complete series of the announcements of the school from year to year, and of the student publication. There will be exhibited the manuscript theses prepared by candidates for the degree of Master of Arts in the school.

All alumni of the school are requested to assist in making this exhibition worthy of the occasion by sending in any material which would be appropriate. The University maintains a Columbiana collection, in which gifts will be permanently preserved, but those who do not wish to give the material sent in are requested to loan it, to be returned immediately after the exhibition. The exhibition will be open from May 25 to June 4.

Tonopah Belmont

The report of the Tonopah Belmont Co., Tonopah, Nev. for the year ended Feb. 28, 1914, shows combined net earnings of $2,015,588 and dividend payments of $1,650,000. Dividends to date total $5,933,002. A summary of the production record for the past three years follows:

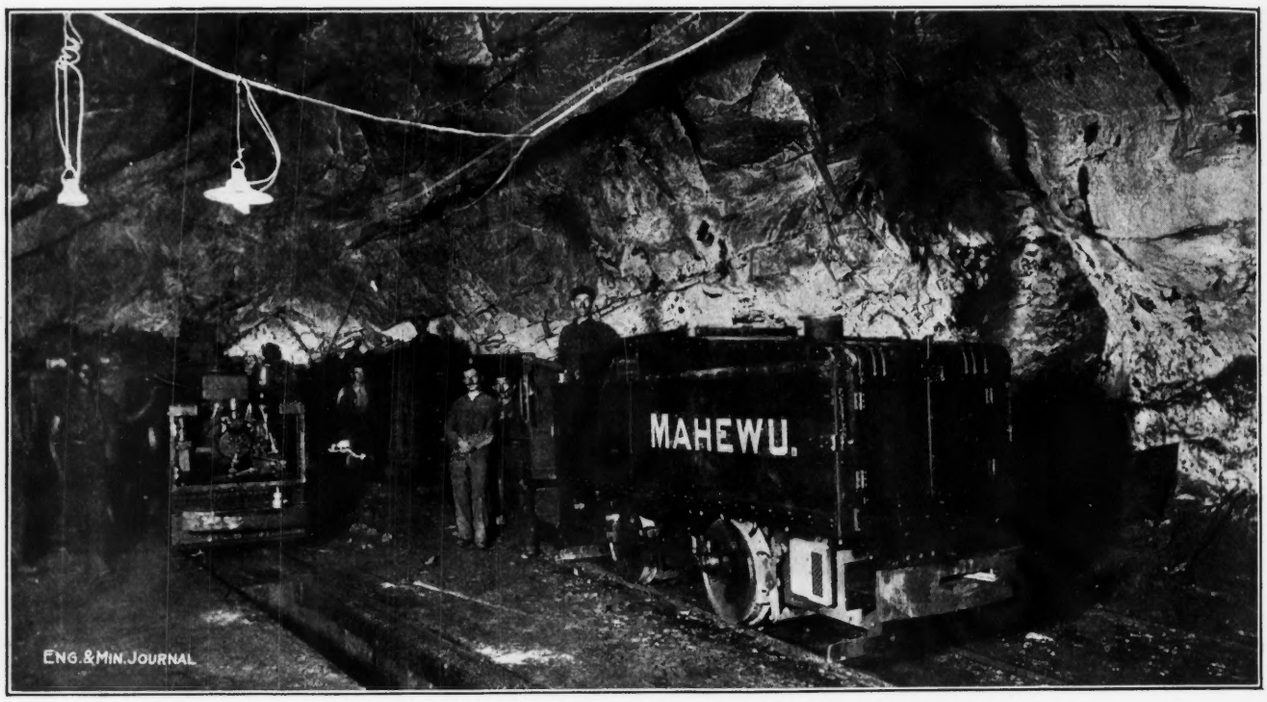
Period ended Feb. 28.	1914	1913	1912
Tons shipped to mill	172,646	128,975	87,952
Average gross value per ton	$21.07	$24.21	$20.84
Tons shipped to smelters	.....	562	27,611
Average gross value per ton	.....	$70.71	$61.35
Total production, dry tons	172,646	129,537	115,563
Average gross value per ton	$21.07	$24.34	$30.51

The operating costs for 1914 summarized were as follows:

	Dry Tons	Average per ton of ore
Receipts from ore:		
Gross value ore milled	172,398	$21.096
Net quantity of ore added to stock on hand	248	8.217
Total mine production	172,646	$21.078
Losses in mill tailings	.....	1.179
Smelting losses in concentrates	.....	0.108
Total losses in treatment	.....	$1.287
Total realization	172,646	$19.791
Costs:		
Mining: Stoping	150,161	$3.014
Development	22,485	11.461
Total mining	172,646	$4.114
Milling and Selling: Milling	172,398	$2.557
Marketing bullion	.....	0.322
Marketing concentrates and slags	.....	0.106
Administration, taxes, office expenses and depreciation	.....	1.073
Total operating charges	172,646	8.172
Net realization from operating	.....	11.619
Miscellaneous profit	.....	0.045
Total profit	.....	$11.664

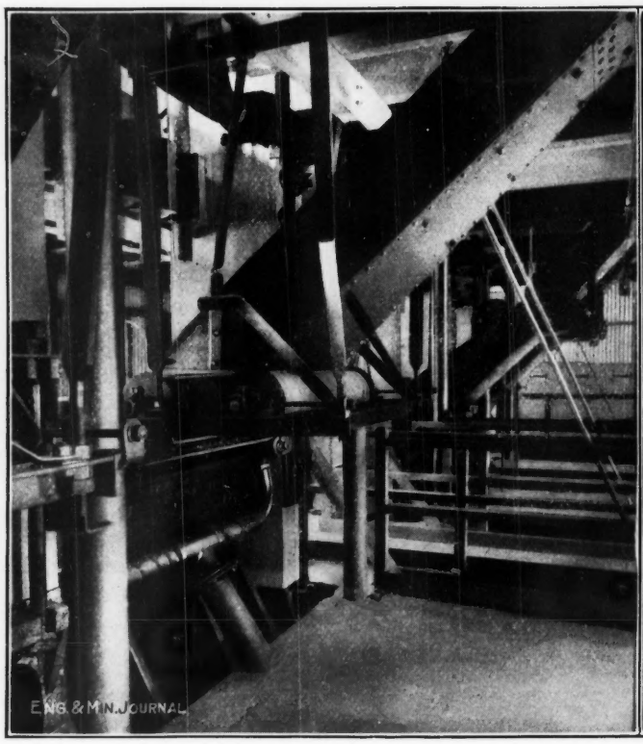
The report states that ore reserves consist of 357,623 tons of positive ore, 59,818 tons of probable ore and 103,676 tons of possible ore, making a total of 521,117 tons. Of the 204,280 wet tons of ore delivered to the crusher bins from the mine, 27,465 wet tons were sorted out as waste, resulting in 176,815 wet tons, or 172,464 dry tons, of mill ore. A balance of $1,694,557 remained in quick assets after the payment of dividends; this is an increase of $379,137 over the 1912 balance.

Photographs from the Field



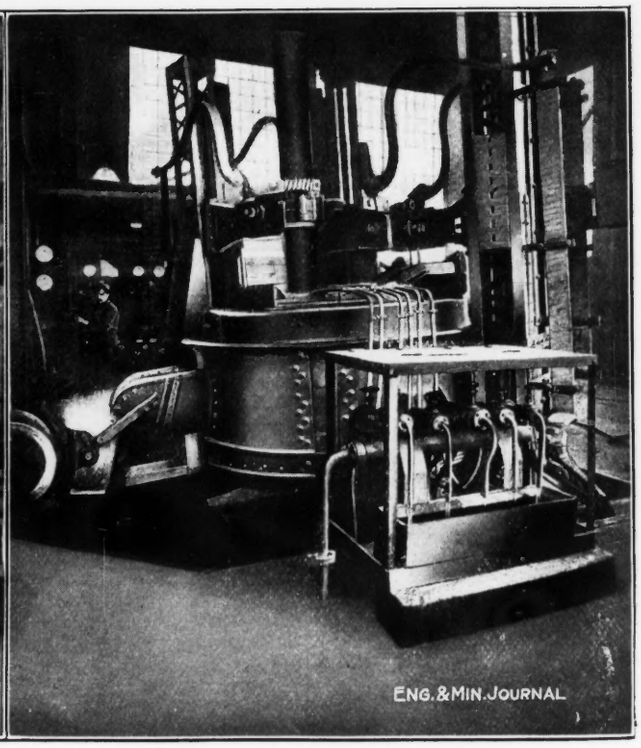
MOTORS IN THE CROWN MINES, LTD., AT JOHANNESBURG, SOUTH AFRICA

These gasoline motors are used for hauling ore through the main haulage drifts.



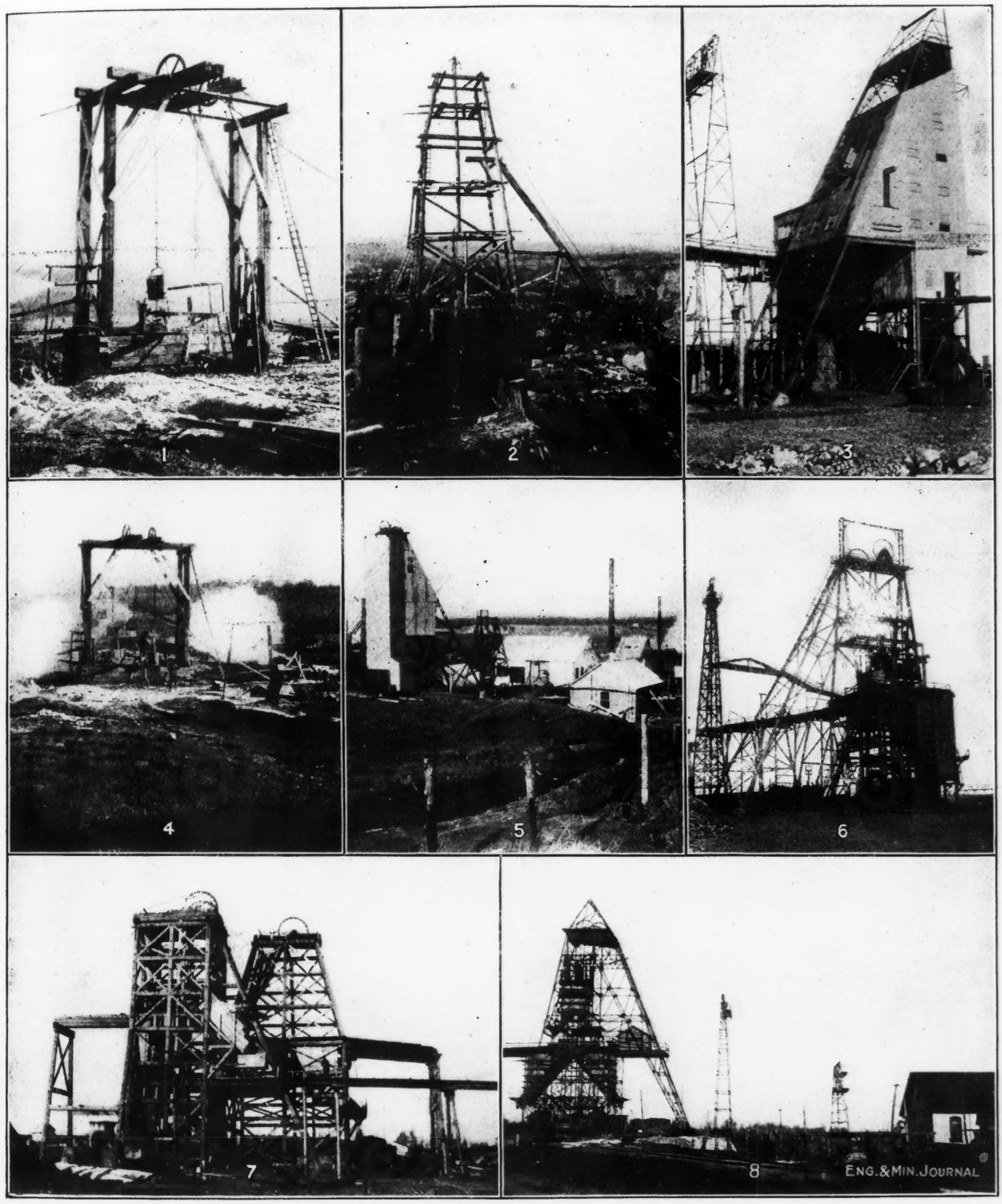
ROLLER FEEDER FOR STAMP MILLS

This type is used in the Langlaagte Consolidated mill, on the Rand where duty is 23 tons per stamp.



A 5-TON GIROD ELECTRIC FURNACE

Installation was made at the Krupp Rheinhausen-Friemersheim works for melting ferromanganese



TYPES OF HEADFRAMES TO BE FOUND ON THE MICHIGAN AND MINNESOTA IRON RANGES

Fig. 1. A headframe built on the drop shaft or "sand shaft" of the Tully mine at Iron River, Mich. As the shaft is sunk the headframe follows on down, but there was only a few feet to go to the rock formation. Fig. 2. Round-timber structure on the edge of the Jordan pit, Chisholm, Minn. The inclined poles on the right carry the upper end of the skip track, which runs down the side of the pit and then goes underground. This is part of an installation for mining out the remaining ore from the almost exhausted deposit. Fig. 3. Steel shaft house of the Bristol mine at Crystal Falls, Mich., partly sheathed in galvanized iron. A gyratory crusher is also supported in the structure. Fig. 4. Another view of the Tully drop shaft. Note the steam exhaust from the pumps, piped from the shaft bottom. Fig. 5. The Ravenna mine at Crystal Falls, Mich. The headframe is of wood, but is a modern type. Fig. 6. Steel headframe of an Oliver mine at Ironwood, Mich. The structure is long and narrow, hoisting over the end of the shaft, the tops of the backstays coming almost to a point. Fig. 7. Permanent wood headframes of the Tully mine at Iron River, Mich. That on the left is set over the shaft. The hoisted ore is dumped to pass through the gyratory shown, is discharged below ground level in a pit and hoisted again on the right-hand frame to the car-loading bins. Fig. 8. Steel headframe and sheave towers at the Gwinn mine, Gwinn, Mich. Hoist house at right. Note the spreading backstays, a typical Cleveland-Cliffs model.

NEW PUBLICATIONS

ARGENTINE SOCIAL MUSEUM, FIRST ANNUAL REPORT, 1912-1913. Pp. 20. Published at Bueno Aires.

METALLURGICAL COKE. By A. W. Belden. Pp. 48, illus. Tech. Paper 50, U. S. Bureau of Mines, Washington, D. C.

MANUAL OF PETROGRAPHIC METHODS. By Albert Johannsen. 6x9½, pp. 649, illus.; $6. McGraw-Hill Book Co., New York.

KARBIDE UND SILIZIDE. By Otto Hönigschmid. 6½x10, pp. 261, illus., paper; 13.60 marks. Wilhelm Knapp, Halle a. S., Germany.

THE OIL FIELDS OF CRAWFORD AND LAWRENCE COUNTIES. By Raymond S. Blatchley. Pp. 442, illus. Bull. 22, Illinois State Geological Survey, Urbana.

MINING DEPARTMENT OF TENNESSEE, TWENTY SECOND ANNUAL REPORT. Pp. 159. George E. Sylvester, Chief Mine Inspector, Nashville, Tennessee.

MUD-LADEN FLUID APPLIED TO WELL DRILLING. By J. A. Pollard and A. G. Heggem. Pp. 21, illus. Tech. Paper 66, U. S. Bureau of Mines, Washington, D. C.

GRAPHITE DEPOSITS OF PENNSYLVANIA. By Benjamin L. Miller. Pp. 147, illus. Report No. 6, Topographic and Geologic Survey of Pennsylvania, Harrisburg.

A GEOLOGIC RECONNAISSANCE OF THE CIRCLE QUADRANGLE, ALASKA. By L. M. Prindle. Pp. 82, illus. Bull. 538, U. S. Geological Survey, Washington, D. C.

FLORIDA STATE GEOLOGICAL SURVEY, FIFTH ANNUAL REPORT. Pp. 306, illus. E. H. Sellards, State Geologist. State Geological Survey, Tallahassee, Fla., 1913.

DANGERS TO WORKERS FROM DUSTS AND FUMES AND METHODS OF PROTECTION. Pp. 85, illus. U. S. Department of Labor, Bureau of Labor Statistics, Washington.

INDUSTRIA DEI MARMI COLORATI E DELL'ALABASTRO IN ITALIA. 7¼x10¼, pp. 42, paper. Ministero di Agricoltura, Industria e Commercio, Ispettorato Delle Miniere, Rome.

THE SAMPLING AND EXAMINATION OF MINE GASES AND NATURAL GAS. George A. Burrell and Frank M. Seibert. Pp. 116, illus. Bull. 42, U. S. Bureau of Mines, Washington, D. C.

WORKMEN'S COMPENSATION LAWS OF THE UNITED STATES AND FOREIGN COUNTRIES. Pp. 477. Bull. 126, U. S. Dept. of Labor, Bureau of Labor Statistics, Washington, D. C.

GEOLOGY OF THE COAST AND ISLANDS BETWEEN THE STRAIT OF GEORGIA AND QUEEN CHARLOTTE SOUND, B.C. By J. Austen Bancroft. Pp. 146, illus. Canada Department of Mines, Ottawa, Canada.

THE ACTION OF ACID MINE WATER ON THE INSULATION OF ELECTRIC CONDUCTORS. A Preliminary Report. By H. H. Clark and L. C. Ilsley. Pp. 26, illus. Tech. Paper 58, U. S. Bureau of Mines, Washington, D. C.

PRINCIPES ET APPLICATIONS DE L'ELECTROCHIMIE. By O. Dony-Hénault, H. Gall and Ph.-A. Guye. Vol. IV of Encyclopédie de Science Chimique Appliquée. 6¼x9½, pp. 702, illus.; 30 francs. Ch. Beranger, Paris and Liége.

ERRORS IN GAS ANALYSIS DUE TO ASSUMING THAT THE MOLECULAR VOLUMES OF ALL GASES ARE ALIKE. By George A. Burrell and Frank M. Seibert. Pp. 16, illus. Tech. Paper 54, U. S. Bureau of Mines, Washington, D. C.

THIRD ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF MINES TO THE SECRETARY OF THE INTERIOR FOR THE FISCAL YEAR ENDED JUNE 30, 1913. Pp. 118, illus. U. S. Bureau of Mines, Washington, D. C.

MINE SAMPLING AND VALUING. A Discussion of the Methods Used in Sampling and Valuing Ore Deposits with Especial Reference to the Work of Valuation by the Independent Engineer. By C. S. Herzig. 6x9¼, pp. 163, illus.; $2. Mining and Scientific Press, San Francisco, California.

ELENCO DELLE PRINCIPALI MINIERE, TORBIERE, OFFICINE METALLURGICHE E MINERALURGICHE, DEI MOLINI PER LA MACINIZIONE DEL SOLFO, DELLA GRAFITE, DEL TALCO, ECC. DELLE FABBRICHE DI PRODOTTI CHIMICI, FORNACI E VETERERIE ITALIANE PRODUTTIVE NEL 1912. 7¼x10¼, pp. 72. Ministero di Agricoltura, Industria e Commercio, Ispettorato Delle Miniere, Rome.

THE MINERS MANUAL. A Handbook of the Law of Mines and Mining with Forms. By George D. Emery. 5x7½, pp. 436; $3.50. Callaghan & Co., Chicago, Illinois.

This book was not written to present a treatise on mining law, but rather a detailed compendium for the use of the practical miner and prospector. This purpose it seems well designed to fill, and it should be of value to the practical man who desires a non-technical explanation of the methods of locating mineral lands, together with a digest of the mining laws and an explanation of the required forms, blanks, statements, etc., which are used in that connection. The laws covering both metal and coal lands of the different states, and of some adjacent countries are outlined in such a way that there is no difficulty of understanding them.

