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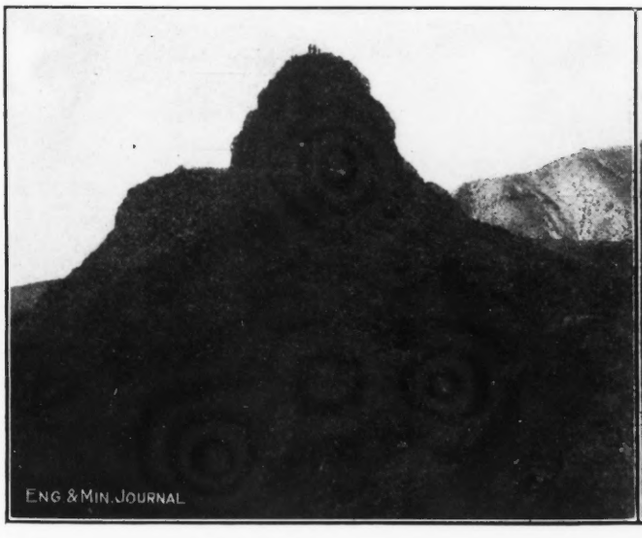
Geology of Fairview, Nevada

By James O. Greenan*

SYNOPSIS—A series of igneous rocks overlying crystalline schists and limestones that have been intruded by granite, has been mineralized by hot solutions ascending the contacts of the several members, resulting in a number of strong veins, oxidized to a depth of 300 ft. and considerably faulted. Similarity with the deposits of Tonopah is pointed out.

The Fairview district is in Churchill County, Nevada, 120 miles east of Reno. The nearest railroad station is Fallon, on the Southern Pacific, 45 miles west of Fairview. Credit for the discovery of the camp is usually given to F. O. Norton and C. K. Jarvis, who made the first locations in the early part of 1906. Reports of the finding of rich float and croppings soon attracted mining men from all parts of the state, with the result that the summer of 1906 saw Fairview added to the list of Nevada's boom camps. For a time there was considerable wildcatting, and the district attained a population of 2000. Within a few years, however, this had dwindled to as many hundred, until, at present, there are but two producing mines in the region, the Nevada Hills, at Fairview, and the Nevada Wonder, at Wonder. Development work is, however, being done on several other promising properties.



Outcrop of "Blout" and Andesite Silicified

Nevada Hills vein glory-hole in right center, rhyolite dike in foreground.

Fairview Peak in the Background

Part of town of Fairview in left foreground, Nevada Hills vein outcrop in left center, Eagle vein outcrop in left middle distance.

Igneous Rocks in Schists and Limestones Intruded by Granite

In this part of Nevada a series of mountain ranges trends north and south with arid valleys between, and occasionally alkali flats. Fairview Peak is an isolated peak on a minor range between the Desatoya and Stillwater ranges. The Fairview district proper is on the western slope of Fairview Peak, at an altitude of 5800 feet.

The important rock types are, without exception, igneous, and appear to rest on a basement complex of pretertiary crystalline schists and limestones, which are intruded by granite. These types are, in order of age, a dacite tuff, earlier andesite, later andesite, tuff and rhyolite. There is also a later series of tuffs and flows on the flanks of Fairview Peak, which is of minor importance. The dacite tuff consists of a thick series of ash-beds and agglomerates varying greatly in physical characteristics. Immediately adjacent to the basement complex it is rather coarse, unstratified tuff, containing granite boulders. This is followed by a much coarser layer, which is overlaid by a series of fine, well stratified ash

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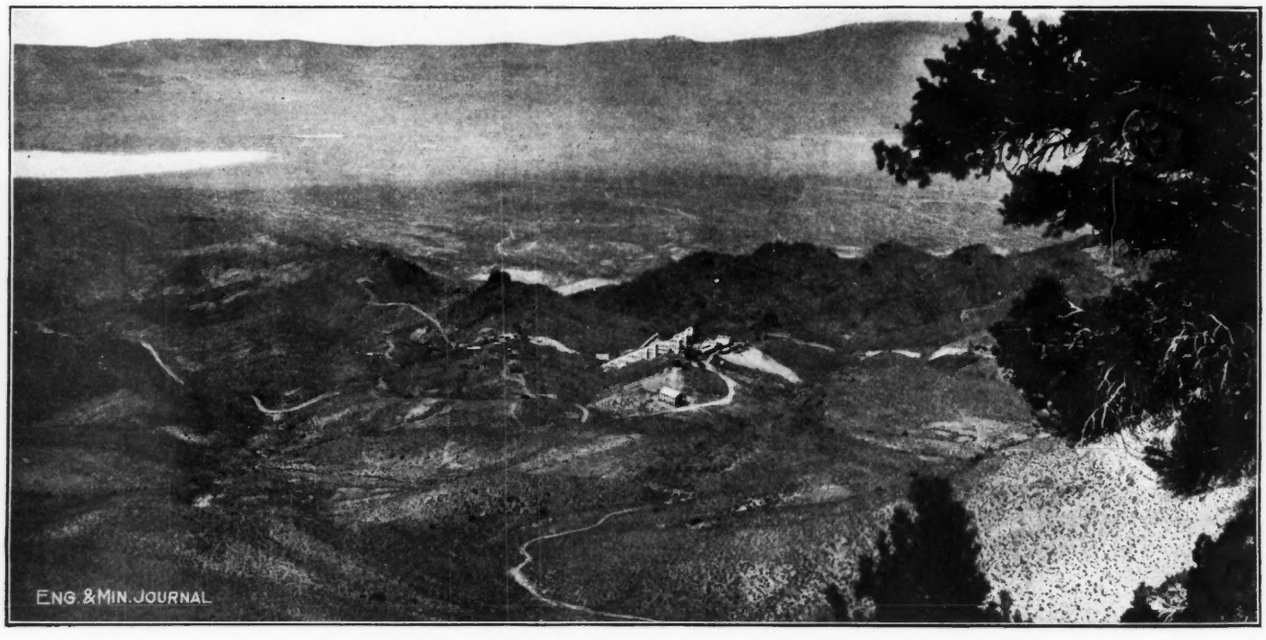
beds, undoubtedly of lake origin. The earlier, or lode andesite, is, as its name indicates, the body in which, or on the borders of which, the important veins of the district occur. Its andesitic character is everywhere apparent, although it tends locally toward a dacite or a trachyte. It is a greenish porphyry, usually containing finely disseminated pyrite, weathers to a light gray or yellow, and was intruded into the older tuff beds as a large, irregularly shaped mass. The later andesite occurs as a surface flow, and is easily distinguished from the lode porphyry by its abundant hornblende and its purplish tint on weathered surfaces. It is overlaid by a second series of tuffs or agglomerates, locally called the "grade tuff" This series is coarser than the former, and is characterized by the presence of large boulders of granite and the earlier volcanics.

All the above mentioned formations are cut by a light-gray rhyolite, which is favorably exposed on Rhyolite Hill as a volcanic plug, sending off an arm to the southward. This same rhyolite is also seen about half a mile further west, where it outcrops as an unusually persistent small dike, in lode andesite for most of its length, and cutting two of the most important veins of the district.



FAIRVIEW DISTRICT FROM FAIRVIEW PEAK, STILLWATER RANGE IN DISTANCE

In left distance, Labou Flat; old town of Fairview now deserted, in left center; Nevada Hills mill and buildings in center; "blout" outcrop at left of mill; Eagle's Nest mine in right center; Dromedary Hump at extreme right.

GEOLOGICAL COMPARISONS WITH TONOPAH

The geologic history of the region is similar to that of Tonopah. In both districts, a pre-tertiary limestone, intruded by granite, is overlaid by tertiary volcanics. The first of these, in Fairview, is tuff of heterogeneous character; Spurr noted "a series of folded gravels, tuffs, lavas, ... ," overlying the paleozoic limestones near Ray, about eight miles north of Tonopah. The ore-bearing body at Fairview is an intruded andesite, while that of Tonopah is a trachytic flow which was for years considered andesitic. In both districts this was followed by a period of mineralization and erosion, after which a later andesite was poured out. Subsequently there appeared a series of rhyolites, dacites and tuffs. This series, in Tonopah, is mineralized, but the veins are of little importance compared with those of the former period. With the exception of small stringers, the lode andesite of Fairview contains the only veins in the district. The analogy, however, is striking throughout the entire geologic column.

The largest vein of the district is the so called "blout" vein, which occurs on the southwesterly contact of the lode andesite with the dacite tuff, and ranges in width from a few to 60 ft. Near its walls it is compact, massive quartz, growing coarser toward the center, where vugs with well developed quartz crystals are found. It is a true replacement vein, formed by hot ascending solutions along the zone of weakness at the tuff-andesite contact. The gradation from true andesite through silicified andesite to pure quartz can be observed in many places. Though ore sulphides are by no means infrequent in the "blout," it is, with the exception of a few isolated bunches, barren.

The Nevada Hills vein, the most important productive vein of the district, runs nearly parallel to the "blout," and dips steeply to the south. Its lower limit is found where it joins the "blout," which dips steeply to the north. Both "blout" and veins appear to have had a common origin in the solutions which ascended along the tuff-andesite contact, as there are many unquestionable points of similarity between them. This hypothesis, however, is open to the objection that the solutions as they ascended in the contact fissure were as eligible for precipitation as they were after they branched out into the fissures in the andesite alone, and they had, in both cases, access to whatever precipitants there were in the andesite. It is possible, however, that the controlling factor was some constituent of the dacite tuff which acted to inhibit precipitation in the contact zone. The solutions, after they entered the andesite body, were free from this restraint, and deposited their metallic burden. This theory

finds some support in the fact that the vein is weak near the "blout," and does not reach its full strength within 20 or 25 ft. of the junction. Also, the fact that the Nevada Hills vein fissure was almost certainly blind makes it reasonable to suppose that the ascending solutions were forced to move more slowly there than in the adjacent open "blout" fissure, thus furnishing conditions more conducive to precipitation.

Zone of Oxidation Is 300 Ft. Deep

The Nevada Hills vein ranges in width from 1 to 15 ft., and is occasionally even wider. Its gangue consists of quartz, partially replaced andesite, calcite and smaller amounts of pyrolusite and rhodochrosite. The minerals are argentite, stephanite, ruby silver, horn silver, pyrite, chalcopyrite, galena, tetrahedrite, sphalerite, silver and gold. The ore of the western segment of this vein is largely primary, with small, rich pockets of secondary; at the eastern end, however, strike faulting has given rise to considerable secondary enrichment. This faulting is most noticeable along the foot wall. Mineralization is conspicuously higher on the hanging side of the fault gouge than elsewhere, this condition persisting even when the gouge leaves the true foot wall, and reaches out into the vein. The proportion of silver to gold, by weight, is 100:1, as the grade of the ore increases, this proportion decreases.

The Eagle vein, which ranks second in importance to the Nevada Hills vein, is roughly parallel to it at a distance of 1100 ft., and dips approximately the same, at 70° to the south. While its genesis was undoubtedly similar to that of the latter, its physical characteristics are widely different, due largely to the important part that secondary enrichment has played in its formation. The vein averages 16 ft. in width, the richest ore being close to the walls. As in the case of the Nevada Hills vein, the strike faults which followed the formation of the original vein allowed ingress to the descending waters of that period. Quartz, calcite, rhodochrosite, rhodonite and ore sulphides were deposited, the last being rather coarser than the primary sulphides. Banded or ribbon structure is characteristic of this period. The banding is most prominent near the walls of the vein, and consists of seams of dark sulphides separated by pinkish calcite and rhodochrosite. A still later series of transverse faults was responsible for a further, though comparatively unimportant enrichment. The maximum depth of oxidation is 300 feet.

The Dromedary vein runs parallel to the Nevada Hills vein, 3800 ft. to the north. It is a strong quartz vein, dipping steeply to the south, and has produced several bunches of bonanza ore near the surface. It is now being developed at depth. The Wingfield and Eagle's Nest veins are well defined quartz veins which resemble the "blout" in many respects. The latter is at present being developed at a depth of 300 feet.

Sixteen Faults in 300 Ft. of Vein

The faults of the district have a general northeast-southwest trend, and dip, on the average, from 50 to 75° to the east or west. The east-dipping series is by far the more important, and is probably older than, or contemporaneous with the west-dipping series. An east-dipping fault invariably throws the east side downward and to the north; a west-dipper throws the west side downward and to the north. The country is much faulted; on the 550-ft. level of the Nevada Hills mine, there are 16 faults in 300 ft., with horizontal movement ranging from 1 to 130 feet.