The prominent chapters of the book include the following: Mineral Lands of the United States and How to Acquire Them; Statutes of the United States; Land Office Regulations; Coal Lands in the United States; Land Office Rules of Practice; Laws of the States and Territories; Mining Laws of Canada and British Columbia, and the Yukon Territory.

An explanation of the character of most of the common minerals is included, and in fact most of the subjects which will require investigation by the man in the field are covered in the book. It will undoubtedly prove to be a valuable addition to the miner's library. This is the second edition of the book, which has been somewhat revised and enlarged, the first edition having been printed in 1906.

MINING MANUAL AND MINING YEAR BOOK. By Walter R. Skinner. 5¼x8¼ in., 1240 pp. 15s. Published by the author, 11-12 Clements Lane, London, E. C., England.

The 1914 edition of this standard manual of registered British mining companies has just been issued. This year's edition covers in complete form over 2600 mining companies, while the index includes the names of 5220 corporations, covering additional active private, and dormant companies. The mining companies are listed in two general divisions: African and Miscellaneous, the latter division including European, Australian, Mexican, Canadian, American, Indian, etc. In addition to the information about the mining companies, the volume contains a list of directors, secretaries, consulting engineers and mine managers. The volume maintains its previous high standard as the reference manual of British mining companies.

THE COPPER HANDBOOK. Vol. XI, 1912-13. A Manual of the Copper Mining Industry of the World. By Walter Harvey Weed. 6x9, pp. 1413; $5. Published by the author at Houghton, Mich., 1914.

Stevens' "Copper Handbook" in the years during which its 10 volumes had been published, had become so well known and such an established authority that when Horace J. Stevens died, not only was much regret expressed, but also a fear that either its publication would be discontinued, or that it might fall into incompetent hands and gradually lose its value. Fortunately, however, it was acquired by Walter Harvey Weed, whose long experience as a geologist and mining engineer and whose extensive knowledge of copper mining and copper properties eminently qualified him to carry on the work. With a slight delay caused by the interregnum after Mr. Stevens' death, volume XI has been issued and not only continues the series satisfactorily, but shows many improvements. Mr. Weed has continued the policy of the previous editions and has sought to give a frank and fearless account of all known copper-mining companies and to present the most accurate and recent information obtainable, with opinions on their value and prospects so far as may be possible. Some changes have also been made in the arrangement of the book, making it more convenient for reference. It is now divided into four parts: Part I, which occupies 980 pages, gives the names and detailed descriptions of the copper mines of North America, including the United States, Canada and Mexico. This is followed by a geographical index, giving mines, both domestic and foreign, grouped by countries, states and mining districts. This is extremely convenient to the user of the book as a sort of condensed reference. Part III, covering 140 pages, is the list and description of the mines of foreign countries arranged on the same plan as those of the North American mines. Part IV includes about 45 pages of statistics of copper production and the copper trade brought as closely uptodate as possible; while Part V, which is a very convenient addition, covering about 40 pages, gives a condensed list of dead companies, including not only those mines which have been exhausted or whose owners have failed, but those which have been merged with or succeeded by others. This list also includes references to early volumes of the "Handbook" in which the companies were more fully described or referred to. It is evident that every effort has been used to make the volume as convenient as possible both for the engineer and the investor. Of course, it is entirely impossible for the reviewer to examine the whole of such a book critically; the only test that can be made is by constant and extended use. It must be said, however, that after steady employment of the book for reference from the date of its publication up to the present time, little or no cause has been found by us for taking exception to its statements, and we cordially accept it as a very useful work. It is to be hoped that the present owner and editor may continue in charge for a long time and there is no doubt that he will do his best to correct any omissions or misstatements, a few of which must necessarily occur in a volume covering so wide a ground and containing such a large number of references. The "Copper Handbook" is already so well known that no further reference to its usefulness or importance is needed.

Present Comstock Affairs

By Henry Lawrence Slosson, Jr.*

In January, 1875, the market value of the mines on the Comstock lode was $398,000,000. This was when the so called "Great Bonanza" was being developed and the amazing quantity and quality of the ore revealed had produced a fever of excitement. The Consolidated California & Virginia mines, which contained the Bonanza, rose in price from 20c. per share to $800, and a sympathetic rise in other mines made the market value as stated above. In view of the fact that the Comstock has produced over $600,000,000 and this in spite of extravagance, litigation, waste and mismanagement, the high prices that once prevailed seem justified to a large extent. In contrast to the past the present prices are almost saddening, particularly as recent developments in the deep levels of the lode have given every encouragement to those who believe in the future of the Comstock.

A situation has recently developed on the Comstock that is unparalleled in recent years. As a result of the public disgust at present conditions, the control of a number of the mines has fallen into the treasuries of the various companies for unpaid assessments. Thus the Gould & Curry, a famous property with a bullion production of over $20,000,000, has over 50% of its 216,000 shares in its treasury, fallen delinquent for a 3c. assessment. The same is true of the Chollar, which produced over $15,000,000, the Savage, with a record of $20,000,000, and a number of others of less fame. On several occasions within the past few years, groups of capitalists have tried to buy the control of the Comstock, but in so doing have gone against that singular thing known as "human nature." It has in such cases always been demonstrated that to buy the control of a Comstock mine held by the public has been almost impossible. Before 10% of the stock has been acquired, the price has doubled, before 20% is taken it doubles again. By this time the public seeing a movement, not only hold its stock, but actually buys more. In addition to this, the "shorts" try to cover and the result is one of the wild fluctuations that have made the lode so famous.

The present situation differs from any previous condition in that the control lies not with the public but with the corporations and their boards of directors. During the past 12 years, electric power has been taken to the lode and the drainage revolutionized. Much mismanagement has existed, but it has been clearly demonstrated that the lode can be easily drained to the 3000-ft. level, and that an enormous amount of unprospected ground lies below the 2000-ft. level, particularly in the east or hanging-wall section. It seems rather surprising that with capital rushing into the remote corners of the earth, this great district that once produced nearly $50,000,000 in a single year should not be seized upon once more. The discovery of the ore on the 2500 level of the Mexican mine, two years ago, and the extraction of over $1,000,000 therefrom at a fraction of the cost per ton required to mine the Bonanza of 1875 has proved the fertility of the Comstock in depth and the profit that can be obtained. The modern electrical pumping plant on the lode is worth many times the money it would take to control it, and in addition the three shafts which give access to the lower levels could not be duplicated for many million. The Sutro tunnel, recently repaired at a cost of $500,000, is in condition to last for many years, and physically the lode is in perfect shape for a strong pool to take the control, begin comprehensive and economical development, shape speculation, and restore the lode to its former proud position in the mining world.

*President, Mexican Gold & Silver Mining Co., San Francisco., Calif.

Paul Louis Toussaint Heroult

Dr. Paul Louis Toussaint Heroult died in Paris, May 9, aged 51 years. He had been in poor health for some time, suffering from kidney disease. He was born at Thury-Harcourt, France, and was educated at Caen, in Normandy, and in Paris, where he entered the Ecole des Mines, in 1882, but left there two years later for his service in the French army and never finished his course, being obliged to devote himself for a time to the business of tanning, after the death of his father. He continued his metallurgical researches, however, using such electrical appliances as were available or accessible to him at the time.

In 1886, he succeeded in developing his process for the reduction of aluminum from bauxite, for which he obtained patents in France, England and the United States. This process for the manufacture of aluminum was first put into practical operation in July, 1888, at the works of the Société Metallurgique Suisse, at Neuhausen, near Schaffhausen, on the Rhine. His patents for the production of aluminum were never tested in the United States, since an agreement was reached between the holders of the Heroult and the Hall patents, by which the latter retained the business in this country during the life of the patents. In Europe, however, his methods are still in use.

Doctor Heroult continued his investigations into the use of the electric furnace with much success. The first work done was in the production of calcium carbide in France, and later he undertook the manufacture of artificial corundum, of ferrochrome, ferrosilicon and other alloys. Finally he extended his researches into the use of the electric furnace in the iron and steel industries. His success in this field is well known, and the use of his furnaces for the refining of steel has extended into various countries, notably France, Austria and Germany. He was first to introduce two electrodes into the furnaces, giving the metal the full effect of the heat, and later he experimented with the use of a third electrode. For his steel furnace, he received in 1904 the medal of the Société Francaise pour l'Encouragement de l'Industrie Nationale. He received many other honors and was made "doctor" by the Technical High School of Aachen, Germany.

Doctor Heroult was well known in this country, where he made many visits and spent considerable time. He superintended the construction of several of his steel furnaces and of the plant for the electric smelting of pig iron from the ore at Heroult, in California. Later, he was consulting engineer in the construction of the important works of the Southern Aluminium Co., at Whitney, N. C., but his failing health prevented him from doing justice to that work and he retired some time ago. He leaves a widow and three children. It is understood that he accumulated a considerable fortune from his metallurgical work.

Correspondence and Discussion

Descriptive Articles and Others

Are the JOURNAL readers permitted an occasional kick, provided the kick be qualified by stating that while voiced in the JOURNAL, that publication is less of an offender than its fellows? I should like to inquire: Why are descriptive articles? In general, they seem to me to be useless. Why not fill the space they occupy with good technical articles? To be sure, a good illustrated description of some district, either new or in the spotlight, is a valuable contribution. But the article by somebody with an ax to grind, obviously booming a district, the tiresome rehash of old geologic data, the bare enumeration of a multitude of small properties; I cannot see what useful purpose the publication of such articles serves. The suggestion has been made that a central depository for uninteresting, but occasionally valuable descriptive material be established, to which the manuscripts might be sent without insuring publication. The author could then announce through the technical press that he had deposited an article on so-and-so, in the archives say, of the Institute, where anybody desiring to read the same, could find it. There might be some who would read it. You can't tell!

A less objectionable type of descriptive article is that which concerns itself more with interesting variations of practice rather than with rock characteristics or lists of machinery. Such an article is of interest and value both to the casual reader and to the engineer concerned with mining methods, but it is a relatively rare bird.

ROBERT OLDS.

New York, May 4, 1914.

Growth of the Small Mines

Considerable has been said and written about the lack of prospecting in the West for new orebodies. The hope for a new camp has been held for some time, but little accurate information is available as to where that new camp is to be. In my travels I find a phase of the situation possibly not so often discussed. There has been an evolution going on of the mining idea changing it from a "gamble" to an industry which has no more risks than those incident to growing oranges or cattle. The increase in drilling the ground of a possible deposit with promising surface showing gives definite facts upon which to proceed. The large companies have done more drilling than ever during this past year.

Another factor insuring safety in mining is the increased number of trained mining engineers to direct the work the same as a superintendent of a factory or a farm would be expected to do. Many of these engineers are taking hold of properties themselves rather than work on a salary for a large corporation or do consulting work with its uncertainties. A number of prospects are being developed in mines by this class of men. There are more exploration syndicates being formed for taking over developed or semideveloped properties, following the example of the several successful exploration companies directed from New York and Boston. These are made up of people who are generally above the average of mining operators so that the chances are in their favor for successful returns on their money and effort. Just now this particular class is more desirous of operating gold properties as the price of that metal does not fluctuate.

Another factor contributing to the growth of mining is the more amenable attitude of the men (and women) who own (or have inherited) mining properties toward the operator. Let the reader observe how many women there are interested in mining property because of the death of some mining relative. The recent laws for taxation make it imperative that these properties should either be worked or sold.

S. EARL BENNETT.

Denver, Colo., May 6, 1914.

Company Houses and Furniture

After reading the article on "Mesabi Company Location" in the JOURNAL of Apr. 25, I am impelled to ask: "Why can't mining companies provide their employees with furnished houses?" Mining folk are from nature, or because of circumstances, prone to move frequently, and it is a serious drain on the family finances, already eaten into by a long journey, to have to buy a new outfit of furniture or else pay heavy freight charges to the usually remote mine. Having assisted my husband three times to dispose of our furniture preparatory to moving, I can testify that the proceeds are of little help in purchasing again. If it has been found a good idea to build houses and rent them to the employees, why should it not be equally advantageous to furnish these houses and increase the rent proportionally?

MRS. CARL MORRIS.

Virginia, Minn., May 2, 1914.

Locating Outcrops with a Transit

In the article published in the JOURNAL, issue of Apr. 4, p. 700, entitled "Locating Outcrops with a Transit," the following corrections should be noted: The halftone shows the transit with the top telescope in use, not the Shattuck as stated. In Fig. 2 the letter *a* on the short side of the triangle as called for in the text is omitted. In Fig. 4, the arrow on the line perpendicular to the vein line is omitted. In the first line of the text, just below the figures, the letter *C* should be omitted; in the same line 40.94 should read 49.94. The data with the caption "Specimen of Notebook Entry," are abbreviated office notes and should be read before the heading "Directions for Making Observations."

WALTER S. WEEKS.

Cambridge, Mass., May 11, 1914.

Editorials

The Flotation Patents

The decision of Judge Gilbert with regard to U. S. patent No. 835,120, issued to Messrs. Sulman, Picard & Ballot, which we reported recently, contains a good deal of interest to the mining and metallurgical industry besides the mere fact of the decision itself. Several points in patent law are stated with great lucidity. They are worthy of consideration by everyone who has contracted the taking-out-of-a-patent habit.

In the opinion of the Court: "Miss Everson was the first to make the important discovery that the affinity of the oil for the metal was increased by the addition of an acid. In the description of her process, she states that in the operation, the mass is broken up and thoroughly stirred in water, in a vessel provided with a mechanical stirer, and having an outlet, or outlets, at the bottom for the escape of the water and sand."

To this Western school teacher, who obtained U. S. patent No. 348,157, in 1886, is therefore given the honor of being the real discoverer of the modern flotation process. The Court found also that Schwartz (1904), Kirby (1903), Froment (1902), and Cattermole (1904), all had ideas contributing to the advancement of the art.

"When the claims and the description of the Sulman, Picard & Ballot process are compared with the patents of the prior art," said the Court, "it will be seen that the only material difference is in the smaller quantity of oil which they use." The use of a smaller quantity of oil than was employed in the prior art is not sufficient to distinguish their process so as to render it patentable. To discover that the desired result may be accomplished with the use of a fraction of 1 per cent. of oil, when formerly a much larger quantity of oil had been used, and had been deemed necessary, is not an invention or discovery within the meaning of the patent law. It is a difference of degree, and not of kind. Quoting from a former decision, the Court said: "A change only in form, proportions or degree, doing substantially the same thing in the same way, by substantially the same means, with better results, is not such an invention as will sustain a patent."

In the opinion of the Court it was not even necessary to say that any of the prior patents should have been put into practical use. Judge Gilbert said: A paper patent, if it fully describes an invention, whether it be a machine, device or process, is just as effective to show anticipation as a patent which describes an invention which has gone into extensive use, for a presumption of operativeness and of some utility attends the granting of letters patent." Further, "The law does not require that the discoverer or inventor, in order to get a patent for a process, must have succeeded in bringing his art to the highest degree of perfection. It is enough if he describes his method with sufficient clearness and precision to enable those skilled in the matter to understand what the process is, and if he points out some practicable way of putting it into operation."

The Court cited a decision in another metallurgical case, referring to the use of zinc dust for the purpose of precipitating gold from a solution, and said: "The right to use the dust being free to all, we think it follows necessarily that all have a right to adjust the quantity of the material to the necessities of each case, and ascertain by experiment or analysis, if need be, the quantity that may be required to produce the desired end; that such a use cannot be made the subject of monopoly, there being involved in it no discovery, but only the exercise of ordinary prudence and skill."

Judge Gilbert made the same distinction between the bulk flotation, or oil buoyancy, process, and the froth flotation process, as was made in a recent decision by the House of Lords, in England. Judge Gilbert held, however, that the Everson, and other patents mentioned, were on the froth flotation process, and he cited the famous description of a trial of the Everson process, which was printed in the ENGINEERING AND MINING JOURNAL of Nov. 15, 1890. The contention that the Sulman, Picard & Ballot froth is a different kind of a froth from that produced by the prior processes, was dismissed rather contemptuously. "The evidence in the case," said the Court, "together with the illustration thereof, afforded by demonstrations of the various processes which were made in the aid of the argument before this court, convince us that the froth in all these processes is the same, with the exception that there is less oil (as there must necessarily be) in the appellees' froth than in others. The froths are all similar in appearance, they all rise to the surface after the same amount of agitation, they all gather with equal efficiency the same quantity of metal, and all may be removed from the surface in the same way."

We gather that the Minerals Separation Co.'s representatives are especially exercised respecting this statement. They held that their froth was different from any other and stand by their opinion. This, of course, pertains to a simple question of fact. There was no point of law involved. The Minerals Separation people said, "Our froth is different." Judge Gilbert said flatly, "It is not."

It will be observed that in this case there was no confusion between the bulk-oil-buoyancy flotation, as exemplified by the Elmore process, and the froth-flotation process pure and simple, in regard to which the Sulman, Picard & Ballot patent was directly challenged. This was, moreover, a challenge in the country where the Everson patent originated and where the fullest evidence of publication could be legally introduced. Of course, no one will seek to minimize the credit that belongs to Messrs. Sulman, Picard & Ballot, and their well organized and accomplished staff, for their development of the froth-flotation process and their enterprise in contributing to its becoming the important commercial factor that it is today. But similarly is the technical staff of the Zinc Corporation, in whose works at Broken Hill the first great commercial success was achieved, entitled to credit.

We think that American mine operators will be disposed to recognize in a substantial way the engineering services of the Minerals Separation Co., even if they will not accept its claims to a monopoly.

The Minerals Separation Co. possesses the "know how" in the application of this process and for that reason, we have no doubt that the majority of American mine owners having difficult ores to treat will go to it and pay it for its knowledge and services, patent or no patent. The whole spirit of the American mining industry is one of freedom in the application of processes, the exchange of information for the benefit of everybody, an abhorrence of royalties and an objection to monopolies. On the other hand the modern ideas of coöperation give the proper recognition, financial and otherwise, to those who contribute to improvements in the arts. We are disposed to think that Mineral Separation's loss of its American patent will prove a blessing to itself.

Comstock Developments

During nearly five decades we have kept our readers acquainted with the mining affairs and politics of the Comstock lode, beginning with the extravagances of the early days, then the wild speculation at the time of the Big Bonanza, next the stealings of the mill ring, in the '80s, and more recently the machinations of the ring of San Francisco brokers. The last, as everybody knows, has controlled the Comstock mines through the possession of the stock legally owned by persons of gambling disposition on the Pacific Coast, and elsewhere, but carried on margins in the offices of the San Francisco brokers, who have elected the boards of directors, put in the executive officers, and run things for the perpetuation of the game. It was only a few years ago that the stockholders of the Mexican company, under the leadership of Henry L. Slosson, Jr., who contributes a little article to this issue of the JOURNAL, took possession of their property and started in to operate it as a mine rather than as a roulette wheel. Their brilliant success in finding a good body of ore and taking it out at a substantial profit, was a gratifying feature of the new venture. Naturally friction arose between the Mexican company, a real mining company, and the old-time concerns, which apparently were desirous of throwing the lion's share of the pumping expense upon the Mexican, just because it alone happened to have money in its treasury. After more or less unpleasantness, chiefly more, the Mexican company withdrew from the pumping association, in order to await developments.