The main fault and the Aztec fault are the most important of the district. The former has a strike-slip of about 130 ft., and a dip slip of 350 ft., and displaces all the veins that have been mentioned. It is noteworthy that the veins are uniformly larger and of higher grade on the east side of the Main fault than on the west; the strongest mineralization is immediately adjacent to the fault. The Aztec fault is nearly vertical; the east side dropped at least 600 ft. The strike-slip has not been determined, but is probably small. Erosion has removed all the later andesite west of the Aztec fault, with the exception of a few shallow patches which doubtless represent depressions in the old lode andesite surface. On the east side of the fault, however, a thickness of 650 ft. of later andesite has been proved. Thus it seems certain that the later andesite flow was at least 700 ft. thick, and that there has been at least 750 ft. of erosion since its eruption. Acknowledgment is made to the Nevada Hills Mining Co. for access to the reports of A. C. Lawson, O. H. Hershey and C. C. Starr, which have formed the basis of this article.

Impending Labor Changes in Lake Superior Region

Special Correspondence

In the Lake Superior region there is a general, though not by any means a concerted, movement for the elimination of certain classes of labor. It may be said to have begun after the strike on the Mesabi range in 1907. It received additional impetus last summer, when a strike occurred on the ore docks of the Great Northern road. It spread to the copper region lately, as the result of the recent disturbance on Keweenaw Peninsula.

While the supply of labor available for mine operation will have its bearing on the rapidity with which this elimination can take place, it is likely to continue until the result desired has been accomplished, that is, until those men who, by race and old world sympathies and education, are anarchistic, shall be in such minority as to make their presence negligible.

Although two of the strikes mentioned were conceived in the minds of leaders of the Western Federation of Miners, they could not have been so serious, nor have left so terrible a heritage of hate and distrust as they have in the copper country, for example, had it not been for the fertile soil into which the utterances of these leaders were dropped. A man who for years has been beaten down by his tyranical government, who has known authority only as something to dread and hate and whose forefathers have lived under the same influence, is easily worked upon by such arguments as Moyer and his associates know how to present.

Such a man cannot be blamed too severely if he responds readily to the discords played upon his heart-strings. Liberty and the rights of man, as we know them, were beyond his conception at home, and he has not been long enough in America to reverse his point of view. He reads such journals as the Finnish daily, *Työmies,* one of the agencies which helped to engender hatred

at Calumet, and he reads nothing else. It is unfortunate that the conservative, reasonable and decent Finnish newspapers published on Lake Superior are not read by the anarchistic element. But the line of division is sharp, the fair newspapers are read by the conservatives, the inflammatory by the radical, and clannishness is extreme. An experiment is about to begin, looking toward a breakup of this class distinction, but its early success is questionable.

Criticism of the anarchistic element among these people must not be too harsh, they scarcely can be blamed for their feelings, induced by years of oppression, of civil and military outrage of all sorts, and of broken promises, solemnly made and repeatedly reiterated by highest authorities, from the Czar down. Criticism should be directed toward the Moyers, the Petronellis, the editors, and the others who circulate false statements.

It will be interesting to observe how far this proposed elimination of an undesirable element will be carried and what effect a sharper demand for labor may have on mine managements. Just now, conditions are somewhat favorable to the movement. It will also be interesting to watch for the next development along lines of Western Federation activities in the Lake Superior region.

Rail Production in 1913

The Statistical Bureau of the American Iron & Steel Association has collected and published figures for the entire production of rails in the United States in 1913. This showed an increase of 174,865 tons, or 5.2% over 1912, but is less than that of 1906, 1907 and 1910. The accompanying table shows the production of rails for two years, classified according to the kind of metal from which they were made.

	1912		1913	
	Tons	Per Cent.	Tons	Per Cent.
Openhearth	2,105,144	63.3	2,527,710	72.2
Bessemer	1,099,926	33.0	817,591	23.3
Electric steel	3,455	0.1	2,436	0.1
Rerolled rails	119,390	3.6	155,043	4.4
Total	3,327,915	100.0	3,502,780	100.0

No iron rails were rolled in either year. The notable point in this statement is the continued increase in the proportion of openhearth rails.

Included in the total for 1913 are 195,659 tons of girder and high T-rails for street railroads. Imports of rails in 1913 were 10,408 tons; exports, 460,553 tons, leaving 3,052,635 tons, as the approximate domestic consumption.

The make of rails in 1912 and 1913 is classified as follows, according to section:

	1912		1913	
	Tons	Per Cent.	Tons	Per Cent.
Under 50 lb.	248,672	7.2	270,405	7.7
50 to 85 lb.	1,118,592	33.9	967,313	27.6
Over 85 lb.	1,960,651	58.9	2,265,062	64.7
Total	3,327,915	100.0	3,502,780	100.0

Openhearth steel was used chiefly for the heavier sections. Of the rails over 85 lb. to the yard, 87.3% were of openhearth steel, while the lighter sections were about evenly divided between openhearth and bessemer.

Alloy steel rails made in 1913 were 59,519 tons, of which 47,655 tons were titanium steel and 11,864 tons manganese, copper or nickel steel. The total was 89,748 tons below that of 1912, and was the smallest reported since 1909.

Mining Radium Ores

WASHINGTON CORRESPONDENCE

Senator Walsh, of the Senate Committee on Mines and Mining, in reporting the bill to provide for and encourage the mining of radium ores, gave a new turn to the measure by inserting into it sundry provisions that operate as a distinct limitation upon the plan. These are now beginning to receive more attention than heretofore because of the news that has been brought from Colorado concerning the alleged fact that prospectors have hastily taken up practically all of the known radium locations, so that the bill is largely an academic proposition in its main features.

The two points that are being given special notice in Senator Walsh's measure relate to method of purchasing ores. The first is as follows:

> If the United States shall at any time fail or refuse to purchase any such radium ores of sufficient value to be merchantable, upon the tender of the same in carload lots at any railroad station, the exclusive right of the United States to purchase such ore or any ores thereafter extracted from the mining claim from which the same were mined and from all other mining claims contiguous thereto and held in common therewith as well as the right to enter upon the same for failure diligently to mine any of such claims, shall thereupon cease and the unrestricted right of disposition of all ores within such claims or extracted therefrom shall thereupon accrue to the owner or other rightful occupant thereof.

The second reads as follows:

> That the Secretary of the Interior is hereby authorized to lease for the purpose of exploration and development of radium-bearing ores unallotted lands within Indian reservations now existing or hereafter established by Act of Congress or Executive Order in such quantities and upon such terms and conditions and under such rules and regulations as he may prescribe: Provided, That such radium-bearing ores when mine shall be sold and delivered to the United States as herein provided: And provided further that all royalties derived from any such leases, rentals or other moneys paid on account of the same shall be deposited to the credit of the Indians entitled to occupy the reservation from which the same come to be expended for their benefit as the Secretary of the Interior may direct.

Options to Purchase Mining Property

BY A. L. H. STREET*

Although it is generally held by the courts that a person who holds an option to purchase property will not be held strictly to a provision in the agreement requiring him to exercise his right to purchase before expiration of the time limit fixed by the contract, unless it appears that such limit was made by the essence of the contract, the New York Supreme Court lately held in the case of Beebe vs. Worth, 146 New York Supplement p. 146, that, since mining property is subject to great fluctuation in value, a holder of an option to buy such property will be held strictly to a clause requiring the purchase to be made within a specified time.

Portland Cement Production

The final figures for the portland cement industry in 1913, as obtained by the U. S. Geological Survey, show a production of 92,097,131 bbl., shipments of 88,689,377 bbl. and stocks on hand 11,220,328 barrels.

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Application of the Crushing-Surface Diagram

By Arthur O. Gates*

SYNOPSIS—The crushing-surface diagram, explained in theory in a former article, is here applied to practical problems. Measurement of the areas considered is easy when coördinate paper is used. A new unit is necessary for convenience, and the term "mesh-gram" is used, representing a unit of surface based on weight being proportional to volume. The crushing efficiency of different machines is measured and compared.

In the article on "The Crushing-Surface Diagram" (Engineering and Mining Journal, May, 24, 1913), it was shown how, accepting Rittinger's law that energy absorbed in crushing is proportional to the surface produced, the screen analysis plotted in a simple diagram gives a measure of the surface produced, and therefore of the energy absorbed in the crushing operation under consideration.

In Fig. 1, taken from that article, weights or percentages are plotted vertically against theoretical mesh (reciprocal of diameter), in inches in accordance with the prevailing American practice The area between the two screen-analysis curves is proportional to the energy expended in reducing the material represented by the curve of coarse sizes to the sizes represented by the curve to the right. The area between the curve of the original material and the zero coördinate lines measures the energy already spent upon the material in reducing it from the earth mass of which it was originally a part. It should also be remembered that the area between the curves is proportional to the surface exposed by the operation, while the area between the zero coördinate lines and any screen-analysis curve is proportional to the actual surface of the material represented by the curve. Applying proper constants, the actual surface, as well as energy absorbed, can be determined.

In this diagram the vertical zero line represents infinite mass, 1 represents particles 1 in. in diameter; 10, particles $\frac{1}{10}$ in. in diameter, etc., while between 0 and 1 are the fractional reciprocals, $\frac{1}{10}$ representing a chunk 10 in. in diameter, etc. It does seem a little absurd that it takes only one-tenth as much energy to break 10-in. cubes off old Mother Earth than it does to break an equal weight of 1-in. cubes, but a little calculation of the surface produced will show it to be the case

In the previous article an attempt was made to show that in accounting for all the energy actually expended in crushing, it would be necessary to go beyond the limit of ordinary screen sizing and into the minus 200-mesh sizes; it is probable that the bulk of the energy is expended upon the minus 200-mesh material.

Measurement of Crushing-Surface Diagrams

The measurement of crushing-surface diagrams is a comparatively simple matter, especially when plotted upon coördinate paper having equal rectangles throughout. A value can be calculated for a single rectangle in suitable units (see meshgrams, etc., under constants) and by counting the rectangles, or by measuring ordinates, or with a planimeter, the area and the number of units within the curves can be determined. If it were necessary to plot percentages after being calculated, there would not be much labor saved over the methods used by some other investigators[1], but with the crushing-surface diagram percentages are unnecessary, as the unit that it seems desirable to use is one into which the weight enters.

With the crushing-surface diagram the individual weights at various meshes (or between meshes) are not required, simply the cumulative weights. I have arrived at the following practice in weighing and recording my crushing-surface diagrams: After screening, the oversize resting on the various screens, commencing with the coarsest and following in order of size, is weighed cumulatively. Starting from the top of the diagram downward weights are plotted against the mesh, everything on the pan of the scale is of such size that it does not pass the screen whose oversize was last added to the pan. When the minus 200-

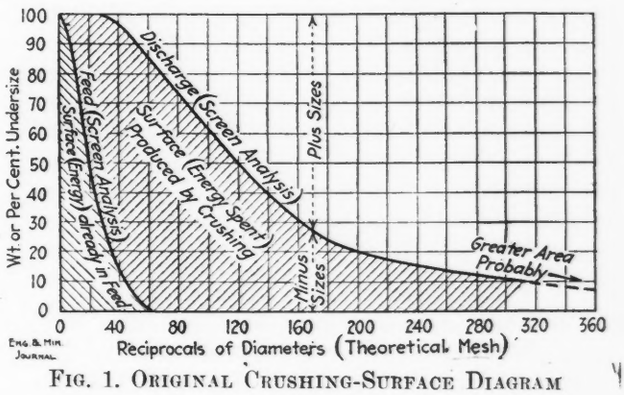

Fig. 1. Original Crushing-Surface Diagram

mesh material is added the zero line can be drawn in, and it will be seen that everything between the zero horizontal line and the curve is that which has passed through the screens. It would be better to start with the minus 200-mesh material and end with the coarsest size, but the possibility of error in adding the different sizes has kept me from starting in this manner. In systematic work, it is the logical procedure. The numerical weights should be written at the plotted points as checks, but plotting first is better than recording the weights first, the shape of the curve as it develops indicating when errors of any moment are made. Average diameters of grains need not be considered, as the curve averages them better than any mathematical calculation could.

Crushing Units or Constants

In order to have some convenient units for use with this work, some suggested by the crushing-surface diagram will be used. I feel that the term "mesh" is somewhat subject to criticism, but the coined terms are nearly self-explanatory; better names may be found later.

The theoretical mesh-gram is a unit of surface based on weight being proportional to volume (true only for

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[1]Algernon Del Mar, "Eng. and Min. Journ.," Dec. 14, 1912.

the same, or material of same specific gravity), and represents the surface produced by a theoretical crushing operation in which one gram of particles of the same diameter is all reduced to a diameter whose reciprocal is one greater than before reduction. Two or three examples will make the unit clear; if one gram of $\frac{1}{10}$-in. rock (10 reciprocal, or theoretical mesh) be crushed until it is all just $^1/_{20}$ in. in diameter (20 reciprocal), the new surface produced is 10 mesh-grams. The one gram of rock already had 10 mesh-grams of surface, so that it now has 20 mesh-grams of surface.