It has not had to wait very long. The other companies quickly ran into debt for electric power, the pumping expense being about $7000 per month for power alone, and something like $100,000 is now owed to the Truckee River General Electric Co., which is controlled by the American Goldfields Consolidated, and is operated by Stone & Webster. The directors of the several companies have levied the usual assessments in order to keep the game going, but at last the real stockholders of the majority of the companies had become tired, the titular stockholders—the brokers—did not want to put up their own money, and consequently the majority of the stock has reverted to the treasuries of the companies for the nonpayment of assessments. This is the case of the Savage, Gould & Curry, Hale & Norcross, Best & Belcher, Chollar, Exchequer, Alpha and Bullion companies. The Sierra Nevada has an assessment pending. The stock of the Ophir, and Consolidated California & Virginia is still out. The Mexican and Union are the Slosson companies.

It should be noted that we are referring to the group of Comstock mines at Virginia City. The more important mines of the Gold Hill section, viz., the Crown Point, Yellow Jacket and Belcher, passed some years ago under the control of E. B. Sturgis of Scranton, Penn., who has been undertaking to operate them seriously.

The present situation is, therefore, that the control of the majority of the Comstock companies may pass to whomever will take out of their treasuries the stock upon which trifling assessments are unpaid. There is, therefore, a good chance that the control may be taken away from the brokerage ring and by interests who are minded to do real mining. The Comstock still has great possibilities as a mining district if it be approached with a view to real development and real mining, as the recent experience of the Mexican company has amply demonstrated. The Ophir also during the last few years had an excellent orebody and ought to have yielded a good profit, if it had been mined in modern fashion. We say from our own observation there was never greater difference between any two mines than between the Mexican and the Ophir, the workings of which are separated only by bulkheads. Modern methods of development, intelligent drainage and ventilation, made of the Mexican a mine which, although hot, nevertheless permitted of efficient work by the miners. Open a door and pass into the Ophir, and there was an inferno.

At the time when the pumping association was formed, in 1898, the water at the Comstock mines stood about 20 ft. below the 1700-ft., or Sutro tunnel, level. The pumping reduced it to the 2500-ft. level. At one time a further gain was made and the 2700-ft. level was reached, but this was obtained with ineffieient machinery and could not be held. At present the water stands at the 2500-ft. level. We hope that somebody will quickly be found to take control of the whole group of Comstock companies, put them under a united management and make a serious effort to unearth the possibilities that many geologists and engineers believe this great mining district still to have. Since its palmy days there have been great improvements in mining methods, mining machinery, mining knowledge, indeed in almost everything pertaining to the mining industry. The Comstock mines have never yet had more than a tenth or a twentieth of a chance to be benefited by the improvements in the art.

The Twelve-Hour Shift

We believe most of the JOURNAL readers will agree with the statements of the Steel Corporation finance committee relative to the twelve-hour shift; we reprint these elsewhere in this issue. The position taken is that the character of the work should be considered in prescribing the number of hours of work. Thus twelve hours of intermittent labor is often less exhausting on the laborer than eight hours of steady application. This is true, by the way, of mental application as well as of physical. It should be noted, however, that labor actually performed is not the only factor involved. Exposure to extreme heat, inclement weather or deleterious gases may have most

profound effects on the workman, which will usually vary in intensity directly with the length of the shift.

The Corporation notes justly that employees may resist strenuously measures intended for their own good This is an old and difficult problem. The cut from a seven- to a six-day week cost the Corporation the services of many of its best men, who objected to the decrease in their earnings. With payment by the hour, the same result might be expected following a reduction of the 12-hr. shift to an 8-hr., where the 12-hr. still persists.

The attitude of miners toward the question of the 6-day or the 7-day week, is variable. In many camps, Sunday work is welcomed. Thus in Bisbee, we understand, where Sunday is reserved chiefly for repair jobs, one of the favors that a boss can grant a man is to call him out for Sunday work; while in such a camp as Grass Valley, a call for Sunday shift is most reluctantly obeyed. The difference probably results from the difference in the opportunities for amusement offered outside. In Grass Valley, the miner has his chickens to tend, his garden to cultivate, and deer and quail to hunt. In Bisbee, the opportunities for edifying outside occupation are exceedingly limited.

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The new buildings of the Massachusetts Institute of Technology, in Cambridge, are going to offer a great opportunity for the designing of the most modern and complete of mining and metallurgical laboratories, and good advantage is to be taken of it, we understand.

BY THE WAY

The Goldfield Unity Club has been organized to promote the general welfare of the people of Goldfield, Nevada, and to assist in the establishment of friendly, social and business relations to all elements in the community. There are several committees which are charged with the regulation of various activities, among them a grievance committee, which adjusts differences between employers and employees. Both have agreed to abide by the committee's rulings, but no case will be considered which has not first been considered by the parties interested. Another committee endeavors to promote good relations between the mine operators and the merchants of Goldfield.

The club maintains quarters which are equipped with billiard room, reading and writing rooms, an exceptionally well equipped gymnasium, besides quarters for entertaining ladies. The only income is from regular dues, as there is no bar and no gambling, nor similar revenue. Albert Burch, manager for the Goldfield Consolidated, is president of the club.

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For a number of years the Butters Divisadero Co., in Salvador, has been raising some of the fuel required for its mining operations. When mining was first undertaken at Divisadero, wood was abundant but later became scarcer. After the surrounding forest had been cut over, a variety of thorn tree which seeded itself was permitted to grow and was harvested when it attained a 4-in. growth, for which about seven years was required. The fuel scarcity became more annoying with each increase in the operations, and it has now been decided to abandon this fuel. In the future, the company will use crude oil under its boilers, and has under consideration a plan to use this oil directly in a crude-oil engine of the Diesel type. At present, however, this change of fuel will simply be under the boilers. California oil will be landed at the port of La Union, where a 10,000-bbl. storage tank will be erected. The oil will then be transported about 40 miles by a railroad in tank cars to San Miguel, and thence by a 3-in. pipe line, 13 miles long, to Divisadero. At San Miguel, a steam pumping station will be established, using a Dean Bros. duplex high-pressure line pump, 12x3x12 in. There will be 1000-bbl. and 5000-bbl. storage tanks at San Miguel and Divisadero, respectively. The elevation of San Miguel is 350 ft., and of the mine power house 850 ft. The present oil installation will cost about $25,000, and it is expected that about 100 gal. per day of 14° Bé. oil will be used in the production of about 1100 hp. and the burning of the lime required for the cyanide plant. It is estimated that the oil will cost about $1.60 per bbl., delivered at the mine.

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The *Safety Bulletin* of Nevada Consolidated is continually interesting—chiefly for the comments of the editor on the accidents which occur and which he describes. A few of these from the April number follow:

John Drakos, a pitman at Copper Flat, was slightly burned by hot cinders thrown by steam shovel fireman who was cleaning his fire in the usual way, a shovelful of cinders striking Drakos, who was passing at the moment. The injured man did not report at the time and the injury might not have been serious if he had not attempted to "doctor" it himself. Infection, due to "dope" and plaster which he put on the burns, caused the loss of nine days' time. Suggestion: By constant repetition we may be able in time to bore through and open up one of the brain cells of these stubborn employees and insert the rule that an injured employee must go to the doctor for treatment. If the injured man in this instance had called at hospital and had his burns properly dressed, he would not have lost his nine days' pay.

J. H. Dever stepped on a strip of wood with a nail in it, up-turned. The foreman's report states that "it was only a" slight wound, but Mr. Dever had it attended to by the doctor. Suggestion: That's the way reports should read. Having the wound, however slight, properly attended to. It shows the good judgment of both the injured man and his foreman. Now if the man who left that strip of wood with a nail in it could be found, perhaps the proper emergency treatment for him could be suggested.

George White, mule skinner at Veteran mine underground tramway, suffered a broken rib by trying to get ahead of a train of cars drawn by a mule. He got caught and squeezed between the moving cars and the timbers of the drift. Suggestion: A mule is sometimes a dangerous piece of machinery. Mr. White probably had the right idea—the safe end of a mule is ahead of him. But the loss of time, the expense and suffering which White brings upon himself could have been avoided if he had stopped his train for the few seconds required to pass it.

Mark Bodine, switchman in the dinky train service delivering concentrates from mill to smelter, tried to make a coupling with his foot. He lost four toes and two or three months' wages. The cars in this service are equipped with standard automatic safety couplers, all parts inclosed, with outside trip and lever handle. It is never necessary for a man to go in between cars to make a coupling. Specific rules, with which injured man was familiar, strictly prohibit the dangerous practice of kicking a coupling. His foreman, who had previously been informed that Bodine had been seen kicking a coupling, warned him not to do it again. Suggestion: It is rather discouraging to everybody concerned, after all that has been said and done in practical endeavor to stop this fool practice, to find a man in the employ of the company who still persists, in obstinate, asinine stupidity, in this method of trying to couple cars. The injured man will probably call it "ill luck," in spite of the fact that he failed to observe an ordinary intelligent rule of safety.

Mining Entries Require Only Substantial Compliance with Law

WASHINGTON CORRESPONDENCE

The Supreme Court, in the case of the El Paso Brick Co. vs. McKnight, has settled a very important point regarding the acquiring of title to mineral lands. This case involved an interesting question, namely, can an application for a patent be properly refused when all other terms of the law relating to mineral land are complied with, but the accompanying affidavit is executed before an officer residing outside of the mining district in which the claims are located?

The Court rendered a decision for the El Paso Brick Co. Mr. Justice Lurton, in delivering the opinion of the Court, said, "The Government does not deal at arm's length with the settler or locator and whenever it appears that there has been a compliance with the substantial requirements of the law, irregularities are waived or permission is given, even on appeal, to cure them by supplemental proofs."

The Supreme Court held the original cancellation of the entry by the Land Department was based on a plain error of law, and the title of the El Paso company to the placer claims in question was perfectly good, despite later acts.

The history of the case dates back to September of 1906, when the Commissioner ruled the entry of the El Paso Brick Co. was fatally defective. This opinion was affirmed in September, 1908, by the Assistant Secretary of the Interior. The Brick company thereupon waived its right to petition for a review of the decision and on the following day, Nov. 25, 1908, filed at the local land office a second application for patent. McKnight thereupon filed his adverse claim. He brought suit in the District of Doña Ana County, New Mexico, and the court rendered a judgment for him, McKnight, which was affirmed, Dec. 17, 1909, by the Supreme Court of New Mexico. The present decision of the Supreme Court of the United States reverses the lower court. It is interesting to note that the Department of the Interior, since July 29, 1911 (Ex Parte Stock Oil Co. decision), has been holding as the Supreme Court did in the present instance.

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Leasing of Fuel and Fertilizer Lands

Chairman Ferris, of the House committee on public lands, has favorably reported the bill authorizing exploration for coal, phosphate, oil, gas, potassium or sodium and the disposition thereof.

This bill provides for the retention by the United States of the title to all phosphate lands and the leasing of the lands for development and production of phosphates. Tracts of not more than 2560 acres of phosphate lands are to be leased for development. The Government is to receive a royalty of at least 2% of the value of the phosphates produced, at the point of production, with a minimum rental of $1 per acre per annum. Leases are to be indeterminate, with full regulation of methods of mining, prevention of waste, monopoly and minimum production. It is left to the Secretary of the Interior to make such terms in the lease concerning the time for development and the use of surface lands for location of factories and for other purposes as may be desirable to encourage location of new industries and protect the public interests.

The bill also authorizes the Secretary of the Interior to issue an oil and gas prospector's permit for a period of two years, conditioned on development and actual drilling. If the prospector discovers oil, he may upon application secure patent to one-fourth of the area of the prospector's permit, which would be one-fourth of 640, or 160 acres, if within 10 miles of production, and one-fourth of 2560 acres, or 640 acres, if more than 10 miles removed from present production.

This bill further authorizes the Secretary to grant prospecting permits, as proposed for oil prospecting, to persons who desire to prospect for wet or dry chlorides, sulphates, carbonates, borates, or nitrates of potassium or sodium. The person or corporation to whom such a permit is issued is to have the exclusive right, for not more than three years, to prospect and explore for such deposits in an area not to exceed 2560 acres.

Upon proof of discovery of such deposits, the discoverer is to be given patent to 160 acres selected by him in such area, and the remainder of the area covered by the permit is to be reserved for lease on a royalty basis of 2% of the value of the output at the point of production. Leases are to be for an indeterminate period, and are subject to the same regulations as are proposed for the leasing of coal, oil and phosphate lands.

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Agricultural Entry on Mineral Lands

WASHINGTON CORRESPONDENCE

The Senate committee on public lands has reported a bill to provide for the agricultural entry of lands withdrawn or classified as phosphate, nitrate, potash, oil, gas or asphaltic minerals, or which are valuable for those deposits. It is provided that they shall be subject to entry, but that the title to the mineral deposits proper shall remain with the United States; and any person who has acquired from the United States the right to mine and remove the reserved deposits, may occupy so much of the surface as may be required for mining purposes, subject to payment of damages caused thereby to the owner of the land.

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Employer's Responsibility for Accident

The Michigan Supreme Court recently announced these rules as being applicable to mining companies' liability for injury to miners while at work:

A pick used in mining operations is so simple a tool that an employer owes no duty to inspect it to determine whether it is reasonably safe. Neither need the employer warn a laborer against the danger of splinters flying from a rock in striking it with a pick. (Toth vs. Osceola Consolidated Mining Co., 146 *Northwestern Reporter*, p.668.)

A miner assumes the risk of injury from unexploded dynamite in blasts set off by other miners, if it is impossible to ascertain whether all the charges have gone off. (Conradson vs. same company, p. 638.)

PERSONALS

Wilber Judson was in New York last week.

Alfred James, of London, is expected in New York.

Lawrence Addicks left for Douglas, Ariz., on May 15.

Kirby Thomas has gone to Quebec to examine some mining property.

J. Parke Channing, who is now in Arizona, is expected back in New York about the end of May.

George M. White and P. D. Burtt have removed their offices to the new Insurance Exchange Building, San Francisco.

Dr. Bruno Bruhn and Dr. Karl Wendt, of the Krupp works in Germany, are visiting various steel works in the United States.

A. H. Boyd has resigned his position with the Denver Rock Drill Manufacturing Co. His present address is 2700 Race St., Denver.

Percy E. Barbour, manager of the Uwarra Mining Co., Candor, N. C., has resigned his position, his resignation taking effect early in June.

George M. Colvocoresses has completed installation of a flotation plant at the smelter at Humboldt, Arizona, and will return to the East soon.

E. G. Spilsbury sailed for Europe on the "Lusitania," May 19, going abroad on professional business. He expects to be home in about three weeks.

George M. Fishburn, Charleston, S. C., is in New York in connection with negotiations for the Newbury-Fishburn process for treating phosphate rock.

L. O. Evans has been appointed chief counsel for the Anaconda Copper Mining Co. The office has heretofore been filled by C. F. Kelley, vice-president of the company.

J. L. Parker is reported seriously ill with pneumonia at Cranbrook, B. C. His disease was contracted while examining a deposit of gold-copper ore on St. Marys River in East Kootenay.

C. W. Purington, of London, has been apointed consulting engineer to the Lenskoy Gold Mining Co., of St. Petersburg, Russia, and technical adviser to the Lena Goldfields, Ltd., of London.

Robert M. Keeney, electrometallurgist of the Bureau of Mines, has resigned to take charge of the construction of a cyanide plant and power house for the Baker Mines Co., at Cornucopia, Oregon.

J. F. Buel, late president of the Navidad Development Co., of Guadalajara, Jalisco, Mexico, is now at Tegucigalpa, Honduras, examining mining property. He expects to remain there for some time.

Henry Lawrence Slosson, Jr., president of the Mexican Gold & Silver Mining Co., San Francisco, Calif., is now in New York on business connected with his company and Comstock affairs generally.

Quincy A. Shaw and Rudolph L. Agassiz, president and vice-president of the Calumet & Hecla and subsidiary companies, have been visiting the copper district in Michigan on one of their usual inspection tours.

Herbert T. Herr, general manager of the Westinghouse Machine Co., Pittsburgh, has been awarded the Edward Longstreet medal of the Franklin Institute, Philadelphia, for recent developments of the steam turbine.

W. D. Jacoway, late superintendent of the openhearth plant of the Lackawanna Steel Co., goes to Australia as superintendent of the new steel plant now being built by the Broken Hill Proprietary Co., in New South Wales.

Frederick W. Snow and family sailed on May 12 from Boston for London on their way to the Belgian Congo. Mr. Snow has accepted a position with Archer E. Wheeler, consulting engineer to the Union Miniere du Haut Katanga.

Dr. Rossiter W. Raymond was to be entertained, May 22, at a special luncheon at the Hotel Albany, in Denver, by the Colorado local section of the American Institute, the Colorado Scientific Society, the Colorado Chapter of the American Mining Congress, and the Denver Chamber of Commerce.

N. H. Darton of the U. S. Geological Survey will spend June to October in the Southwest obtaining data for a description of the geology and other features of interest along the line of the Santa Fé R.R., to be published as a Survey bulletin for use of travelers to the Panama Exposition in San Francisco in 1915.

Henry H. Armstead has been in Virginia making an inspection of the copper deposits of the Virgilina District. All of the properties operated by the Armstead United Companies, Inc., in Mexico are closed, and in charge of Mexican watchmen. All of the American employees of this company who have been on duty in Mexico landed at New Orleans May 15, by steamer, from Puerto Mexico.

John J. Shannon, for years with the Sloss-Sheffield Steel & Iron Co., has been made assistant to the vice-president of the Woodward Iron Co., and will be general superintendent of all the furnaces of the company at Woodward and Vanderbilt, Ala. B. E. Purser, who has been with the Woodward Iron Co. for 21 years, and who was mine superintendent at Dolomite, has been made superintendent of all mines.

OBITUARY

J. Howard Ewald, President of the Pittsburgh Forge & Iron Co., died at St. Louis May 18. He was for many years engaged in the iron business and was well known as an operator.

Wilson B. Chisholm died in Cleveland, Ohio, May 10. He was long connected with the Cleveland Rolling Mill Co., and after that was absorbed by the American Steel & Wire Co., he engaged in other enterprises.

Alexander B. Scully died in Chicago May 7, aged 58 years. He was born in that city and for many years was in the employ of Joseph T. Ryerson. Later he formed the Scully Steel and Iron Co., of which he was president up to the time of his death.

W. T. Hardesty died at Warren, Ohio, aged 57 years. He had lived all his life in the Mahoning Valley in Ohio and was engaged in the steel industry in that district. He is credited with building the first tin plate mill in the United States, having superintended the erection of that mill for the Falcon Iron & Nail Co., at Niles, 22 years ago.

E. J. Walter died at Butte, Mont. April 17 aged 77 years. He was born in England and was brought to this country when a child. He first went to Montana over 50 years ago being among the pioneers who went there after the first discovery of gold in Alder Gulch. He was for many years a resident of Virginia City and was engaged in mining in that part of the state. He retired a few years ago and since then had resided in Butte.

The mystery surrounding the disappearance of Marshall S. Dudley, mining engineer, and for more than 20 years confidential agent of ex-United States Senator Jonathan Bourne was cleared up May 5, when a badly decomposed body found floating in the Willamette River at Oregon City, Oregon, was positively identified as his. It is thought that he committed suicide as he has worried over some Mexican mining property that he was not able to work on account of the trouble down there. He had interested Portland people in the Neil Development Co. which was to work the old Mina La Paloma 150 miles across the Mexican line.

Professor Newton H. Winchell died May 9 at Minneapolis, aged 74 years. He was born in Dutchess County, New York, but the greater part of his life was spent in the West. He attained a wide reputation as a geologist and writer, and had held many important positions. He was connected with the Geological Survey of Ohio at one time, and also with that of Michigan, and was state geologist of Minnesota. He had also served as a member of the United States Assay Commission and as president of the Geological Society of America, and was at one time editor of the "American Geologist." He leaves two sons, Horace V. Winchell long chief geologist of the Anaconda Copper Mining Co., and Professor Alexander N. Winchell, formerly of the Montana School of Mines and now head of the department of geology at the University of Wisconsin.