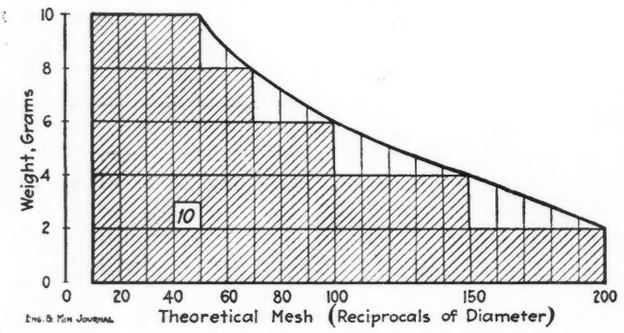

FIG. 2. THE CRUSHING-SURFACE DIAGRAM

If 10 grams were reduced to 100 mesh from 10 mesh, the increase in mesh-grams would be 900; or if the 10 grams were reduced, say, 2 grams to 50 mesh (2x40 mesh-grams), 2 grams to 70 mesh (2x60 mesh-grams), 2 grams to 100 mesh (2x90 mesh-grams), 2 grams to 150 mesh (2x140 mesh-grams), and 2 grams to 200 mesh (2x190 mesh-grams), there being no intermediate sizes, these being theoretical mesh, there would be produced the sum of 80, 120, 180, 280 and 380, a total of 1040 mesh-grams. In Fig. 2 is shown a crushing-surface diagram for this crushing, the layers of the hatched portion being the separate items of the above, one square representing 10 mesh-grams. If the weights and meshes given above were those obtained for the theoretical sizes in practice, where there are all sizes of particles in between the meshes used for measuring, we can safely assume that the sizes would follow a smooth curve between the upper corners of the steps in the figure, as shown. Taking into account the increased area of our diagram, or more properly, the increased area of the rock particles as shown by the curve, we now have some 1180 mesh-grams.

While for rough work, such as comparing the daily duty of a given machine, the commercial meshes may be used, for accurate work the mesh must be the theoretical, that is, with the mesh wire taken of zero diameter, or the reciprocal of diameter taken as the mesh.

The term mesh-gram is a weight, or volume, divided by a diameter, and is therefore a measure of surface, so that we can speak of so many mesh-grams of surface if we wish. Similar expressions may be made use of, such as mesh-tons, mesh-pounds, mesh-per cents., etc., all of which are self-explanatory. Mesh-ton is the term that will be used in mill work, given per hp.-day or per hp.-hr., as desired.

Assuming that the rock breaks into cubes, for quartz one mesh-ton is equal to the production of approximately 900 sq.ft. of surface, and one sq.ft. of surface is equal to approximately 1014 mesh-grams. (If the rock breaks slabby there will be a greater amount of surface, if in spheres a less amount, probably cubes as figured show less surface than actually is made.) One mesh-ton is equal to 908,000 mesh-grams.

Mesh-grams per foot-pound will be a useful term in making calculations of rock-crushing resistances, but the larger unit, mesh-tons per horsepower-hour or day as mentioned above, will be the unit to be used in measuring machine efficiencies; 2.18 mesh-tons per horsepower-hour is the equivalent of one mesh-gram per foot-pound.

NATURAL DIAGRAM

In this diagram, Fig. 3, the particles resulting from a crushing operation are supposed to have been sized in a perfect manner, and then arranged according to size, the rows being of a length proportional to the reciprocal of their diameter, the theoretical mesh, all particles touching adjacent ones, as well as the surface upon which they are placed. Without any mathematics, it will be seen that the surface of the particles occupying unit areas at any point in the figure are equal. For the areas in the plane of the paper are naturally equal, and the areas at right angles to the paper are the product of the height of the particles at that point by the number of rows of particles in that area, times four; the number of rows being inversely as the diameter, the vertical areas are

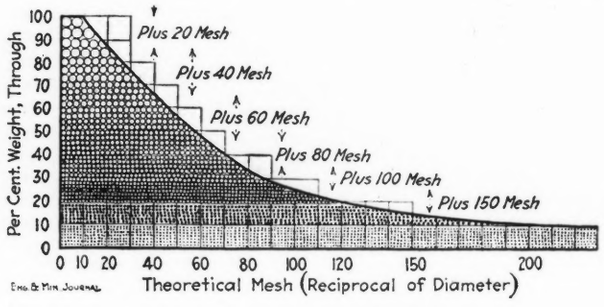

FIG. 3. NATURAL DIAGRAM

equal, and therefore equal areas contain equal rock surfaces. This is another reason for speaking of mesh-tons (etc.) of surface. The outlines of this natural diagram are exactly the same as the crushing-surface diagram for the same material.

FORM OF THE DISCHARGE LINE

An examination of a great many screen analyses, particularly of finely crushed products, plotted in the form of crushing-surface diagrams indicates the general tendency of crushing operations to form increasing quantities of the finer sizes, as shown by the tendency of the discharge lines, as in Fig. 1, to flatten out as they extend toward the finer sizes. Plotting such analyses upon logarithmic paper, weights against reciprocals, as in Fig. 4 (the values here are taken from data given in Robert Franke's paper, "Hardinge Mills vs. Chilean Mills," Bull., A. I. M. E., July, 1913), we find that this curve among the finer sizes is a straight line, which indicates that the same analysis plotted in the crushing-surface diagram is in the form of a hyperbola. Of a considerable number of screen analyses of crushed products obtained by crushing between the faces of a testing machine, few failed to show this logarithmic straight-line characteristic. The difficulty in plotting published screen analyses is that they are given in meshes, which is a rather indefinite term, and the variation in ratio between diam-

eters of holes and thickness of wire among the different sizes precludes the use of these values for these diagrams.

If the curve continues to possess the same characteristics among the finer sizes that it has among the sizes that are measured, we can by continuing the plotting of the straight line (on logarithmic paper) determine the probable weight of the various fine sizes to reasonable accuracy. For instance, from Fig. 4 we can say that the probable amount of 1000 theoretical mesh in the Hardinge product is about 25%, and in the chilean-mill product 32%, and at 100,000 theoretical mesh, 2½% and 6½% respectively, and so on out to the molecular

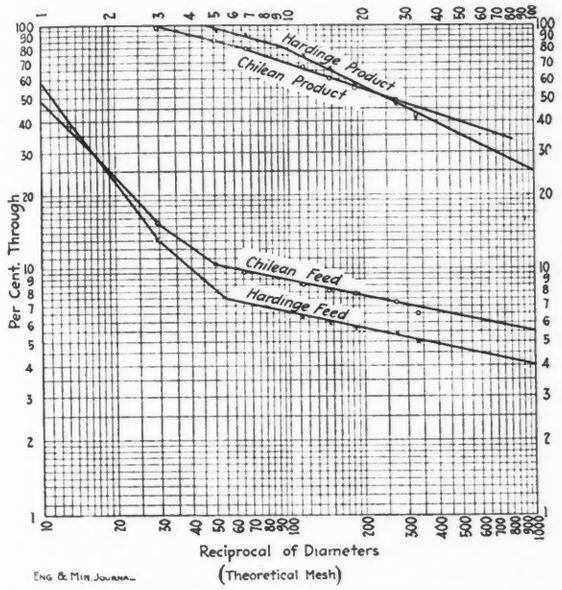

FIG. 4. SCREEN ANALYSIS ON LOGARITHMIC PAPER

state which some physicists tell us would be in the neighborhood of 100,000,000 theoretical mesh, if I am not mistaken. There undoubtedly is a law of crushing indicated by the shape of this curve, which may be formulated later as more data are available, and the matter becomes better understood.

The perfect crushing-surface diagram would be that in which the discharge line is vertical, indicating that all particles have been reduced to one size, a thing absolutely impossible in practice, and yet claimed occasionally for new crushing devices. But this is the goal toward which all advance in the art of crushing must tend, the steeper curve always indicating the more efficient practice, machine friction not being considered.

Before discussing practical applications of the crushing-surface diagram, I wish to emphasize certain points about the diagram that may be confusing if not well understood. Vertical distances are a measure of weight or volume; the material represented or confined between two equally spaced horizontal lines has equal weight or volume. Horizontal distances from the vertical axis of coördinates represent the reciprocal of diameters (theoretical mesh) at the point on the curve, or the distances measure the difference in reciprocals between two points in the screen analysis curve. Areas represent so much surface as already explained. Areas below the discharge line represent surface already produced, areas above the discharge line represent surface possible, either to be produced, if necessary or possible, or to be left unmade as metallurgical requirements demand. In the diagram, the area inclosed between two horizontal lines, the vertical axis and the discharge curve measures the surface of the particles between the sizes intercepted on the discharge line by the horizontal lines. These are the areas added by each screen sizing when making the analysis, and approximately these areas are cut out and fed to concentrating machines when a screen, trommel or a hydraulic sizer is used.

MEASUREMENT OF CRUSHING-MACHINE EFFICIENCY

The first thing necessary in an efficiency measurement is some means of measuring the work done (theoretically) upon unit weight or volume of rock in reducing it or in producing new surface upon it. The method was indicated in the writer's previous article already referred to (in Figs. 4 and 5); the crushing energy in foot-pounds being compared with the surface produced. Measuring the energy, in foot-pounds, applied to the rock of known weight between the faces of a testing machine, and plotting the screen analyses before and after the testing machine crushing, enables us to determine the number of mesh-grams (under 350 theoretical mesh, the oversize of the 200-mesh screen used) of surface produced per

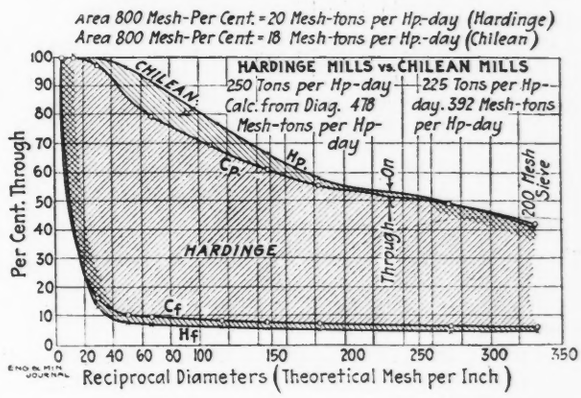

FIG. 5. COMPARISON OF CRUSHING-SURFACE DIAGRAMS

foot-pound of energy applied. On a Mexican ore two tests gave 16.64 and 19.70 mesh-grams per ft.-lb., an average of 18.17, while from data as to horsepower, tonnage, screen analysis of product, etc, the tube mill operating upon this ore appears to produce about 1.5 mesh-grams per ft.-lb., indicating an efficiency in the sizes under the 200-mesh screen used of 8 or 9 per cent.

In another case, the application of 330 ft.-lb. of energy to 69 grams of Bingham quartzite indicated that 560 mesh-tons per horsepower-day could be produced. (This test was made in a small stamp mill, not in the testing machine, so results are only of qualitative value.) Crushing-surface diagrams of the feed and discharge from rolls crushing this material were plotted, and from these and the other factors (horsepower and tonnage) it was determined that the rolls were producing 134 and 142 mesh-tons per horsepower-day, showing efficiencies of 23.8% and 25% respectively. I feel certain that this efficiency is high both on account of the stamp used in making the resistance tests, and on account of other factors.

On Bedford limestone, which I have been testing lately, I get values ranging from 29 to 88 mesh-grams per ft.-lb. (all under 350 theoretical mesh), the higher values

when the feed is coarse and the crushing fairly free, while the lower values have been made when I got the effect of choke crushing, the material being densely packed as the crushing was completed, or when the feed was finer. The explanation of this variation is that the work has been done on the minus 200-mesh material, when the above values are low.

When there is to be a comparison of two machines, both working upon the same ores, the theoretical crushing resistances need not be known, as the ratio of the mesh-tons per horsepower-day gives the relative efficiencies for the conditions under which the test was made. In Fig. 5 is an example of this, the crushing-surface diagram of a chilean mill being superimposed

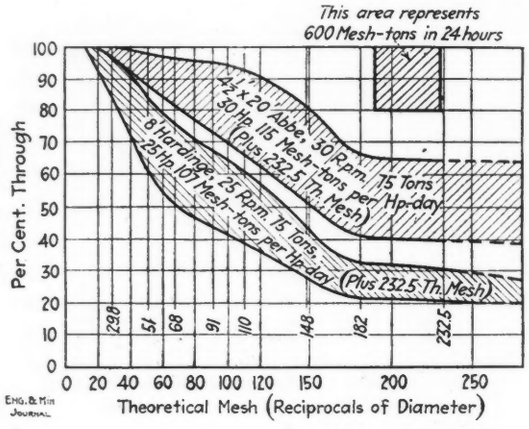

FIG. 6. COMPARISON OF GRINDING MACHINES

upon that of a Hardinge mill. The boxes in the diagram show the relative value of the diagram areas for the two mills From the data of Fig. 5, it may be calculated that the chilean mill produced 392 mesh-tons per hp.-day, while the Hardinge mill produced 478 mesh-tons per hp.-day, all of these quantities being plus 200-mesh sieve (353 reciprocal of diameter). Within this limit the Hardinge mill in this case shows an excess efficiency over the chilean of about 22%. If the diagrams were extended into the finer sizes this excess efficiency would decrease, the slope of the "product lines" in Fig. 4, indicating an increased area for the minus sizes in the chilean-mill product.