W. J. Sutton, geologist for the Canadian Northern Collieries, Ltd., died suddenly from a stroke of apoplexy at Ucluclet, on the west coast of Vancouver Island, on May 9. He was a pioneer in the development of Vancouver Island and an authority on its mineral and other resources. Born at Kincardine in Bruce County, Ontario, in 1859, he went to Victoria in 1877 and for several years was assayer in the provincial Department of Mines, afterward associating himself with the Dunsmuirs in their coal mining operations on Vancouver Island. He took courses in mining and geology in Trinity College, Cornell, Columbia School of Mines and in the

Michigan College of Mines. Mr. Sutton's reputation as a mineralogist was by no means local. He was a member of the American Institute of Mining Engineers, a vice-president of the Canadian Mining Institute and chairman of the Western Branch of that Society

SOCIETIES

Society of Chemical Industry—The New York Section held a joint meeting with the New York section of the American Chemical Society and the American Electrochemical Society at Rumford Hall, New York, May 22. The program for the evening was: "Refractories," Gilbert Rigg; "Substitutes for Automobile Gasoline," Gail Mersereau; "Theoretical Problems Involved in the Cracking of Oils," W. F. Rittman; "Ferro-Silicon and its Dangers," Charles E. Pellew.

University of Utah—There has been established in connection with the Utah State School of Mines, a department of the University of Utah, a Metallurgical Research Department, to find ways of profitably treating low-grade ores, of securing a higher percentage of extraction of metals from their ores, and of obtaining other information that shall have for its object the benefit of the mining industry. In connection with this new department there have been established five research fellowships in metallurgy, each having an annual value of $720. These fellowships are open to college graduates who have had a good training in chemistry and metallurgy and application for them will be received up to June 15, 1914. Applicants should send a copy of their records from the registrar's office of the college where they have, or will be, graduated, and the names and addresses of at least three references who know their character, ability and attainments. Holders of these fellowships will be subject to the rules governing employees of the National Bureau of Mines and will report for duty about Sept. 15, 1914. They must also register as students in the University of Utah and become candidates for the degree of Master of Science in Metallurgy (unless this or an equivalent degree has been previously earned). Fellows are appointed for one year, but the appointment may be renewed. Applications should be addressed to Joseph F. Merrill, Director of the Utah State School of Mines, Salt Lake City.

INDUSTRIAL NEWS

The general sales offices of Abendroth & Root are now located in the Hamburg-American Building, 45 Broadway, New York, N. Y.

The Hardinge Conical Mill Co., 50 Church St., New York, N. Y., reports that the Spassky Copper Co. of Russia has ordered two 8-ft. Hardinge Mills.

The Gun-Crete Co., specializing in cement gun work for engineering, industrial and mining structures, has opened new offices in the McCormick Bldg., Chicago.

A. J. Baggs and W. H. Bines will engage in the mine car-wheel business at Huntington, W. Va. Mr. Baggs has had 20 years' and Mr. Bines 14 years' experience in the business.

Escobar Ehrensperger, Calle de Ayacucho N. 174 Medellin, Colombia, S. A., have organized an engineering company to carry on a business of analyzing minerals and chemicals, etc., and also to take charge of mine enterprises.

At the annual meeting of the stockholders of the Joseph Dixon Crucible Co., held in Jersey City, N. J., on Monday, Apr. 20, 1914, the retiring board of directors, consisting of George T. Smith, William Murray, George E. Long, Edward L. Young, William G. Bumsted, J. H. Schermerhorn and Harry Dailey, were unanimously reëlected.

The Sizer Forge Co., Buffalo, N. Y., which does a general forging business, for all classes of work, recently shipped to the Utah Copper Co., at Magna, Utah, six shafts 10 ft. 3 in. long, 6½ in. diameter, and weighed 1400 lb. each. The company is also now shipping three carloads of axles, pins and other steam shovel parts to the Marion Steam Shovel Co., Marion, Ohio, these being forwarded in the rough state to be machined up by the Marion company. The work done by the Sizer company consists entirely of forgings of special character. In the past it has made a large number of shafts for stamp heads for the stamp mills at Lake Superior.

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.

AIR—Apparatus for Controlling the Humidity and Temperature of Air. Willis H. Carrier, Buffalo, N. Y., assignor to Buffalo Forge Co., Buffalo, N. Y. (U. S. No. 1,095,156; Apr. 28, 1914.)

ALUMINUM-BEARING MATERIALS, Treatment of. Harry P. Bassett, Catonsville, Md. (U. S. No. 1,095,306; May 5, 1914.)

CHARGING FURNACES—An Improvement in or Relating to Screw or Worm Conveyors, with Special Reference to the Charging of Rotary Reduction Furnaces. A. E. Bourcoud, London, Eng. (Brit. No. 10,207 of 1913.)

CLASSIFICATION—Improvements in Apparatus for Sorting or Grading Ores by Means of Air Currents. F. O. Stromberg, Seattle, Wash. (Brit. No. 7214 of 1913.)

COMPLEX ORES—An Improved Process for the Treatment and Separation of Complex Sulphide Ores. T. R. Forland, Broken Hill, N. S. W. (Brit. No. 7107 of 1913.)

COPPER—Improvements in or Relating to the Recovery of Copper from Its Ores and Solutions. H. L. Sulman and H. F. K. Picard, London, Eng. (Brit. No. 1152 of 1913.)

DRILLING—Electromagnetic Fishing Tool. Calvin N. White, Maricopa, Calif. (U. S. No. 1,094,106; Apr. 21, 1914.)

FURNACE GASES—Filtration of Flue Dust, Fume and Like Fine Solid Impurities from Furnace Gases. Gilbert Rigg, Palmerton, Penn., assignor to New Jersey Zinc Co., New York, N. Y. (U. S. No. 1,095,676; May 5, 1914.)

MANGANESE-STEEL INGOTS, Process of Treating. Charles G. Osborne, Chicago, Ill. (U. S. No. 1,094,090; Apr. 21, 1914.)

METALLIZING FURNACE. Edward P. Mathewson and Frederick Laist, Anaconda, Mont. (U. S. No. 1,094,802; Apr. 28, 1914.)

METALLURGICAL FURNACES—Improvements in and Relating to Metallurgical and Other Furnaces. A. Williams, Brymbo, Eng. (Brit. No. 26,218 of 1913.)

METALLURGICAL PROCESS. Warren F. Bleecker, Pittsburgh, Penn. (U. S. No. 1,094,114; Apr. 21, 1914.)

MINE-CAR TRUCK. David S. Johnston, Hiawatha, Utah. (U. S. No. 1,093,783; Apr. 21, 1914.)

MINER'S LAMP. Frederic E. Baldwin, New York, N. Y. (U. S. No. 1,094,358; Apr. 21, 1914.)

ORE SEPARATOR. Elmer W. Hoffman, Joplin, Mo. (U. S. No. 1,094,566; Apr. 28, 1914.)

PLACER MACHINE. John Berger, Salt Lake City, Utah. (U. S. No. 1,093,760; Apr. 21, 1914.)

PLATINUM ALLOY. Ezechiel Weintraub, Lynn, Mass., assignor to General Electric Co. (U. S. No. 1,096,655; May 12, 1914.)

QUARTZ MILL. Harold F. Randall, Tiffin, Ohio. (U. S. No. 1,094,248; Apr. 21, 1914.)

REFINING—Electrolytic Apparatus. William Thum, Hammond, Ind. (U. S. No. 1,095,748; May 5, 1914.)

REFRACTORY METALS AND ALLOYS, Process for the Manufacture of Bodies of. Paul Schwarzkopf and Siegfried Burgstaller, Berlin, Germany, assignors to Wolfram Laboratorium Dr.-Ing. Paul Schwarzkopf-G. m. b. H., Berlin, Germany. (U. S. No. 1,096,464; May 12, 1914.)

SEPARATION—Improved Method of and Means for Separating Different Kinds of Minerals or Other Substances Such as Coal, Ores and the Like. J. W. Blackhurst, Thornton Dale, Chesterfield, and I. C. Blackhurst, Sheffield. (Brit. No. 26,418 of 1913.)

SEPARATION—Improvements in Concentrating Apparatus for Cleaning, Separating and Classifying Metalliferous Ores. G. H. Harris, Wadebridge, Cornwall, Eng. (Brit. No. 7233 of 1913.)

SEPARATORS—Improvements in Dry Ore Separators. W. W. Bonson, Dubuque, Iowa. (Brit. No. 20,831 of 1913.)

SINTERING—Process of Agglomerating Fine Ores or Metalliferous Products. Edmond Alexandre Pretceille, Nantes, France, assignor to the Corporation of Metallurgische Gesellschaft A. G., Frankfort-on-the-Main, Germany. (U. S. No. 1,096,054; May 12, 1914.)

SKIP ROADS—Sliding Track for Skip Roads. Otto Lieber, Hancock, and Chester A. Gibbs, Houghton, Mich. (U. S. No. 1,093,708; Apr. 21, 1914.)

STEEL—Hardening or Treatment of Steel, Iron, Etc. Adolph W. Machlet, Elizabeth, N. J. (U. S. No. 1,092,925; Apr. 14, 1914.)

STEEL—Improvements in Making or Refining Steel. E. Humbert, Barleduc, France. (Brit. No. 18,116 of 1913.)

SULPHUR—Process for the Recovery of Sulphur from Pyritic Ores. W. A. Hall, New York. (Brit. No. 26,370 of 1912.)

TESTING—Apparatus for Testing Coal or Ores. P. Habets, Montegnee, Belgium, and A. France, Liége, Belgium. (Brit. No. 4992 of 1913.)

TUNNELING AND EXCAVATING MACHINE. Charles H. Bonnett, Port Huron, Mich. (U. S. No. 1,093,603; Apr. 21, 1914.)

URANIUM, ETC.—Method of Extracting Uranium, Vanadium and Radium from Ores and Other Material Containing the Same. Joachim H. Burfeind, Nucla, Colo. (U. S. No. 1,095,377; May 5, 1914.)

Editorial Correspondence

SAN FRANCISCO—May 14

Refinancing Natomas Consolidated is reported in San Francisco to have been arranged with English interests, according to a plan substantially the same as the one presented by H. C. Hoover. This information is said to have come by cable from Frank B. Anderson, president of the Bank of California, who is in London engaged in this negotiation. As no one in San Francisco connected with the Natomas Consolidated has yet been advised of changes that may have been made in the Hoover plan, any recital of the plan would at present be valueless, and possibiy misleading. However, if the arrangements said to have been consummated correspond in general with the Hoover plan the Natomas Consolidated would he in a financial condition to carry out its large projects in the reclamation and cultivation of lands made possibie by the profits derived from gold dredging on the American and Feather Rivers.

Inspection of Southern California Mines by H. M. Wolflin, mining engineer for the California State Industrial Commission and Bureau of Mines, extended from Mar. 24 to Apr. 24, but this period was not sufficient to include all the mining districts in that part of the state, and the visits will be resumed May 25. The visits already made included the portland-cement plants at Riverside and Colton, the mines and mills at Randsburg and Johanneshurg, the American Trona Corporation piant at Searles Lake, the quartz mines at Skidoo, the Mojave Consolidated mines at Mojave, the Tropico mines at Rosamond, and the Tumco and the American Girl mines at Ogilby. The second visit will embrace Gold Mountain, Virginia Dale, Ludlow and Amboy districts in San Bernardino County, the Julien and Warner Spring districts in San Diego County, and such other mining districts as may he decided upon during the visit. Wolflin has adhered strictly to the plan of offering suggestions for improvements in methods for the safety of miners without demanding anything of the operators. In every instance his suggestions have heen well received, and in a large number of cases the improvements suggested have been begun. This was noticeable particularly at the Yellow Aster in Randsburg district where within 24 hr. after the visit, General Manager Singleton hegan instaiiation of improvements. It was also noticeable that at many of the mines visited by Wolflin, some means of precaution had already been taken for the safety of miners, so that such changes as were suggested would in most cases require comparatively small additional outlay. However, there are a number of mines operating in southern California, as elsewhere in the state, which will require a great deal of change in methods to conform to the provisions of the workman's compensation law and other mining iaws of the state. These are facts well known and are matters which Wolflin does not discuss. The Industrial Commission and the Bureau of Mines do not give out any specific information regarding these visits, until issued in a formal report. There is every evidence that the methods adopted by the commission and the bureau will result in great value to the mine operators in California. Wolflin purposed visiting the mines at Nevada City and Grass Valley before resuming the visits in southern California.

DENVER—May 14

General Mining Conditions in Colorado are reflected in the attention being given to resumption of activities in numerous old camps where mining has not been much of an industry for years. No one general explanation can be advanced to account for the dullness that succeeded early mining in all these places. The reason most commonly given is that the camps were prosperous until mining exhausted the oxidized ores and encountered the then refractory sulphides. This is true with regard to some of these regions. In one or two districts, sulphides were not really objectionable until zinc became a prominent component. With the exhaustion of the easily mined bonanza orehodies, some camps dwindled because the operators failed to keep up with progress in mining and treating ore. Still other districts have been dull because the citizens thereof made it a practice, for years, to "play suckers from the East." The reaction came, of course, in time, and, notwithstanding the natural merits of such a district, investors could think of it only as a place where dividends never accrued. Some districts have been failures in the past through the premature erection of mills that exhausted capital before orebodies could be developed. Reports from most of the pioneer camps indicate that many old mines that have heen idle for decades are being, or will be, opened, while old mills are being remodeled or new mills built to include uptodate machinery. In most cases, electric power will be used.

BUTTE—May 13

P. Geddes vs. Alice Gold & Silver Mining Co. Suit has been set for trial, June 17, by Judge Bourquin, of the federal court on the request of L. O. Evans, chief counsel for the Anaconda company. Geddes, as a minority stockholder of the Alice company, started suit a year or more ago to have the sale of stock, which changed the control of the property to the Anaconda company, set aside. The trial will be held in Helena and Senator T. J. Walsh will represent the defendants.

Butte, Anaconda & Pacific Ry. has been operated by electricity for several months, but the first completely electrified passenger train was not operated between Butte and Anaconda until May 10. The coaches are equipped with electric lights and are electrically heated. The lights are on the 600-volt circuit from the motor, and the heaters are operated directly from the 2400-volt circuit. A fan biows air through the heaters up into the car. Work has been started on the electrification of the Chicago, Milwaukee & St. Paul Ry. from Three Forks to Deer Lodge. Poles for the trolley are being delivered. The copper wire for this road will be rolled at Waukegan, Ill.; 1750 tons of wirebars will be required.

SALT LAKE CITY—May 14

Transfer of International Control is expected to take place May 26, but this will not affect the operations, as the different departments will continue under the same officials. There is a possibility that under the control of the Anaconda Copper Mining Co. more ores will be secured for the International Smelting & Refining Co.'s Tooele plant, so that the copper furnaces will be run at full capacity. At present two of the copper reverberatories are in use. All of the five lead furnaces are in blast.

Assay Offices at Salt Lake, Boise, Helena and Deadwood, and the mint at Carson City may be continued for the current fiscal year. The Senate appropriations committee on May 9 decided to amend the legislative appropriation bill by providing funds to continue the assay offices for the coming fiscal year. If the Senate adopts the amendment the question of retaining the offices will be transferred to the conference committee, composed of House and Senate members. The report of the director of the mint for the fiscal year 1912-1913 showed that the Salt Lake City assay office bought during this period $585,172 worth of bullion, from the mountain states. The largest amount, $318,361, was from Utah, Nevada and Idaho being next. Arizona, California, Montana and Oregon also contributed.

HOUGHTON—May 15

Quincy Operations at the Pontiac Shaft have not yet been resumed. This work has been suspended ever since the strike started last July. Now, however, the Quincy has all the men it can use in other departments and plans for the opening of this shaft are being made. A particularly encouraging sign about the work in the Quincy's lower levels is the fact that at two widely separated places some rock of unusual grade has been cut quite above the average. It is well established that the Pewabic lode has been getting leaner and leaner with depth. In fact, the low-grade rock from this lode has made the Quincy more and more of a manufacturing proposition, which required the highest degree efficiency and large tonnage. The recent developments are encouraging, coming as they do at such great depth. In both instances the good showing is closer to the foot wall than is usual.

Winona has a good chance of going on a paying basis this month. The management is not authorizing any such hope or prediction. A total force as large as before the strike is employed. Tonnage is increasing gradually and

before another month passes a daily tonnage of better than 1400 tons will be hoisted. The mine has been operating for 16 years, starting under its present management in 1898. Its record has been one of assessments to date. Production first started in 1902, when a small tonnage was taken out. In the following year 1,036,944 lb. were taken out, but in 1904 half that amount was mined and in the next year there was no output. In 1906 and 1907 1,500,000 lb. were taken out, followed by a three-year period of no production. In 1911 a new campaign of productivity was inaugurated which was well under way and showed good signs of putting the mine on its commercial feet when the strike came. In 1912 a total output of 2,307,237 lb. was secured, but this amount was not equaled in 1913. With copper selling at 15c. and a daily output of 1500 tons, the Winona, maintaining the grade of vein matter that is now showing in the various openings, can be put on a basis of self-support. No effort will be made under the existing plans to extend operations which are confined to two shafts.

Copper Range Consolidated annual report was looked upon as satisfactory by the shareholders in this district, and there is a large number of them considering the strike. The management is careful to explain that the high yield of copper was due to an unusually careful selection and a desire to produce as much copper as possible with the limited working force which operated after the strike. It is to the credit of the management that such results could be secured when the working force included quite a number of new men, many of whom never saw a mine shaft before. The fact that the Champion rock yielded 29 lb. of copper per ton occasions most comment. It indicates that the average for the few months of the year following the strike must have been considerably over 30 lb. This showing, in an amygdaloid lode, is little short of sensational, notwithstanding the frank manner in which the officers of the company explain that it is not to be expected in the future. The copper average, at this mine, was close to 28 lb. per ton for the first six months of 1913, a record which beats Ahmeek and Wolverine. There are many things about Copper Range properties that ought to be especially satisfactory to the shareholders. The general underground conditions at each mine are better than in former years and while the increase in copper for last year will not be continued it will be commercially profitable to handle more rock, which will yield a smaller unit return in copper. The introduction of regrinders in the stamp mill resulted in saving a larger percentage of copper, and the management is introducing new departures in work underground.

NEGAUNEE—May 16

New Metals Process Co. has been organized to erect and operate at Marquette a Jones step-process furnace. This company has been incorporated under the laws of Illinois; capitalization $25,000. John H. Lee, of Chicago, is president; John T. Jones is general manager. The contracts for the machinery have been closed. Jones is on the ground and work on the buildings has commenced. The parent company is known as the "Boston pool." In the event that furnaces are erected, other than the one at Marquette, subsidiary companies with small capitalization will be formed to build and operate the plants.

MARQUETTE—May 16

First Shippers on the Menominee this year were mines of Corrigan, McKinney & Co., of Cleveland, the Armenia and Dunn, at Crystal Falls, and the Tully and Baker, at Iron River. Other properties to start ore on its way to Lake Michigan at an unusually early date were the Zimmerman, Davidson and Wickwire, of the Iron River group and each operated by the company from which it takes its name. A prospective shipper in the Iron River district, hardly this year, however, is the Buchholz. Organized to explore this property and to operate it if developments are satisfactory, the Enterprise Mining Co. has been incorporated under the laws of Wisconsin with a capitalization of $150,000, the new corporation succeeding to the interests of the Iron River Ore Co., former holder of the tract. The Buchholz has been equipped with a new and larger plant of machinery and with the working unwatered and repaired search for ore will be started. The shaft is 300 ft. deep.

IRON RIVER—May 15

Indiana Mine is to be Reopened after 28 years' idleness, by the John M. Thomas Furnace Co., of Milwaukee. The mine is in Section 27, 40-30, in the Iron Mountain zone, of the Menominee range, and adjacent to Lake Fumee. The Indiana was opened in 1880 and closed in 1886, producing during that period 18,000 tons of ore. It was a wet mine and with the pumping machinery of the time was difficult to keep drained, besides, the operators were men of limited financial means. Capt. John T. Spencer, of Iron Mountain, has been exploring in the vicinity for the last few years under a lease procured from the Keweenaw Association of Boston, the owner of the fee, the tract concerned comprising 80 acres and including the Indiana. Captain Spencer found new ore and subleased the property to the Thomas company. Machinery is already being delivered and development will soon be in progress. Railroad facilities will be provided by a spur line to be built by the Chicago & Northwestern. The old shaft is 250 ft. deep. It will be unwatered and connected with the Spencer workings. At the Spencer there are several thousand tons of ore in stock. The product averages, it is understood, better than 40% iron and is unusually low in phosphorus The ore mined at the Indiana is said to have been bessemer of high grade. The property was leased by the furnace company after Thomas and his engineers had made a thorough examination.

JOPLIN—May 15

Panama-Pacific Exhibit of the state's mineral resources will be in charge of Ruhl & Shanklin, mining engineers of Joplin, who have been appointed by the state commission to design, collect and install an exhibit which shall comprehend all branches of the state's mineral industry and which under way contemplate showing the mineral products of the state from the raw ores through to the manufactured products with the methods of manufacture and treatment. An attempt is being made to so arrange matters that there will be a sequence of exhibits showing the prospecting of mining lands, mine development mining, milling, smelting, and the delivery of the products to the consumers.. These plans will be carried out to the fullest extent with the lead- and zinc-mining industries. Model mines, model mills, model smelting plants and model machinery in actual operation so far as conditions permit will be utilized to exemplify processes and methods of work.

FAIRBANKS—Apr. 18

A Better Placer Season in the way of profits is now expected, although a backward spring threatens to delay sluicing. The total gold production for 1913, including nearly $300,000 from the lode mines, was $3,250,000, a decrease of more than $1,000,000 from 1912. This loss was due in large part to an unusually dry season. While it is impossible to make more than a rough guess as to the probable output for this year, owing to uncertainty as to how many of the operators that plan work will find their ground too lean to yield a profit, it may be predicted that 1914 will see a total production of about $3,000,000. Considering the district as a whole, profits during the last two years have gone almost entirely to claim owners in the form of royalty. It is estimated that fully 90% of the production of the Fairbanks district has been won under lease, and that 15% of the yearly output is paid as royalty, $500,000 on a production of $3,250,000. The principal producing creeks will be the same as heretofore: Ester, Goldstream, Cleary, Dome and Fairbanks. Little Eldorado, Engineer, Smallwood and several others will also make important contributions. Gilmore and Pedro, tributaries of Goldstream, will show an increased production by reason of the numerous outfits engaged in working the low-grade but shallow ground by means of power scrapers. There are also several scraping plants on Fairbanks Creek and its promising tributary, Alder. Plans have been announced for operating the dredge on the upper end of Fairbanks. Cleary Creek, which is credited with nearly one-third of the $61,000,000 produced by the Fairbanks district, will be more active in its upper portions than last year, a result due largely to the long Hilty drainage adit, which has made it possible to work the wet ground on Discovery and several adjacent claims. On the flats where Cleary Valley merges with the valley of the Chatanika River there will be about the same amount of work as for several years past. Operations in this portion of the district are characterized by the perseverance of a group of ingenious operators who have brought working costs down to the lowest figure yet attained under similar conditions, one firm making a small profit in 1913 on ground that sluiced only 60c. per sq.ft. of bedrock. The reported discovery of pay on Twentymile Creek, a tributary of Salchaket River, 60 miles up-river from Fairbanks, is encouraging, as are the plans of the Chena River Development Co. for working the low-grade gravel of Palmer Creek, in the Chena River district. There are believed to be large deposits of workable gravel on many other creeks tributary to the upper Tanana, but they require capital and machinery beyond the means of the pioneer. Lodes in this area are also receiving a good share of attention, and encouraging developments are reported from several quarters.

The Mining News

ALASKA

TWENTYMILE CREEK, in Salchaket district, is attracting attention because of discovery by Pearson & Anderson, of pay running nearly $3 per sq.ft. of bedrock. Depth to bedrock is 75 ft. in discovery shaft. Heretofore prospecting on this creek has been hindered by finding of thawed gravel and much water near bedrock, but present shaft is entirely in frozen material, as is crosscut, that has penetrated pay for 60 ft. at bottom. Twentymile Creek, which is 56 miles from Fairbanks, is a tributary of Hanson Creek, which in turn enters Salchaket River from right limit, about half mile above Redmond Creek. Redmond, which has produced considerable gold in past, is a left limit tributary of Salchaket. Government road to Valdez from Fairbanks passes within 16 miles of discovery, and there is said to be a road up Salchaket that requires only two or three small bridges to make a good summer route. It is figured that supplies can be delivered to branch road by autotruck and taken to Twentymile from there at a total cost but little more than that of transporting supplies to many creeks in Fairbanks district proper.

10 BELOW, PEDRO CREEK (Fairbanks)—James McPike plans extensive operations. Work will be done by open-cut methods, for which two 50-hp. boilers, a three-drum hoist, and a Bagley scraping outfit have been purchased. It is planned to strip a cut covering 90,000 sq.ft. of bedrock.

BEATSON COPPER CO.—Preparations have been made for immediate construction of a concentrator of 500 tons daily capacity, cost of which will approximate $250,000. Mine is on Latouche Island and has been shipping ore for 10 years, but with completion of new plant will ship only concentrates.

ARCTIC—This company is planning to install a large dredge on Sunset Creek in Port Clarence district.

ARIZONA

Gila County

INTERNATIONAL SMELTING & REFINING CO. (Miami)—Nearly all foundations for power plant near smelter site are in place, so that erection of steel will be started as soon as receiving conveyor housing is completed. Oscar Daniels company erected first steel at smelter site May 7.

INSPIRATION CONSOLIDATED (Miami)—Concreting of main east shaft station on 400 level is completed and shaft work has been resumed. Work on main west shaft was started last week at a point 40 ft. below 400 level. By time two shafts are finished, necessary excavations for underground bins on 600 level will have been completed. These will have a capacity of 3000 tons and will be of ferro-concrete construction throughout. A smaller bin for handling Live Oak ore is also to be installed. Carpenters and corrugators have nearly finished work on storage bin, and a good start has been made on conveyor housing and crushing plant. Conveyor and feeder machinery for mine plant is due to arrive soon and will be installed as soon as inclosing of various buildings is completed. Excavation for transformer stations near compressor and hoist house are being made and similar work for those at concentrator is to be started in a few days. Both transformer stations are arranged in duplicate, as two sources of supply are to be available, that from Roosevelt having to be handled at 45,000 volts, while that which will be supplied from company's power plant, in cases of emergency, will only have to be stepped down from 6600 volts; 2200 will be normal operating voltage. Because locomotive crane was out of commission for several days last week, work on concentrator was curtailed. Several men are making changes in bay adjoining shop extension, remainder having been put on finishing work at Inspiration. It is now estimated that American Bridge Co. will have its contract completed by Sept. 1.

Yavapai County

CROSBY (Hillside)—Cleanup from a test run made by C. K. Crosby in his mill on Santa Maria River yielded 21 lb. of gold bullion, worth $5000. Property is 15 miles from Hillside.

FORTUNE (Big Bug)—Fortune tunnel has been driven 900 ft. and is still in good ore. It is expected that work on mill, purchased some time ago, will begin in near future.

GREAT WESTERN COPPER CO. (Courtland)—Company has closed its properties. Pumps have been taken out of lower levels and lower workings bulkheaded. Machinery will be knocked down and shipped to property recently purchased by Young Bros., at Mammoth, in Pinal County.

CALIFORNIA

Amador County

DEFENDER (Defender)—It is reported that installation of a cyanide mill is contemplated.

GRILLO (Volcano)—New pay streak of gravel is reported. Property is being developed by a new company headed by W. I. Smart.

PLYMOUTH CONSOLIDATED (Plymouth)—Progress in construction of new milling plant is as rapid as receipt of material will permit. Present electric hoist will probably be supplemented by a larger one.

ZEILA (Jackson)—Wrecking of surface equipment is still in progress. Headframe and building have been removed, but hoisting machinery is in place and will probably not be dismantled. It is stated that no further negotiation for sale of property has been undertaken.

Butte County

NIMSHEW MINING CO. (Nimshew)—Reopening of Kid mine is contemplated. This was formerly one of the best producers in district, and was closed down several years ago on account of dissension among owners.

Calaveras County

ROYAL CONSOLIDATED (Hodson)—It is reported that Edwin A. Fordice & Co., of Boston is negotiating for purchase of these mines in west belt of Mother Lode region.

CALAVERAS COPPER CO. (Copperopolis)—It is reported that Ames estate of Boston is paying creditors, and it is expected within 90 days entire $70,000 indebtedness will be settled. Plans for reopening mine and resumption of smelting are contemplated.

Eldorado County

UNION (Eldorado)—It is reported that mine has been bonded to San Francisco and Oakland men. Mine was operated in early days by Hobart, Hayward & Lane and was credited with large production. Later it was operated by Philadelphia men under management of C. P. Harpending. Litigation over water rights caused closing down. Mine is equipped with a 60-stamp mill; main shaft is 1600 ft. deep.

COLORADO

Boulder County

PUZZLER (Ward)—E. B. Hill, et al., have taken lease and bond and will push development of this old mine.

DENVER, BOULDER & WESTERN R.R.—Under instructions from state railroad commission, company must clear its Ward line of snow and run trains thereon by June 2. This will permit White Raven mine to resume rail shipments.

Clear Creek County

BURNS-MOORE (Idaho Springs)—It is planned to resume operations in both mine and mill soon.

CROWN POINT & MINT (Empire)—New electric hoist is installed. Shaft is cleaned and drifting has begun.

QUITO (Idaho Springs)—Adit level is being cleaned out and retimbered. Old oreshoots left because of litigation will be removed.

JACKSON MILL (Idaho Springs)—Plant is kept well supplied with ore from the Sun & Moon, Rockford, Ben Harrison and other mines.

EDISON MILL (Silver Plume)—Plant is running full capacity. Process is maintained as a secret but mining men believe it is successful as there is talk of erecting another plant using same process.

EMPIRE TUNNEL (Georgetown)—Granting a 100-years' lease resulted in a dispute between stockholders. Factions held meetings simultaneously in same room. While taking train for Denver, some old directors were served notice by sheriff of $250,000 damage suits.

La Plata County

MANY MEN ARE COMING INTO CAVE BASIN DISTRICT and many more are expected to come in as soon as snow melts. Snow is still from two to three feet deep but many places are beginning to show up bare and it is thought that by May 20 ground will be entirely free from snow. Mineralization extends over a large area and all ore so far found on different properties is of the same general character. It is three miles from Dowell mine to Mary Murphy property and high-grade float has been found between these two. Several discoveries made recently would indicate that district is much larger than at first expected and that there is reason to expect that some rich finds will be made this summer.

Lake County

STAR OF THE WEST (Leadville)—Lessees have put mine into shape to begin steady shipments of silver-lead ore.

DOWNTOWN PUMPING ASSOCIATION (Leadville)—All leases sought by Jesse McDonald are now either signed or promised. Three months will be required to install machinery for unwatering large area through Penrose shaft. Electrically driven centrifugal pumps of foreign make will be used.

San Juan County

BAGLEY TUNNEL (Silverton)—Mine and mill are being put in shape after winter closing and will soon start operations.

KITTIMAC (Howardsville)—Mill is being remodeled and new machinery is being installed. Operations will be resumed as soon as aërial tramway towers destroyed during the winter can be repaired.

SILVER LAKE MILL (Silverton)—American Smelting & Refining Co., owner, will start this old plant on custom basis, but will also probably treat company ore. Equipment includes crushers, trommels, rolls, jigs, classifiers, chilean mills, tables, vanners, and canvas slimers. Experiments have been made in flotation and this method may be installed later. Mill has two units, one for lead-zinc ores, the other for lead-copper ores. L. R. Clapp is superintendent.

IDAHO

Coeur d' Alene District

MINING OPERATIONS ON PINE CREEK, near Kellogg, are beginning for summer and several properties have started work. A contract has been let for 200 ft. of tunnel on Spokane group, on west fork of creek, to Harry Lotz. International is working and much development will be done. Sherman also is preparing to put on a shift. In Government Gulch Cooper & Rowley lease at the Crown Point has ordered a new jig and arrangements have been made to ship two cars per month to smelter, all ore to be treated on jigs. Machinery for Odd Fellow group has been shipped and is expected soon, trail being opened to property. Machinery includes a compressor, drills, air line and other accessories for development.

NATIONAL MINING CO. (Mullan)—New mill which began operations Apr. 1, treated approximately 12,000 tons of ore in first 30 days, or a daily average of 400 tons. Mill is running three shifts, and it is believed that maximum limit of production will be reached by June 15, as machinery will have been adjusted thoroughly by then. Tests of tailings show that plant is saving 7% in excess of original estimate.

CALEDONIA (Kellogg)—Mine was scheduled to begin shipping last week. Raise from long lower tunnel of Bunker Hill & Sullivan company into Caledonia workings was recently completed, and entire output of property will be handled through Bunker Hill level. The 300-ton unit of Bunker Hill mill set aside for treatment of Caledonia ores has been repaired, machinery readjusted, and the plant is ready to operate. Caledonia soon will be producing at capacity, as old workings have been repaired and put in shape and mine subjected to a general overhauling.

GERTIE MINING CO. (Burke)—Plans are being made to drive a long lower tunnel from Calumet claim, recently acquired by Gertie company, through the Russell, owned by Federal company, and portions of Marsh and Hecla holdings, into Gertie ground. Bore will be started 55 ft. above creek level near schoolhouse and will have to be driven 3700 ft. before entering Gertie lines, where a vertical depth of not less than 1500 ft. will be attained. Tunnel will cost $75,000 and will require 15 months for driving. Work will begin July 1, and it is estimated that bore will be advanced 250 ft. per month. Funds to finance development will be secured by increasing Gertie capitalization from 1,500,000 shares to 2,500,000 shares at a special meeting of stockholders. Added shares will be distributed pro rata among stockholders of record when books close for meeting, at a price to be set by directors, and shares remaining after those who desire to increase their holdings have availed themselves of opportunity will be taken over by A. A. Booth and L. W. Hutton, the heaviest individual stockholders.

MICHIGAN

Copper

AHMEEK MINING CO. (Kearsarge)—Working force is gradually increasing at Nos. 3 and 4 shafts and increased shipments are resulting. Work at stamp mills on two-head addition is progressing well. Machinery is being erected and will be ready to meet new conditions when north-end shafts are on a regular producing basis.

OSCEOLA CONSOLIDATED (Osceola)—Company has over 1200 men in its employ, a much larger force than it had before strike. It is shipping 4000 tons of rock daily to mill, 1700 tons of which is coming from North Kearsarge branch, where Nos. 3 and 4 shafts are in commission. Work of remodeling surface equipment at No. 1 shaft is underway and when completed this shaft will be able to handle an increased tonnage. At old mine, Nos. 5 & 6 shafts are in commission and are producing rock of average grade for this lode.

Iron

IRONTON (Bessemer)—Corrigan, McKinney & Co. have closed down this mine and will allow workings to fill with water to 15th level. Many men have been given work at Colby mine, at Bessemer, owned by same company.

CASCADE MINING CO. (Palmer)—This company has closed a contract with Lake Shore Engine Works for a large hoist for mine now being opened to be known as Isabelle. Shaft will be bottomed within a short time at 950 ft. It is considered one of the finest and largest shafts in the Michigan district, being of steel and concrete.

PALMS (Ironwood)—Newport Mining Co. is now hoisting 600 tons daily through new shaft. Old shaft on Anvil property, through which ore was removed during development period, had started to get badly out of line just at time new shaft was ready. It is believed that old shaft will not be used again for hoisting ore or men.

ATHENS (Negaunee)—It is thought that sinking will soon be resumed as all machinery is installed. Shaft work was stopped last autumn when a depth of 80 ft. had been reached but shaft will have to be sunk to 2200 ft. before mining can be started. Equipment greatly resembles that at Negaunee mine, both of which are owned by Cleveland-Cliffs company.

ASHLAND (Ironwood)—Placing of steel sets in main shaft to take place of old wooden timbers is completed and ore is coming to surface through this opening. During period that repairs were under way, an old shaft was in commission. It was costly to keep shaft in repair before as it had buckled in several places and caused great trouble. It is believed all this will be eliminated now as some curves have been reduced and steel will prove more serviceable than wood.

BATES (Iron River)—This mine was flooded to 150 ft. above bottom level, when pumps recently went out of commission. Electric pump burned out first, but steam pumps would have been able to handle water if one of them had not become disabled and it was not long before other was drowned out. Two bailers which were put in commission could not handle all water and three sinking pumps were pressed into service. It took several days to get water out and pumps repaired, but operations are now going on as formerly.

MINNESOTA

Cuyuna Range

RESULT OF LOW PRICES established for 1914 will be a greatly reduced output from Cuyuna range, especially from underground operations. Prevailing mining costs are so high that lower prices leave little or no profit for operator. Armour No. 2 and Kennedy mines are shipping regularly and Barrows stockpile is being loaded for shipment. No other output is going from the district although other mines continue preparations for season. Railroads are curtailing operations and many men are being laid off. Considerable diamond and churn drilling is being done. Reduced price of ore has brought about a reduction in vessel carrying charges to lower-lake docks. The 1912 rate has gone into effect, being 50c. from head of the lakes and 35c. from Escanaba; 10c. from these figures goes for unloading charges.

BARROWS (Barrows)—A steam shovel is now at work loading 40,000-ton stockpile. Mine continues to hoist ore daily. This is first movement of ore from south range this season. Barrows mine shipped but 9000 tons last season, being only shipper on South range.

CUYUNA IRON & MANGANESE ORE CO. (Crosby)—After months of exploratory work, this company has taken a 30-year lease on NW-NE and NE-NW of Sec. 10, 46-29, north of Pennington mine. Rovalty is 40c. per ton, with minimum shipment of 25,000 tons first year, 35,000 second, 50,000 third and 75,000 tons annually thereafter.

MISSOURI-KANSAS-OKLAHOMA

Joplin District

FIRE IN POCAHONTAS MINE at Thoms Station caused cessation of operations at Powhattan, D. & R., and Boston-Aurora temporarily. Rise of water, due to Pocahontas pumps being drawn, prevented working these mines.

OPERATION OF TWO NEW MILLS IN LAWTON, KAN., has swelled output there considerably. Last week's production for camp was 144,840 lb. of blende. New concentrators are those of the Lawton Mining Co. and Hall Mining Co.

JACK POT (Zinc, Ark.)—New concentrator is now running regularly.

QUAPAW MINING CO. (Miami, Okla.)—Concentrator is nearing completion.

KRAMER (Cave Springs, Mo.)—This old mine has been dewatered to first ore level and operations will begin soon. Mine now in charge of Cave Springs Mining Co.

OSCEOLA LEAD & ZINC CO. (Joplin, Mo.)—Waneta plant, destroyed by fire, to be replaced by this company on Riseling Land Co.'s mine No. 3.

SEALS LEASE (Thoms Station, Mo.)—Work on new concentrator to begin soon; lease is near Pocahontas. Ground comparatively new, though good producers surround it. Homer Seals and associates are operating.

GRANBY MINING & SMELTING CO. (Granby, Mo.)—Drilling on tract south of Granby reveals ore run. Prospecting will continue. Company is successfully operating B. & H. mine near Joplin, and may erect concentrator soon.