In Fig. 6 are given crushing-surface diagrams for a Hardinge and an Abbé tube mill with the data as given in an article published in the *Mining & Scientific Press* in 1910 by Algernon Del Mar. In this case, preparing an ore for cyaniding, the Abbé mill showed an excess efficiency of about 7% within the limits of the screen opening used (232.5 reciprocal of diameter), while a glance at the diagrams would lead one to expect a much greater excess of efficiency for the Abbé mill were the screen analyses carried into the finer sizes. One would assume from the way one diagram lies against the other that the Abbé mill followed the Hardinge, the feed to the Abbé containing some classified undersize bypassed around the Hardinge.

SCREENING APPLICATIONS

The horizontal line through the crushing-surface diagram is the line of perfect screening, while the practical screening line would slope perhaps along the discharge line, as shown in Fig. 7. The actual screen size would be that of the intersection of the horizontal line of perfect sizing with the discharge line, all the surface above this horizontal being oversize, while that below is undersize. Conversely, the screen size determines the location of this perfect-screening line. The area between the perfect and the practical lines is the undersize in the oversize. The ratio of the total area under the practical line to that under the perfect line $\frac{A}{A+B}$ is suggested as the screening efficiency. The importance of near-perfect screening or classification is emphasized in such diagrams as Fig. 6, where the discharge lines seem to follow the fluctuations of the feed lines. In Fig. 7, perfect screening would leave the area above to be recrushed, and a rather steep discharge line would result from crushing in a tube mill. On the other hand, if the oversize from the practical screening were plotted as a new feed line of a crushing-surface diagram, there would be a break in it, producing a similar break in the discharge line, as in Fig. 7a. It is possible, had there been perfect screening, that the discharge line would have taken the position of the dotted line, permitting a greater tonnage through the crushing machine with the same horsepower.

APPLICATIONS IN CYANIDE PRACTICE

There must be some relation between the surface exposed to the action of leaching solutions and the extraction, or the solution of the mineral, both in percentages

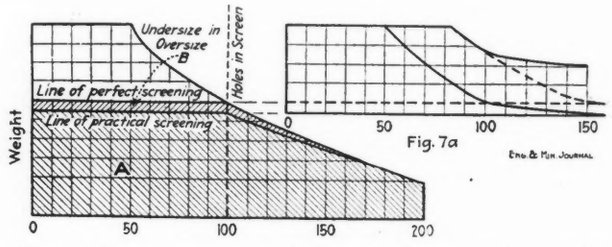

FIG. 7. EFFICIENCY BY CRUSHING-SURFACE DIAGRAM

and in time required. And the washing or filtering likewise must have some relation to the surface. Some investigators have believed this to be true, while others have considered it otherwise but in either case it is doubtful whether they took into full account the surface of the minus 200-mesh sieve particle. Usually a value for the average diameter of the minus particles has been assumed, and with accurate values for the plus particles, the surface has been calculated and deductions drawn, all of which deductions are influenced largely by the assumed average diameter of the fine particle.

There must be in any given ore, a maximum size of particle, the values of which can be totally dissolved by the treatment given. Here it is a matter of volume, but as the size of the particles increases, the amount untreated in the center of the particle increases, the depth of penetration being perhaps the same for all size particles, so that when we consider the coarser particles, solution is practically proportional to surface. In the crushing-surface diagram, the area beneath the sizing line is exposed surface, while the area above is unexposed, or unbroken, the exposure of which would hasten solution. Suppose we tried leaching different rows, from coarse to fine, of our screen-sized particles in Fig. 8, and finally found that row *ab* gave practically perfect extraction with a given treatment. Then there would be no need of

crushing finer than the mesh at *b*, the minus *b* surface is not only useless, but it has taken energy to make it and it will carry off some solution as tailing. Of course, the ideal crushing-surface diagram would have a vertical discharge line. In Fig. 8, solution would be complete in the sizes below *ab*, while above it solution would be more or less proportional to surface. On the assumption that solution is proportional to surface above *ab* and complete below it, the efficiency of solution would be the ratio of

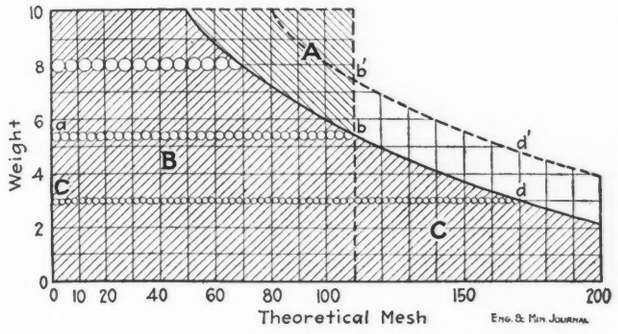

FIG. 8. EFFICIENCY OF LEACHING SHOWN BY CRUSHING-SURFACE DIAGRAM

the crushing-surface diagram surface out to the ordinate *bb'* to the total surface possible out to this ordinate, $\frac{B}{A+B}$ in Fig. 8.

Suppose we find that row *ab* gives perfect solution in a certain time and that row *cd* gives perfect solution in a certain lesser time. On the row *ab* with the time allowed for perfect solution of the row *cd* less than 100% of the values would be brought into solution, but other considerations, such as plant investment, interest, labor, etc., might make it more profitable to use the shorter time. Again, by crushing longer in the tube mill, the sizing curve, or the discharge line, may be raised to *b'd'*. Here as seen from the areas on the crushing-surface diagram, the solution of the values would be increased, but the surface in the minus sizes may make so much trouble that we would prefer to go back to the *bd* line of sizes. As cyanide tests are made today and are liable to be for a long time to come, with all the minus particles in the treatment test, it is the size of the coarsest particle present that would determine the line *ab* to be used in determining efficiency, that is, when extraction is perfect.