AMERICAN LEAD, ZINC & SMELTING CO.—Drilling operations by this company coöperating with citizens of Aurora, Mo., who subscribed $2000 to meet expense, have been begun. It is estimated that six months' will be required to make tests contemplated.

ORONOGO CIRCLE (Oronogo, Mo.)—This old mine has been sold by J. B. Mess and Henry Russell Platt, of Chicago to Turner & Co., 500 Fifth Ave., New York. Consideration withheld, but is believed to have been $500,000. Mine has been producing for last 40 years, total output being valued at $7,000,000. Operations are conducted on three levels 150, 240 and 360 ft. The five concentrators were combined a few years ago to make one of 1000-tons capacity with a modern sludge mill.

MONTANA

Cascade County

BIG SEVEN (Neihart)—David Barker and associates who have been driving a 3000-ft. tunnel for four years cut into oreshoot recently and since then have been stoping. They shipped one car of silver-lead ore, which, they report, netted $20,000.

Deer Lodge County

HOLDFAST (Georgetown)—Main shaft of this property caved May 11 from surface to 200-ft. level. None of the six men at work were injured, and all escaped through an old inclined shaft. Accident will necessitate sinking of a new shaft.

Jefferson County

BALTIMORE COPPER MINING CO. (Boulder)—Jacob Matson, who has a lease on company's mine, four miles north of Boulder, is stoping ore in three places. Two cars of ore shipped returned $773 for gold, silver and lead.

Lincoln County

LIBBY CREEK PLACER (Libby)—Butte men who own this property are preparing to resume operations. Comet Placer Mining Co. on Little Cherry Creek is also getting ready for sluicing.

Silver Bow County

PILOT-BUTTE (Butte)—Drifting on middle vein on 2200 has disclosed some high-grade copper ore. Officers say that a story lately circulated that vein has "fizzled into a body of zinc ore" is untrue and malicious.

BUTTE-BALLAKLAVA (Butte)—New crosscut on 1600 level, at a distance of 170 ft. from shaft, cut through Jessie vein, which is 16 ft. wide, half of which is claimed to be shipping ore and remainder second class. A few assays of first-class ore indicate 8% copper and 9 oz. of silver.

BUTTE DULUTH (Butte)—Contract made with a company to mine by steam shovel and to deliver ore at mill at 18c. per ton, had to be canceled because of objections of miners' union. Company will continue old method of mining for a time and will then put in a steam-shovel system of its own.

NEVADA

Churchill County

NEVADA HILLS (Fairview)—Statement for March, 1914, as reported in these pages, issue of May 2, was that of March, 1913. Correct statement for March, 1914, is as follows: Tons milled, 5080; gross value, $49,175; loss in tailings, $5705; ore purchased, $1959; costs, $30,981; net profit, $10,530. During same month 502 ft. of development work was done.

Elko County

SUCCESS (Jarbidge)—Good-grade ore is being developed on 400-ft. level. This same shoot has been opened on sixth level. Raising in oreshoot 5 ft. wide, is being done on No. 2 level.

DIAMOND PEAK GOLD & COPPER MINING CO. (Elko)—A 400-ft. crosscut tunnel will be driven to cut oreshoot at greater depth. Shoot is opened by 200-ft. tunnel, and contains gold and copper. This property is in Diamond Valley in southern part of county.

Esmeralda County

DIAMONDFIELD MINING & MILLING CO. (Goldfield)—Cyanide plant of 20 tons daily capacity will be installed at 5-stamp mill on Great Bend ground. Mining is being done by lessees on Great Bend and Daisy ground.

GOLDFIELD ORO (Goldfield)—East and west crosscuts, each 50 ft. long, will he driven from bottom of 825-ft. shaft, before starting development work on 810-ft. level. These crosscuts will serve as storage reservoirs for water which will result from development. On 810-ft. level, South drift will be driven, also crosscut to west to explore Columbia Mountain fault plane.

Humboldt County

NATIONAL MINES CO. (National)—Shipment of 420 sacks of concentrates was made recently to Selby smelting plant.

SEVEN TROUGHS COALITION (Seven Troughs)—New pump is in operation at bottom of Bird winze and sinking has been resumed. Oreshoot has been opened by drift for length of 150 ft., and 2 ft. of high-grade ore is exposed in bottom of winze.

WEST DIP (Golconda)—Crosscut has been driven to hanging wall of vein and 4-ft. shoot of milling-grade ore has been opened. Equipment of compressor and drills has been installed. This property is 12 miles south of Golconda, and is owned by C. T. Porter and associates of Salt Lake City.

Lander County

STARR & GROVE (Battle Mountain)—A larger engine and a compressor will be installed.

BUNKER HILL (Bullion)—Property is being examined for San Francisco men, and if report is favorable, Kerr & Peterson lease will be taken over.

AUSTIN CONSOLIDATED (Austin)—Drifting in Richardson tunnel has been resumed. A gasoline-driven compressor and machine drills will he installed.

Lyon County

MOHAWK (Yerington)—Shaft is being sunk, and car of good-grade copper-gold-silver ore, from this work, was shipped recently.

EMPIRE-NEVADA (Yerington)—Churn drilling by Miami Copper Co. has been discontinued and drill moved elsewhere. Several sets of lessees are still mining a good-grade copper ore.

NEVADA-DOUGLAS (Ludwig)—An experimental leaching plant has been installed and tests on a large enough scale will be made to determine adaptability of process, as outlined by previous tests, to mill of commercial size.

SMITH VALLEY MINES CO. (Yerington)—Hoist is installed and operating, engine for compressor is also installed and foundation for compressor nearly completed. Main shaft is being sunk another 100 ft. and an oreshoot was unexpectedly cut in this work, about 40 ft. below 250-ft. level. Good-grade ore has been developed.

MASON VALLEY MINES CO. (Thompson)—Freight rates between Coram, Calif., and Thompson, Nev., have been reduced by Southern Pacific R.R. Balaklalla company will ship 100 tons daily to Thompson smelting plant. Ore receipts at plant for April, 1914, were as follows: From Mason Valley mine, 8364 tons; from Nevada-Douglas, 3163 tons; from other mines, 2312 tons; total, 13,839, or a daily average of 461 tons. During same month, 11 cars of blister copper were shipped.

Mineral County

LONE STAR (Rand, via Gillis)—Three shafts, 75, 100 and 175 ft. deep have been sunk and oreshoot 5 ft. wide opened. Shipments netting from $32 to $160 per ton have been made. A gasoline hoist will be installed. A fraction has been bonded to Berkeley, Calif., men. On same vein is Last Hope property. Here a 250-ft. shaft has been sunk and ore shipped. Other good prospects are being worked. Water in camp is short, but can be obtained three miles distant or by sinking 150 ft. Electric power could be supplied from line to Fairview and Wonder if growth of camp justified.

LUNING-IDAHO MINING CO. (Luning)—Adjoining property of the Luning Gold Mines Co. Property comprises 13 claims. Several of its neighbors' veins enter property and sufficient work has been done to prove continuation. Copper showing is good and most work has been done on deposit which is 250 ft. wide. It appears to have a granite hanging and quartzite foot-wall and can be traced on the surface for 3000 ft. Work consists of several open cuts, trenches and shafts, opened to determine best place to sink a working shaft. Company is now sinking shaft, which is 30 ft. deep all in ore. Sulphides are just making their appearance. Shipping to smelters will be started as soon as roads are completed to ore dumps.

ANDERSON (Luning)—This mine situated 4½ miles east of Luning, was taken over upon a lease and bond by Mason Valley Mines Co. one year ago. Company has worked it continuously since that time and has shipped 6000 tons of ore with an average copper content of 3% and 1 oz. silver. Most of the ore was extracted above 50-ft. level. Between 50- and 80-ft. levels there are blocked out 1000 tons averaging 4% copper, and between 80- and 200-ft. levels ore is 56-ft. wide and will assay more than 3% copper and 1 oz. silver. This property promises to be a great producer after suitable machinery is installed and economical transportation is supplied. Property adjoins Nevada Champion mine which claims 40,000 tons of ore blocked out.

LUNING GOLD MINES CO. (Luning)—This company, reorganization of Luning Gold Mines Syndicate, owns 13 claims six miles northwest of Luning. Development work has been done. Large shoots of ore have been blocked out of sufficient grade to yield a good profit could ore be worked on ground, but not rich enough to stand expense of shipment to Salt Lake City. Ore in these veins yields gold, silver and lead. They trend nearly north. Two years ago a cross-vein was discovered, carrying gold and silver, and $7000 worth of ore has been shipped since from above 50-ft. level. Little work has been done recently, but the company expects to start work on a larger scale soon and tap this vein with a tunnel, 400 ft. below outcrops. This tunnel will he 450 ft. long. On completion of tunnel company should be able to make a large production of ore at a good profit. Some carload shipments yielded $50 per ton.

Nye County

PROSPECTING FOR POTASH IN RAILROAD VALLEY will be resumed. Deep drilling will be done to determine depth of gaylussite bed discovered last year and to prospect for potash beneath this bed.

RECENT DEVELOPMENT OF ORE IN TONOPAH has been reported by following companies: Tonopah Belmont, in shaft and west vein on 12th and 13th levels; Tonopah Extension, in Midway vein; Jim Butler, on eastern extension of West End-MacNamara vein; Tonopah Merger, west drift and northwest crosscut on 1170-ft. level, latter high-grade shipping ore; Tonopah-Midway, on 625-ft. level of old workings, and Mizpah Extension, on 1160-ft. level.

RESCUE EULA (Tonopah)—Vein has been cut in south crosscut on 800-ft. level. It is 5 ft. wide and samples from $10 to $19.

TONOPAH MERGER (Tonopah)—Merger oreshoot has been recovered on 1170-ft. level after driving through fault and crosscutting 20 ft. Shoot is 4 ft. wide and of good grade.

Washoe County

GOLD STRIKE AT OLINGHOUSE was made recently, it is reported. Strike was made at mouth of Olinghouse Cañon, below Cottonwood Springs, and is believed to be continuation of old channel which was large producer several years ago. A number of claims have been located.

White Pine County

CONSOLIDATED COPPER MINES CO. (Ely)—Churn drills are working on crest of hill west of Morris workings.

NEW MEXICO

Bernalillo County

COPPER HILL MINING CO. (Albuquerque)—Incorporation papers have been filed with corporation commission; capitalization, $100,000. O. N. Maron is statutory agent. Company owns copper property in Zuni Mountains. Mining operations are contemplated also building of a treatment plant.

Doña Ana County

BIG THREE GROUP (Organ)—Air drills and engine are being installed preparatory to extensive development.

Grant County

DAVID TULLOCH (White Signal)—The 200-ft. shaft is being retimbered and preliminary work being done before actual mining begins.

STAUBER & WRIGHT (Pinos Altos)—Work has been started on lease secured on property of Savannah Copper Co. Gillett shaft is being retimbered.

Otero County

DARROCK & FUNK (Brice)—Partnership between J. R. Darrock and Z. E. Funk who were working mines of Jarilla Mining Co., known as Lucky mine group, has been dissolved by mutual consent.

ORO GRANDE SMELTING CO. (Oro Grande)—Property was sold by order of district court to satisfy tax lien of $2812. J. C. Peyton, of El Paso, Tex., was awarded property at bid of $3000. It is believed Peyton will place property on market.

Socorro County

SOCORRO MINING & MILLING CO. (Mogollon)—On May 1 stockholders of company received 1% dividend. These dividends will aggregate 12% per annum and are on common stock, preferred stock being retired some time ago.

Taos County

BLACK COPPER (Red River)—Work was resumed on property May 6. Shaft is being unwatered.

FRASER MOUNTAIN GROUP (Twining)—Property was inspected by Ira B. Joralemon of Calumet & Arizona Mining Co. Property will be more fully inspected after snow now covering mountain has melted.

OREGON

Jackson County

DE LUSE MINING & DREDGING CO. (Gold Hill)—New machinery for development has been purchased.

PENNSYLVANIA

Allegheny County

AMERICAN ZINC & CHEMICAL CO. (Langeloth)—From present rate of progress being made on new plant of this company, it is expected that acid making will start on a small scale sometime this summer and spelter will be made this autumn.

SOUTH DAKOTA

Lawrence County

CUSTER PEAK (Roubaix)—Tests are being made on copper ore from this property to determine its adaptability to leaching. Mine shows large shoot of ore carrying malachite and azurite.

DEADWOOD LEAD & ZINC CO. (Deadwood)—Local men, including C. S. Ruth and W. McMackin have been making tests and experiments on ore, believing that separation can be made by oil flotation.

HOMESTAKE (Lead)—Recreation Hall is being rapidly completed. Interior decorations have been finished throughout. Grading and excavation for steam plant near Amicus miil has been started with a big crew.

TITANIC (Carbonate)—Bad roads have interfered with delivery of coal for steam purposes and it has been necessary to use cordwood to keep water out of workings. This is practically all work now being done.

DEADWOOD STANDARD (Ragged Top)—Hodges, Nicholls & Burkett, who have leased this property, have started mill at small capacity which is gradually being increased. Mine work has disclosed some good ore in a new place.

ORO HONDO (Lead)—Boiler plant has been found to be insufficient for continuing work of sinking, and two additional boilers are being installed, when mining will be resumed. It is planned to sink 1500 ft.; shaft is now 1050 ft. deep.

HEIDELBERG (Two Bit)—Under agreement made last summer local men have subscribed $5000 for development, final installment of which will be payable May 23. To secure additional funds it is proposed to incorporate. Exploratory work costing $10,000 is planned, to include sinking diamond-drill hole to quartzite and later sinking a shaft. During last 10 months 370 ft. of development has been done all of which except one crosscut, is in ore. Ore removed has been sorted, and material assaying $16 and upward has been shipped, except 30 tons now in bins, which will be sent to mill immediately. During last few months 50 tons of ore went to Golden Reward mill which returned net, above cost of shipment and treatment, $371.

Pennington County

DAKOTA CONTINENTAL COPPER CO. (Hill City)—Crosscutting at depth of 850 ft. is now in progress; sinking has been suspended. Rock is extremely hard and progress is not rapid.

PRODUCERS' MICA CO.—An offer of $12 per ton has been made for scrap mica in any quantity up to 10 tons daily, and as result considerable activity is noted among mica miners of Keystone and Custer district.

UTAH

Beaver County

SOUTH UTAH (Newhouse)—Mine and mill have shut down, throwing 130 men out of employment. Negotiations are reported pending for taking over of property by other interests.

Piute County

SHAMROCK GOLD MINING & MILLING CO. (Marysvale)—Negotiations are in progress for a consolidation of this property with the Glen Eyrie and the Roosevelt, formerly Deseret. Mill ore has been developed.

Summit County

PARK CITY SHIPMENTS for week ended May 8 amounted to 2,421,490 lb. During April output from camp was 5289 tons.

DALY (Park City)—Development is being done from Central tunnel, which is one of the old workings. A raise is up 100 ft. in back vein, which has been productive in different parts of property. Some ore has been encountered.

SILVER KING COALITION (Park City)—New electrical equipment has been installed in a large concrete underground station recently completed on Alliance tunnel level. Extensions of some large orebodies have been opened.

SNAKE CREEK TUNNEL (Park City)—During April, 314 ft. was driven with two shifts working. Progress includes, ditch, track, and telephone iine. Ground breaks well and requires little timbering. An 18-in. air pipe is kept within 100 ft. of face. Present flow of water amounts to about 5000 gal. per minute.

MINES OPERATING CO. (Park City)—Recovery during April averaged 82%, the best yet made. Average grade of ore was lower than it has been recently. A new roaster is being used, which handles ore automatically. Mill averages 165 tons per day, of ore from old Ontario stope fillings, although up to 200 tons per day has been treated.

DALY WEST (Park City)—Wreckage from burned mill and shaft is being cleared away, and shaft timbers, burned several sets below collar, are being replaced. Other preparations for construction of new shaft house and hoisting equipment are in progress. New hoist has been ordered. Location of new mill is still undecided, but it is probable that site of old mill will be chosen. Other possible sites are being considered. Orders for new mill equipment have not yet been placed.

DALY-JUDGE (Park City)—During April approximately 1000 ft. of development was done from 500-ft. level to 1500. Production amounted to 5700 tons or somewhat less than 200 tons per day. About 500 tons were mined from new orebody on Daly vein, of which 100 tons was shipping ore carrying 25 to 30% lead and 60 oz. silver. This orebody has been opened for 25 ft. on strike on 1200 level, and is apparently making out on to bedding. Dimensions are not yet known. Mill ore was mined 1000 ft. from shaft on Bonanza Flat side.

Tooele County

HIDDEN TREASURE (Stockton)—Ore hauling has been started from this property in Dry Cañon.

GETHIN LE ROY (Wendover)—This property in Silver Island district has a shipment of rich silver-lead ore on market. Ore came from Blacksmith tunnel workings on Le Roy fissure, and from recent work on main vein. Much development is in progress. Raising is being done in ore in No. 1 tunnel; and in tunnel No. 2 a winze down 25 ft. has opened 18 in. of ore. This vein has been opened for several hundred feet on surface. A crosscut tunnel, which is being driven further down mountain will cut Le Roy fissure, and give a vertical depth of 250 ft. Development on ore is being done in five different places.

Utah County

AMERICAN FORK CAÑON ore is now being taken out. On May 7 first ore teams of season carried ore down from Dutchman mine, which is being worked by lessees, and where there is more lead-carbonate ore sacked and ready for shipment. Other properties will soon start shipping.

CANADA

British Columbia

HOPE—A promising find of free-milling gold ore has been made on Coquihalla River; 10 claims have been located on a 6-ft. vein.

HEDLEY GOLD MINING CO. (Hedley)—Power dam on Similkameen River is nearly completed and work is being done on right-of-way for ditch and flume.

ZINC SMELTING—Byron E. Eldred, president, Johnson Electric Smelting Co., of New York, accompanied by Joseph Struthers, of New York, and A. E. Barlow, of Montreal, have interviewed premier of British Columbia in regard to securing use of government plant at Nelson for treatment of zinc ores. Their intention is to establish a smelting plant to experiment with Johnson process of electro-thermic smelting of complex ores of this class. They stated that interview had been encouraging.

GRANBY CONSOLIDATED (Anyox)—First shipment of copper from plant at Hidden Creek has been sent to a refinery in New York. There were 930 bars in consignment, metal weighing 122 tons, and being valued at 15c. per lb. It was stated at local office of the company that now plant is in operation there will probably be two shipments sent out a month, of 400 or 500 tons each. Special freight tariffs, quoting through rates from Granby Bay to points in Eastern states have recently been issued by Great Northern Ry. Company has bonded Maple Bay group on Portland Canal, 30 miles below Stewart. Group was formerly operated by Brown-Alaska Copper Co. and shipped 2200 tons per day to smelter at Kasaan Bay, Prince of Wales Island. It was discovered by a Naas Indian 12 years ago.

Ontario

COBALT PRODUCTION IN APRIL WAS: Beaver, 31.22; Chambers Ferland, 29.34; City of Cobalt, 37.87; Cobalt Lake, 96.81; Cobait Townsite, 178.47; Coniagas, 150.88; Crown Reserve, 20, by Dominion Reduction Co., 147.73, or 167.73; Hudson Bay, 77.30; Kerr Lake (Dominion Reduction Co.), 111.45; La Rose, 95.92; McKinley-Darragh, 308.86; Nipissing, 116.22; O'Brien, 31.88; Peterson Lake, 34.10; Penn Canadian, 42.29; Timiskaming, 24.90; Trethewey, 47.93; total. 1583.17 tons.

KENORA (South Porcupine)—Work has been resumed.

SENECA-SUPERIOR (Cobalt)—Quarterly dividend of 10% with a 2½% bonus has been declared.

PORCUPINE SYNDICATE—Stock control has been purchased by General Assets, Ltd., which company controls Gouid lease on Peterson Lake in Cobalt.

McINTYRE (Timmins)—Production for April was 4200 tons averaging $10.70. Bullion shipped was valued at $46,100. Mill capacity is being increased 300 tons per day.

GROWN JEWEL (Elk Lake)—This company with a nominal capital of $1,000,000, of which $750,000 is stated to be paid up, has been ordered by court to be wound up.

MILLER LAKE O'BRIEN (Gowganda)—Electric equipment operated with power from plant on Gowganda Lake, has been tried out and is now ready for steady use, supplying 500 horsepower.

KERR LAKE (Cobalt)—Company is now working with its own compressor as power companies report a shortage of air. Pumping of mud out of Kerr Lake is making but slow progress, owing to lack of power. Production is being maintained at a rate sufficient to pay dividends.

Saskatchewan

BEAVER LAKE—This company has a vein 4½ ft. wide which has been stripped for 250 ft. It has let a contract for sinking several shafts to determine extent of ore before putting in a mining plant.

MEXICO

Jalisco

FOREIGNERS KILLED AT HOSTOTIPAQUILLO proved to be C. B. Hoadley, American, and G. E. Williams, British. They were killed by Mexicans at the El Favor mine. Dispatch said that Hoadley and Williams were stabbed to death and mutilated by enraged Mexicans, after foreign staff in charge of mines had endeavored to search native laborers to trace silver bars stolen from the mines. Foreigners were attacked while search was in progress, and Hoadley and Williams gave up their weapons, believing they would be spared. Both were immediately stabbed. All other foreigners were placed in jail, but afterward were released.

CHOSEN

SEOUL MINING CO. (Pyeng Yang)—Electric plant, it is expected, will be completed by September, 1914. It will contain two 1000-kw. Westinghouse-Parson's turbo-generator sets, developing three-phase, 60-cycle current at 2200 volts. Equipment includes two Westinghouse surface condensers, and six Heine water-tube boilers with 2255 sq.ft. of heating surface each and rated at 225 hp., fitted with superheaters and Babcock & Wilcox chain stokers. Pumps will be motor driven, a 12-ton crane will be installed, and current will be transmitted over 52-mile line from Pyeng Yang to mine at 44,000 volts. The electric plant buildings are steel framed and of reinforced concrete.

The Market Report

METAL MARKETS

NEW YORK—May 20

The metal markets have been rather more active and slightly stronger than in the preceding week. Price changes have not been large.

Copper, Tin, Lead and Zinc

Copper—A moderately large business has been transacted during the last week, both for domestic and foreign delivery. Some domestic consumers have bought million-pound lots, which, in view of the previous stagnation, is encouraging. However, all of the business during the last week has been done at relatively low prices. The largest business in the early part of the week was reported at 14c., cash, New York; during the latter part 14¼c., delivered, usual terms, equivalent to about 14.10c., cash, New York, was realized, but at the same time business was done at lower prices. All sellers were offering at 14¼c., and up to the close there was no evidence of any disposition to raise the price, the producers and agencies freely supplying all the copper that was wanted.

Some small business in Lake copper was done at 14.25@14.30c., basis cash, New York.

The average of electrolytic quotations for the week was 14.029 cents.

The London market for standard copper has been strong. On Thursday, May 14, spot was £63 and three months £63 12s. 6d. It gradually advanced until at the close on Wednesday, May 20, spot was quoted at £63 7s. 6d., and three months £64 per ton.

Base price of copper sheets was decreased ¼c. on May 14, and is now 19½c. per lb. for hot rolled and 20½c. for cold rolled. The usual extras are charged and higher prices for small quantities. Copper wire is 15@15¼c. per lb., carload lots at mill.

Copper exports from New York for the week were 8434 long tons. Our special correspondent reports exports from Baltimore for the week at 1427 tons.

Visible Stocks of Copper in Europe, May 15, are reported as follows: Great Britain, 11,870; France, 3590; Rotterdam, 3200; Hamburg, 4190; Bremen, 1110; other European ports, 650; total, 24,610 long tons, or 55,126,400 lb. This is an increase of 1230 tons over the Apr. 30 report. In addition to the stocks given 2220 tons are reported afloat from Chile and 5100 tons from Australia, making, with the stocks, a total of 31,930 tons.

Tin—While the improvement in the London market continued during all of last week, consumptive inquiry in this market was not stimulated thereby. Consumers did not trust the advance, and the correctness of their judgment was proven by the severe decline, which set in in the beginning of this week. The market on Monday opened at a decline of over £6, which was followed by a further drop of £1 each on May 19 and 20. At this lower level, some good business was done and some future orders were placed by consumers. The market closes steady at £149 for spot and £150 15s. for three months, and about 33c. for May tin here.

Lead—The market has been active and firm. Prompt and near-by metal has been sold on the basis of 3.80@3.82½c., St. Louis. Some important producers have filled their order books for this month and are disinclined to sell ahead, looking for an advance in the price.

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

Spelter—A considerable tonnage is reported sold at 4.92½@4.97½c., St. Louis. A St. Louis dealer reports: "Spelter is strong as far as sellers are concerned, but very dull from a buying point of view. Consumers claim they are well stocked and do not believe in present prices. We call the market 5@5.05c. sellers, but spelter is not salable on a large scale above 4.95@4.97½c." A leading consumer is said to claim that he can buy thousand-ton lots at 4.95c. The trouble with spelter is that there is still too big an unsold stock.

The London market is unchanged, good ordinaries being quoted at £21 7s. 6d., and specials 15s. higher.

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

Foreign Trade of Great Britain in Metals other than iron and steel four months ended Apr. 30, in long tons:

	Imports		Exports	
Metals:	1913	1914	1913	1914
Copper	46,042	57,527	23,813	22,312
Tin	15,467	16,359	14,854	14,935
Lead	73,507	77,265	19,565	20,066
Zinc	46,211	45,269	3,125	3,692
Quicksilver	951	773	408	282
Minor metals	2,864	3,099	10,159	8,959
Ores, etc.				
Tin ore and concentrates	10,947	14,050	.....	.....
Pyrites	314,473	315,186	.....	.....

Copper includes contents of ore and matte imported. Exports include reëxports of foreign material.

DAILY PRICES OF METALS

NEW YORK

May	Sterling Exchange	Silver, Cts. per Oz.	Copper: Electrolytic, Cts. per Lb.	Tin: Cts. per Lb.	Lead: New York, Cts. per Lb.	Lead: St. Louis, Cts. per Lb.	Zinc: New York, Cts. per Lb.	Zinc: St. Louis, Cts. per Lb.
14	4.8810	58⅜	13.95 @14.05	34	3.90	3.80 @3.82½	5.07½ @5.10	4.92½ @4.95
15	4.8815	58⅜	13.95 @14.05	34½	3.90	3.80 @3.82½	5.07½ @5.10	4.92½ @4.95
16	4.8820	58½	13.95 @14.05	34½	3.90	3.80 @3.82½	5.07½ @5.10	4.92½ @4.95
18	4.8815	58½	14.00 @14.05	33¼	3.90	3.80 @3.82½	5.10 @5.12½	4.95 @4.97½
19	4.8830	58	14.05 @14.10	33	3.90	3.80 @3.82½	5.10 @5.12½	4.95 @4.97½
20	4.8840	57⅞	14.05 @14.10	33	3.90	3.80 @3.82½	5.10 @5.12½	4.95 @4.97½

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

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumer. To reduce to New York basis we deduct an average of 0.15c. representing delivery charges. The price of electrolytic cathodes is usually 0.05 to 0.10c. below that of electrolytic; of casting copper 0.15 to 0.25c. below. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Western brands. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb., are: St. Louis-New York, 15½c.; St. Louis-Chicago, 6c.; St. Louis-Pittsburgh, 12½c.; New York-Bremen or Rotterdam, 15c.; New York-Havre, 16@17½c.; New York-London, 16c.; New York-Hamburg, 18c.; New York-Trieste, 22c.

LONDON

May	Silver	Copper: Spot £ per Ton	Copper: Spot Cts. per Lb.	Copper: 3 Mos.	Copper: Best Sel'td	Tin: Spot	Tin: 3 Mos.	Lead: £ per Ton	Lead: Cts. per Lb.	Zinc: £ per Ton	Zinc: Cts. per Lb.
14	26 15/16	63	13.69	63⅜	67⅜	153¾	155½	18⅜	3.99	21⅜	4.64
15	26 15/16	63 3/16	13.73	63 11/16	68	156½	158	18½	4.02	21⅜	4.64
16	26⅞	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	26⅞	63 3/16	13.73	63 11/16	67⅞	150¼	152	18¾	4.07	21⅜	4.64
19	26⅞	63 5/16	13.76	63 11/16	68	149¼	151	18⅞	4.10	21⅜	4.64
20	26⅞	63⅜	13.78	64	68	149	150¼	19	4.13	21⅜	4.64

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latte being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.2 = £25 = 5.44c.; £70 = 15.22c. Variations, £1 = 0.21⅞c.

Other Metals

Aluminum—Business is quite active but there is considerable competition for orders and prices are a little weaker. No. 1 ingots have been offered at 17½@18c. per lb., New York.

Antimony—Business is quiet, with little doing in futures. Quotations for ordinary antimony—Chinese, Hungarian, etc.—are 5.75@6c. per lb. Special brands are a little weaker and 6.90@7.40c. is asked.

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

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

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

Gold, Silver and Platinum

Gold—Early in the week a premium on gold was still charged on the open market in London, 77s. 9⅞d. being charged for bars. France and Russia again took most of the gold offered. Later the premium fell, and the price of bars was 77s. 9¼d. to 77s. 9½d. per oz. In New York another $2,000,000 was taken for export to Paris.

Imports of gold into Great Britain, four months ended Apr. 30, were £17,781,036; exports, £14,939,382; excess of imports, £2,841,654, which is a decrease of £1,776,566 from last year.

Iridium—The price of this metal is unchanged, dealers asking $75@78 per oz., New York.

Platinum—The market is quiet and unchanged here. Dealers ask $43@44 per oz. for refined platinum, and $46@49 per oz. for hard metal.

French papers report that the Compagnie du Platine has closed a large contract for refined metal at 7500 fr. per kg., which is equivalent to $45 per oz. The deliveries are to run over three months.

Silver—The market has been a sagging one the past week on the limited demand and a continuance of large shipments notwithstanding the Mexican situation.

China has been a moderate seller and India has been only buying on recessions in price. Market closes steadier at 26½d. in London.

Shipments of silver from London to the East, Jan. 1 to May 7, as reported by Mesrs. Pixley & Abell:

	1913	1914	Changes
India	£2,682,300	£2,726,000	I. £43,700
China	216,000	40,000	D. 176,000
Total	£2,898,300	£2,766,000	D. £132,300

Imports of silver into Great Britain, four months ended Apr. 30, were valued at £4,114,473; exports, £5,518,436; excess of exports, £1,403,963. Of the imports £2,864,727 are credited to the United States, which is a decrease of £1,383,392 from last year.

Gold and Silver Movement in the United States, four months ended Apr. 30, as reported by the Department of Commerce:

	Gold		Silver	
	1913	1914	1913	1914
Exports	$50,697,809	$19,072,269	$23,260,767	$16,026,149
Imports	19,961,361	24,957,169	12,673,446	9,013,097
Excess	E.$30,736,448	I. $5,884,900	E.$10,587,321	E.$7,013,052

Exports of merchandise this year were valued at $727,854,834; imports, $658,209,727; excess of exports, $69,645,107, making, with the gold and silver, a total of $70,773,259 as the net export balance.

Zinc and Lead Ore Markets

JOPLIN, MO.—May 16

Blende sold no higher than $43, though there was an advance of $1 to $1.50 per ton on all grades. The assay base price ranged from $38 to $41, with the bulk of the ore sold on a $40 base, and the metal base ranged from $36 to $39 per ton of 60% zinc. Calamine sold strong at $20@22.50 per ton of 40% zinc. The average of all grades of zinc is $37.88 per ton. Lead sold as high as $49.50 on a base price of $46 per ton of 80% metal content, and the average of all grades is $46.12 per ton.

A decided falling off in the Western production of zinc ore is announced as the reason of the strength in the local market. One buyer asserted that there was no Western production of sulphide ore aside from the Butte territory, and that is all contracted, while the carbonate production was decidedly small. With no ore coming in from Mexico the situation promises an early shortage in ore production.

SHIPMENTS WEEK ENDED MAY 9

	Blende	Calamine	Lead	Value
Totals this week...	10,868,360	194,500	1,770,300	$250,320
Totals 20 weeks....	210,756,520	13,019,110	35,926,160	$5,157,900

Blende value, the week, $207,370; 20 weeks, $4,139,395.
Calamine value, the week, $2140; 20 weeks, $146,425.
Lead value, the week, $40,810; 20 weeks, $872,085.

PLATTEVILLE, WIS.—May 16

The base price paid this week for 60% zinc ore was, $39@39.50 per ton. The base price paid for 80% lead ore was $48 per ton.

SHIPMENTS WEEK ENDED MAY 16

	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Week	2,540,740	149,900	835,300
Year	56,439,340	2,373,700	17,485,530

Shipped during week to separating plants, 3,082,930 lb. zinc ore.

IRON TRADE REVIEW

NEW YORK—May 20

The market begins to show rather a better undertone and there is some anticipation of an early improvement in orders.

Some lines are exceptionally busy. The tinplate mills are full of work and more orders are reported coming. The structural people are getting quite a number of contracts, though at low prices. Small building is reported more active and the jobbing trade is hopeful. Other lines are less active.

The pig-iron market is improving a little. Basic iron is in considerable demand both East and West, and some good orders are reported. Prices are unchanged.

PITTSBURGH—May 19

It is generally claimed that there is an improvement in sentiment in the iron and steel trade, though this is not accompanied by any increase in the volume of business, apart from the fact that basic pig iron both east and west is somewhat more active.

Operations at steel mills are down to an average of 50 or 55% of capacity, and the steel interests are blowing out more blast furnaces to harmonize their pig iron production with their steel output.

After a period of relative steadiness steel prices have definitely weakened in the past week or ten days. Plates are openly done at 1.12½c. on desirable orders, and the same is true of steel bars, representing a decline of 50 cents a ton. Competition is particularly keen in these two lines, shapes holding up quote well at 1.15c. Chicago mills are making delivered prices on both plates and bars equivalent to 1.10c., f.o.b. maker's mill, Pittsburgh, and it is possible that some of the Pittsburgh district mills are meeting this competition, though for near-by trade they are able to maintain a better level.

The American Sheet & Tin Plate Co. has booked two important orders from parts of the former Standard Oil Co., involving more than 500,000 boxes of tinplate for second-half delivery in connection with the oil export trade. Similar orders were taken last December for the first half of this year, but at better prices, since the Welsh mills were then more fully engaged. The American mills are operating almost at capacity.

Sheets are fairly steady at 1.85c. for black and 2.80c. for galvanized. Rivets have declined to 1.60c. and 1.70c. respectively for structural and boiler rivets, while shafting has sold as low as 66% off list.

Pig Iron—The Valley furnaces appear firm in the matter of prices, at the following figures: Bessemer, $14; basic, $13; malleable, $13.25; foundry, $13.25@13.50; forge, $12.75, at Valley furnaces, 90c. higher delivered Pittsburgh.

Ferromanganese—The open reduction of $1 a ton in the price of English and German ferromanganese to $38, Baltimore, has not brought out any business.

Steel—The market continues very quiet, with little negotiating for third quarter, and no inquiry for earlier deliveries. Prices are largely nominal at $20 for billets, $21 for sheet bars and $26 for rods, Pittsburgh or Youngstown.

FOREIGN NOTES

The British Blast Furnaces report for the first quarter shows that on Mar. 31 there were 300 furnaces in blast, against 293 on Dec. 31, 1913. The average number of furnaces active during the quarter was 295, against 318 in the previous quarter.

IRON ORE

Statistics collected by the "Marine Review," give the winter movement of Lake Superior ore as follows:

	1912-13	1913-14	Changes
Stocks on docks, Dec. 1	9,497,168	9,261,676	D. 235,492
Winter shipments to furnace	3,790,691	3,341,519	D. 449,172
Stocks, May 1	5,706,477	5,920,157	I. 213,680

The amount shipped to furnaces during the navigation season of 1913 was 35,747,800 tons. The entire movement of ore to furnaces over Lake Erie docks during the year ended May 1, 1914, was, therefore, 39,089,319 tons.

Shipments of ore from the Lake Superior region by lake in April were as follows:

Port	1913	1914	Changes
Escanaba	217,029	110,729	D. 106,300
Marquette	37,494	.....	D. 37,494
Ashland	53,481	40,838	D. 12,643
Superior	252,875	62,338	D. 190,537
Duluth	160,372	.....	D. 160,372
Two Harbors	145,136	55,781	D. 89,355
Total	866,387	269,686	D. 596,701

As was generally expected, the April movement this year was light; the May shipments are also small so far. Marquette and Duluth shipped no ore in April.

COKE

Rather more demand for coke is reported with some orders closed for fair quantities. Production is not increasing, however, and shipments show little change.

Connellsville Coke—It is just learned that several contracts for Connellsville furnace coke for delivery beginning July 1 have been quietly booked by one selling interest, at concessions from $2. An arrangement was closed May 19, by which one consumer takes coke at the rate of 10,000 tons a month at not over $1.85, shipments to be discontinued when desired.

Fuel Production of German Empire, three months ended Mar. 31, in metric tons:

	1913	1914	Changes
Coal	47,558,449	47,981,665	I. 423,216
Brown coal	20,917,977	22,724,375	I. 1,806,398
Coke	7,991,860	8,018,811	I. 26,951
Briquettes	6,484,485	7,170,565	I. 686,080

Of the briquettes reported this year 5,627,381 tons were made from brown coal, or lignite.

Foreign Coal Trade of Austria for the year, in metric tons:

	Imports	Exports	Excess
Coal	13,689,149	708,975	Imp. 12,980,174
Brown coal	33,097	7,016,606	Exp. 6,983,509
Coke	933,669	369,802	Imp. 563,867
Briquettes	263,241	142,169	Imp. 121,072
Total	14,919,156	8,237,552	Imp. 6,681,604
Total, 1912	12,987,887	8,597,118	Imp. 4,390,769

Of the imports reported in 1913 the United States furnished 37,688 tons of coal and 723 tons of coke.

CHEMICALS

NEW YORK—May 20

The general market remains quiet with only moderate buying reported.

Arsenic—Business is moderate only. The speculative features have been entirely eliminated and the price is steady at $3 per 100 lb. for both spot and futures.

Copper Sulphate—Business remains on a fair scale. Prices are lower, $4.65 per 100 lb. being quoted for carload lots, and $4.90 per 100 lb. for smaller parcels.

Nitrate of Soda—The market is quiet, as is usual at this season. Quotations are 2.22½c. per lb. for spot; 2.20c. for May; 2.17¾c. for June; 2.15c. for deliveries from July forward.

Pyrites—Imports at Baltimore for the past week included 4001 tons of pyrites from Huelva, Spain.

Metal and Mineral Exports of Spain, two months ended Feb. 28, as reported by "Revista Minera," in metric tons:

	Metals		Ores	
	1913	1914	1913	1914
Iron	1,570	611	1,624,299	1,358,145
Copper	1,915	2,226	29,245	21,615
Copper precipitate	867	1,686	.....	.....
Lead	31,129	28,137	244	510
Zinc	19	487	20,781	16,189
Quicksilver	417	410	.....	.....
Manganese	.....	.....	5,296	2,757
Pyrites	.....	.....	519,375	471,754

Exports of salt were 77,446 tons in 1913, and 92,322 in 1914; an increase of 14,876 tons this year.

PETROLEUM

Exports of mineral oils from the United States in April were 219,977,769 gal. For the four months ended April 30 the total exports were 606,333,384 gal. in 1913, and 706,322,149 gal. in 1914; an increase of 99,988,765 gal., or 16.5%, this year.

COPPER SMELTER'S REPORTS

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

	December	January	February	March	April
Alaska shipments	3,104,155	2,701,258	1,803,579	2,069,960	1,279,537
Anaconda	25,100,000	24,400,000	21,300,000	23,800,000	22,900,000
Arizona, Ltd	2,920,000	3,474,000	3,062,000	3,286,000	3,570,000
Copper Queen	9,033,459	8,796,358	6,987,366	7,637,042	7,562,723
Calumet & Ariz	5,230,000	5,975,000	5,596,850	5,875,000	5 450,000
Chino	4,390,018	6,488,220	5,642,426	5,399,814	.....
Detroit	2,021,034	1,590,681	1,814,214	1,973,725	1,790,926
East Butte	1,324,560	1,256,000	1,193,960	1,546,180	.....
Giroux	197,649	148,411	90,017	287,980	.....
Mason Valley	1.372 000	944,000	1,254,000	1,250,000	.....
Mammoth	1,400,000	1,625,000	1,100,000	1,800,000	1,850,000
Nevada Con	5,343,862	5,791,122	4,588,243	5,218,257	.....
Ohio	722,940	700,728	582,000	597,520	610,518
Old Dominion	2,613,039	2,797,000	3,066,000	2,997,000	2,779,000
Itay	5.075,202	5,'05.000	5,432,000	6,036,908	.....
Shannon	1,078,000	937,432	903,761	1,082,000	1,012,000
South Utah	242,362	275,569	333.874	406,381	.....
Tennessee	1,700,000	1,474.890	1,232,812	1,262,184	1,370,800
United Verde*	3,000,000	3,000,000	2,700,000	3,100,000	.....
Utah Copper Co.	10,306,646	10,329,564	9,207,111	12,323,493	12,739,757
Lake Superior*	5,600,000	7,400,000	8.500,000	11,000,000	13,000,000
Non-rep. mines*	6,250,000	6,200,000	5 600,000	6,200,000	6,000.000
Total prod	98,024,926	102,100,233	92,290,213	102,536,667	.....
Imp., bars, etc	23,578,938	24,504,249	19,918,448	22,676,605	.....
Total blister	121,603.864	126,604,482	112,208,661	125.213,272	.....
Imp. ore & matte	12,205,187	10,893,969	9,713,164	7,029,646	.....
Total Amer	133,809,053	137,498,451	121,921,825	132,242,918	.....
Miami†	3,210,000	3,258,950	3,316,482	3,361,100	3,130,772
Shattuck-Arizona	1,050,781	1,276,636	1,134,480	1,136,458	1,386,594
Brit. Col. Cos.:					
British Col. Cop.	795,004	607,930	.....	.....	.....
Granby	1,605,382	1,793,840	1,661,212	1,775,852	.....
Mexican Cos.:					
Boleo†	2,315,040	2,369,920	1,984,080	2,535,680	2,204,720
Cananea	3,646,000	3,460,000	2,688,000	4,260,000	2,632,000
Moctezuma	3,139,613	3,024,556	2,642,543	2,882,884	2,654,926
Other Foreign:					
Braden, Chile	2,122,000	2,430,000	2,362,000	1,810,000	2,720,000
Cape Cop., S. Af.	683,200	519,680	459,200	.....	.....
Kyshtim, Russia	1.742,720	1,559,040	1,534,400	.....	.....
Spassky, Russia	900,480	902,720	902,720	896,000	.....
Exports from					
Chile	10,640,000	5,488,000	6,720,000	6,944,000	9,072,000
Australia	6,720,000	5,712,000	7,952,000	8,176,000	7,168,000
Arrivals-Europe‡	13,787,200	8,599,360	18,354,560	17,572,800	17,299,520

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

Month	United States: U.S.Refin'y Production	United States: Deliveries, Domestic	United States: Deliveries, for Export	Visible Stocks: United States	Visible Stocks: Europe	Visible Stocks: Total
Year, 1912	1,581,920,287	819,665,948	746,396,452	.....	.....	.....
V, '13	141,319,416	81,108,321	68,285,978	75,549,108	85,948,800	161,497,908
VI	121,860,853	68,362,571	68,067,901	67,474,225	77,235,200	144,709,425
VII	138,074,602	58,904,192	78,480,071	52,814,606	77,904,000	124,808,606
VIII	131,632,362	73,649,801	73,263,469	53,594,945	66,420,480	120,015,385
IX	131,401,229	66,836,897	73,085,275	38,314,037	63,716,800	102,030,837
X	139,070,481	68,173,720	68,123,473	29,793,094	53,625,600	83,418,692
XI	134,087,708	48,656,858	70,067,803	32,566,382	48,787,200	81,353,582
XII	138,990,421	21,938,570	73,542,413	47,929,429	46,592,000	94,521,429
Yr., '13	1,622,450,829	767,261,760	869,062,784	.....	.....	.....
I, 1914	131,770.274	47,956.955	87.955,501	91,438,867	53,916,800	145,355.667
II	122,561,007	47,586,657	83,899,183	87,296,685	50.108,800	137,405,485
III	145,651,982	69,852,349	89,562,166	78,371,852	47,376,000	125,747,852
IV	151,500,531	63.427,633	82,345,216	64,609,319	46,435,200	111.044,519
V	.....	.....	.....	70,337,001	52,371,200	122,708.201

Note—Visible supplies in Europe do not include copper afloat.

Assessments

Company	Delinq.	Sale	Amt.
Belcher, Nev.	May 4	May 26	$0.10
Booth, Nev.	May 11	June 15	0.02
Bullion Beck & Champion, Utah	Apr. 24	May 25	0.20
Cedar Creek, Ida.	Apr. 27	May 26	0.01
Challenge, Nev.	May 12	June 2	0.05
Davis-Daly, Mont.	.....	June 1	0.25
Ely Gibraltar, Nev.	May 18	June 15	0.0025
Emerald, Utah.	May 15	June 6	0.13
Grutli, Utah.	May 16	June 3	0.002
Hale & Norcross, Nev.	May 19	June 9	0.03
Idaho-Nevada, Ida.	May 7	June 1	0.001
Keweenaw, Mich.	.....	.....	1.00
Nabob, Ida.	May 13	June 8	0.005
Overman, Nev.	May 8	May 28	0.05
Rescue Eula, Nev.	Apr. 21	May 27	0.01
Rico Argentine, Ida.	May 20	June 5	0.01
Samson, Ida. postponed	.....	May 28	0.002
Sierra Nevada, Nev.	May 25	June 15	0.10
Slavonian, Ida.	Apr. 30	May 30	0.002
Snowshoe, Ida.	Apr. 28	May 28	0.002
Snowy Peak, Ida.	Apr. 29	June 6	0.01
Springfield, Ida.	May 18	June 15	0.002
St. Mary's, Utah.	.....	May 25	0.02
Sunset, Ida.	May 12	June 6	0.002
Syndicate, Utah.	May 22	June 13	0.0005
Tar Baby, Utah.	May 1	June 1	0.005
Tintic Standard, Utah.	May 11	June 1	0.005
Victoria, Mich.	Apr. 15	May 24	1.00
Wallace, Ida.	May 15	June 5	0.0025
Wisconsin, Ida. post'd.	.....	June 5	0.003

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1912	1913	1914	1912	1913	1914
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61.642	57.506	27.190	28.357	26.573
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59.207	59.490	58.519	28.284	27.416	26.958
May	60.880	60.361	.....	28.038	27.825	.....
June	61.290	58.990	.....	28.215	27.199	.....
July	60.654	58.721	.....	27.919	27.074	.....
August	61.606	59.293	.....	28.375	27.335	.....
September	63.078	60.640	.....	29.088	27.986	.....
October	63.471	60.793	.....	29.299	28.083	.....
November	62.792	58.995	.....	29.012	27.263	.....
December	63.365	57.760	.....	29.320	26.720	.....
Year	60.835	59.791	.....	28.042	27.576	.....

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

COPPER

Mouth	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16.767	14.772	71.741	64.304
February	14.971	14.491	15.253	14.929	65.519	65.259
March	14.713	14.131	14.930	14.625	65.329	64.276
April	15.291	14.211	15.565	14.563	68.111	64.747
May	15.436	.....	15.738	.....	68.807	.....
June	14.672	.....	14.871	.....	67.140	.....
July	14.190	.....	14.563	.....	64.166	.....
August	15.400	.....	15.904	.....	69.200	.....
September	16.328	.....	16.799	.....	73.125	.....
October	16.337	.....	16.913	.....	73.383	.....
November	15.182	.....	16.022	.....	68.275	.....
December	14.224	.....	14.904	.....	65.223	.....
Year	15.269	.....	15.686	.....	68.335	.....

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

TIN

Month	New York		London	
	1913	1914	1913	1913
January	50.298	37.779	238.273	171.905
February	48.766	39.830	220.140	181.556
March	46.832	38.038	213.615	173.619
April	49.115	36.154	224.159	163.963
May	49.038	.....	224.143	.....
June	44.820	.....	207.208	.....
July	40.260	.....	183.511	.....
August	41.582	.....	188.731	.....
September	42.410	.....	193.074	.....
October	40.462	.....	184.837	.....
November	39.810	.....	180.869	.....
December	37.635	.....	171.786	.....
Av. year	44.252	.....	206.279	.....

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

LEAD

Month	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4.321	4.111	4.171	4.011	17.114	19.665
February	4.325	4.048	4.175	3.937	16.550	19.606
March	4.327	3.970	4.177	3.850	15.977	19.651
April	4.381	3.810	4.242	3.688	17.597	18.225
May	4.342	.....	4.226	.....	18.923	.....
June	4.325	.....	4.190	.....	20.226	.....
July	4.353	.....	4.223	.....	20.038	.....
August	4.624	.....	4.550	.....	20.406	.....
September	4.698	.....	4.579	.....	20.648	.....
October	4.402	.....	4.253	.....	20.302	.....
November	4.293	.....	4.146	.....	19.334	.....
December	4.047	.....	3.929	.....	17.798	.....
Year	4.370	.....	4.238	.....	18.743	.....

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

SPELTER

Month	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
Jauuary	6.931	5.262	6.854	5.112	26.114	21.533
February	6.239	5.377	6.089	5.228	25.338	21.413
March	6.078	5.250	5.926	5 100	24.605	21.460
April	5.641	5.113	5.491	4.963	25.313	21.569
May	5.406	.....	5.256	.....	24.583	.....
June	5.124	.....	4.974	.....	22.143	.....
July	5.278	.....	5.128	.....	20.592	.....
August	5.658	.....	5.508	.....	20.706	.....
September	5.694	.....	5.444	.....	21.148	.....
October	5.340	.....	5.188	.....	20.614	.....
November	5.229	.....	5.083	.....	20.581	.....
December	5.156	.....	5.004	.....	21.214	.....
Year	5.648	.....	5.504	.....	22.746	.....

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

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1913	1914	1913	1914	1913	1914
January	$18.15	$14.94	$17.35	$13.23	$18.59	$13.90
February	18.15	15.06	17.22	14.12	18.13	14.09
March	18.15	15 07	16.96	13.94	17.53	14.18
April	17.90	14.90	16.71	13.90	16.40	14.10
May	17.68	.....	15.80	.....	15.40	.....
June	17.14	.....	15.40	.....	15.10	.....
July	16.31	.....	15.13	.....	14.74	.....
August	16.63	.....	15.00	.....	14.88	.....
September	16.65	.....	15.04	.....	14.93	.....
October	16.60	.....	14.61	.....	14.80	.....
November	16.03	.....	13.91	.....	14.40	.....
December	15.71	.....	13.71	.....	14.28	.....
Year	$17.09	.....	$15.57	.....	$15.77	.....

STOCK QUOTATIONS

COLO. SPRINGS May 19

Name of Comp.	Bid.
Acacia	.02¼
Cripple Cr'k Con.	.006
C. K. & N.	.05½
Doctor Jack Pot	.05½
Elkton Con.	.40
El Paso	1.40
Findlay	‡.01½
Gold Dollar	.03
Gold Sovereign	.02
Golden Cycle	‡1.50
Isabella	.10½
Jack Pot	.06
Jennie Sample	.04
Jerry Johnson	.03
Lexington	.004
Old Gold	.01½
Mary McKinney	.44
Pharmacist	.009
Portland	1.09
Vindicator	.93

SALT LAKE May 15

Name of Comp.	Bid.
Beck Tunnel	.04½
Black Jack	.06½
Cedar Talisman	.00½
Colorado Mining	.10
Crown Point	.02½
Daly-Judge	5.00
Gold Chain	.12
Grand Central	.60
Iron Blossom	1.31½
Little Bell	.10
Lower Mammoth	.01½
Mason Valley	2.12½
May Day	.06½
Nevada Hills	.30
Prince Con.	.16
Silver King Coal'n	3.17½
Silver King Cons.	2.00
Sioux Con.	.03
Uncle Sam	.03
Yankee	.01½

TORONTO May 19

Name of Comp.	Bid.	Name of Comp.	Bid.
Bailey	.02½	Foley O'Brien	.17
Conlagas	7.30	Hollinger	5.90
Peterson Lake	.40	Imperial	.01½
Right of Way	.04½	Jupiter	.12½
T. & Hudson Bay	75.00	Pearl Lake	.05½
Timiskaming	.16½	Porcu. Gold	.08½
Wettlaufer-Lor	.05½	Preston E. D.	.01½
Big Dome	9.40	Rea	.15
Crown Chartered	‡.00½	Swastika	.01½
Dome Exten.	.08½	West Dome	‡.10

SAN FRANCISCO May 19

Name of Comp.	Bid.	Name of Comp.	Bid.
Comstock Stocks		Misc. Nev. & Cal.	
Alta	.09	Belmont	7.20
Belcher	.30	Jim Butler	.99
Best & Belcher	.03	MacNamara	.03
Caledonia	.48	Midway	.32
Challenge Con.	.08	Mont.-Tonopah	.77
Chollar	.05	North Star	.34
Confidence	.20	West End Con.	.84
Con. Virginia	.08	Atlanta	.17
Crown Point (Nev.)	.24	Booth	.05
Gould & Curry	.02	C.O.D. Con	.04
Hale & Norcross	.03	Comb. Frac.	.06
Mexican	.85	Jumbo Extension	.21½
Occidental	.68	Pitts.-Silver Peak	.32
Ophir	.11	Round Mountain	.24
Overman	.23	Sandstorm Kendall	.13
Potosi	.01	Silver Pick	.04
Savage	.08	Argonaut	2.80
Sierra Nevada	.07	Bunker Hill	‡1.90
Union Con.	.07	Central Eureka	.30
Yellow Jacket	.19	So. Eureka	1.25

N. Y. EXCH. May 19

Name of Comp.	Clg.
Amalgamated	73½
Am.Sm.&Ref. com	64¼
Am. Sm. & Ref., pf.	100¼
Am. Sm. Sec., pf. B.	80½
Anaconda	32¼
Batopilas Min.	⅛
Bethlehem Steel, pf.	85½
Chino	42
Colo. Fuel & Iron	27¼
Federal M. & S., pf.	33½
Great Nor., ore., ctf.	33¼
Guggen. Exp.	54¼
Homestake	116
Inspiration Con.	17
Mex. Petroleum	62
Miami Copper	22½
Nat'l Lead, com.	47
National Lead, pf.	108½
Nev. Consol.	14¼
Phelps Dodge	179
Quicksilver, pf.	2½
Ray Con.	21¼
Republic I&S, com.	23½
Republic I&S, pf.	87½
SlossSheffi'd, com.	28
Sloss Sheffield, pf.	83½
Tennessee Copper	35
Utah Copper	57¼
U. S. Steel, con.	63½
U. S. Steel, pf.	110

N. Y. CURB May 19

Name of Comp.	Clg.
Beaver Con.	.29
Big Four	.06
Boston Montana	8½
Braden Copper	8
B. C. Copper	1¼
Buffalo Mines	1½
Can. Cop. Corpn	2¼
Can. G. & S.	.08½
Caribou	.68
Chambers Ferland	.16
Chile Cop., 7s	102
Con. Ariz. Sm.	1/16
Coppermines Cons	1½
Davis-Daly	9/16
Diam'field-Daisy	.05½
Ely Con.	.03
Florence	.53
Gold Hill Con.	⅛
Goldfield Con.	1 7/16
Greene Cananea	34
Greenwater	.07½
Internat. S. & R.	‡1.05
Kerr Lake	4 7/16
La Rose	1 7/16
McKinley-Dar-Sa.	.70
Mines of Am.	3½
New Utah Bingham	‡.68
Nipissing Mines	6¼
Ohio Copper	5/16
Oro	.10½
Puebla S. & R.	2¼
Stand'd Oil of N.J.	411
Stand'd Silver Lead	1¼
Stewart	1 9/16
Stewart Min.T't C.	1 7/16
Tonopah	6½
Tonopah Ex.	1 9/16
Tonopah Merger	.57
Tularosa	.25
West End Ex.	.04½
Yukon Gold	2¼

LONDON May 12

Name of Comp.	Clg.
Camp Bird	£0 11s 0d
El Oro	‡0 12 3
Esperanza	‡0 15 7½
Mexico Mines, ..	‡4 7 6
Oroville	0 12 6
Santa Gert'dis.	‡0 13 9
Stratton's	0 0 6
Tomboy	1 0 0

BOSTON EXCH May 19

Name of Comp.	Clg.
Adventure	1½
Ahmeek	270
Alaska Gold M	28½
Algomah	.90
Allouez	40½
Am. Zinc	16¼
Ariz. Com., ctfs.	4¼
Bonanza	.51
Butte & Balak	2¼
Calumet & Ariz.	66½
Calumet & Hecla	425
Centennial	16¼
Cliff	1 1/16
Copper Range	37½
Daly West	1½
East Butte	10½
Franklin	5½
Granby	82½
Hancock	15½
Hedley Gold	‡15
Helvetia	.25
Indiana	5½
Island Cr'k, com.	49
Island Cr'k, pfd.	85½
Isle Royale	21½
Keweenaw	2¼
Lake	6½
La Salle	4½
Mass.	4¼
Michigan	.50
Mohawk	45
New Arcadian	6¼
New Idria Quick	3½
North Butte	27
North Lake	1½
Oilbway	.99
Old Dominion	48
Osceola	76
Quincy	59
Shannon	5½
Shattuck-Ariz.	24½
Superior	29½
Superior & Bost.	2¼
Tamarack	36
Trinity	3½
Tuolumne	.50
U. S. Smelting	34½
U. S. Smelt'g, pf.	45½
Utah Apex	1¼
Utah Con.	10½
Victoria	2¼
Winona	3½
Wolverine	42
Wyandot	.50

BOSTON CURB May 19

Name of Comp.	Bid
Bingham Mines	.04¼
Boston & Corbin	.28
Boston Ely	.25
Butte & Lon'n Dev.	.40
Cactus	‡.01
Calaveras	1¼
Chief Cons.	.90
Contact Copper	‡.05
Corbin	.99
Cortez	.25
Crown Reserve	1½
Eagle & Blue Bell	1
First Nat. Cop.	1¼
Houghton Copper	2¼
Majestic	.19
Mexican Metals	.13
Moneta Porc	‡.02
Nevada-Douglas	1 1/16
New Baltic	1¼
Oneco	.80
Raven Copper	.13
Smokey Dev.	.25
So. Lake	3½
S. W. Miami	1
Tonopah Victor	.30
Trethewey	.20
United Verde Ext.	.54

‡Last Quotation.