With regard to solution losses in the tailings, it is probable that in filter pressing and other pressure-drying operations, the solution covers all particles to the same depth, so that the solution which goes off in the rejections must be proportional to surface. This is likewise true where continuous decantation is practiced. Here, where there usually is a large percentage of minus 200-mesh material, our crushing-surface diagram only indicates something as to the amount of the water on the surface of the finer particles. The steeper the sizing curve the less surface there will be to retain water or solution, and consequently there will be less solution carried off with the tailing, for equal washing of the pulp. It is well to repeat here that fact previously stated, namely, that the shape of the feed curve influences the shape of the product curve; that a flat feed line among the finer sizes produces a flat discharge line, which serves to indicate that a much greater amount of very fine particles than would be produced were the feed line more vertical as it becomes when more of the finer material is cut out before crushing. Fig. 9 is a crushing-surface diagram, plotted on the assumption that the meshes reported had the same dimensions as the standard Tyler screen. It shows the characteristic conformation of the discharge line to the variations of the feed line. Suppose that the feed to this mill were so classified that only the plus 120-mesh material were fed to the mill, which would be 36 tons instead of 104 tons. Feeding this 36 tons into a suitable tube mill, the expenditure of the same amount of power as before should make the total discharge line higher and steeper, as shown dotted. Such a product should be more easily leached and washed, or if that is not required, the power consumption could be cut down. A study of crushing-surface diagrams in connection with

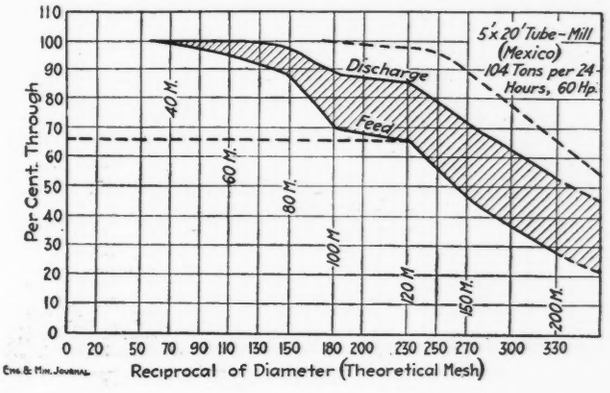

FIG. 9. DIAGRAM SHOWING POSSIBLE IMPROVEMENT BY SIZING

operating results surely would emphasize the importance of better sizing apparatus before crushing.

CEMENT AND CONCRETE

Of course, the principles outlined for crushing and sizing are applicable to the cement plant. Ordinary portland cement is a product about 90% of which passes a 200-mesh screen, and practically all passes a 100-mesh screen. Its sizing curve is therefore very high up and also very flat, and its crushing-surface diagram would show it to possess an enormous amount of minus 200-mesh product. If the cement be ground finer, showing a higher percentage of minus 200-mesh, it will have the property of "setting" more quickly. If sufficient points can be obtained on its discharge line, it is possible that the crushing may be controlled to give the qualities required with less cost of power per barrel.

In the making of concrete, the function of the cement is first to coat each particle of the agglomerate all over, and then to fill the voids. A screen analysis of the rock and sand plotted as a crushing-surface diagram will indicate the surface to be covered, and for equal strength the cement may be proportioned to the surface, as shown, due allowance being made, of course, for cement to fill the required voids. Some of the methods at present in use in getting the proper proportions of sand and rock in a mix are somewhat similar to that suggested here, they appear to be empirical rules based on experience. A standard shape of crushing-surface diagram might be adopted for the mixture, one in which the amount of voids is a minimum, and various sands and crushing products be added together to give this curve.

Mill Analysis

The crushing-surface diagram may be invoked to show quantitatively and perhaps qualitatively the various operations taking place in a mill, or in a part of a mill. Or it may be used in planning the flow sheet, the sizes of separated material, the loading of each machine, and the number of machines. Fig. 10 shows how the flow sheet, loading, sizes, etc., may be determined by the crushing-surface diagram. The combined product, after passing through each crushing machine, crusher, coarse rolls and fine rolls, is shown by the product curves, the crushing-surface areas produced by each being indicated on the figure. The crusher is here given credit for the surface produced in the mining operation. Of the crusher product, 1040 lb. of plus 2-mesh pieces are put through the coarse rolls, resulting in the crushing-surface diagram B which is added to A as B'; 780 lb. of plus 5-mesh resulting from the two previous crushing operations put

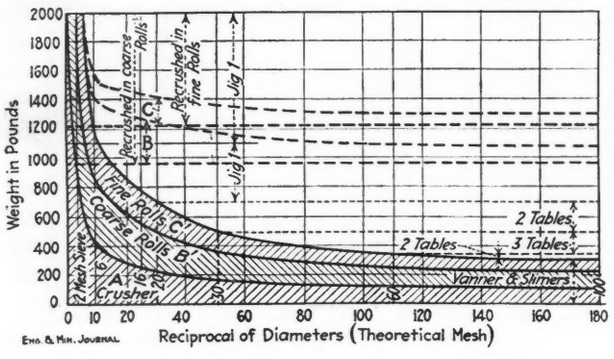

Fig. 10. Mill Analysis by Crushing-Surface Diagram

through the fine rolls gives crushing-surface diagram C, which is added below as C'', the combined crushing-surfing diagram consisting of $AB'C''$.

This material is to be treated by concentration, first with jigs and then with tables. If we take as a basis of capacity an equal number of layers of particles for machines of a type, each machine of a type will be given an equal area of the crushing-surface diagram to handle. If the jigs are to treat all plus 20-mesh material, they will handle 1300 lb., leaving 700 lb. for the tables. All the surface on the diagram above the horizontal line intersecting the final product line at the same point as the 20-mesh line is to be equally divided among the two jigs. Dividing the area by a horizontal line as a screen would do it, into two approximately equal areas, gives some 900 lb. for the coarse jig and some 400 lb. for the fine jig, the dividing line being about the intersection of the 7-mesh line, which would be the intermediate screen to use.

A similar scheme would be used for the loading of the tables, assuming for the simplest case that the sizing would be along horizontal lines so far as area of surface is concerned. On the above basis, if two tables were required for the 20- to 30-mesh, three tables would be needed for the 30- to 60-mesh material, and two tables for the 60- to 150-mesh product, perhaps two tables or vanners for the next product of our sizing, and then just as much concentrating surface for the fines as the economics of the proposition will permit. It probably will be found that the products of classification will not be horizontal in the crushing-surface diagram, but will give lines inclined toward the intersection of the axes at O. The tables would still be given loads of equal areas of the crushing-surface diagram. The meshes used above are practical, and so are not scientifically accurate, but perhaps sufficiently so for the practical man.

There is an interesting possibility of indicating the process of wet concentration on the diagram, locating a curve of the economic mineral contents, putting in curves of screening, classification, jigging, table separations, and slimer separations. The crossing of such curves would indicate how the separations were taking place, and would suggest better balancing of loads and other improvements in manipulation.

The crushing-surface diagram looks to me like a very good tool for the metallurgist, the mill designer and the mill operator, and I hope some of them will find it so by using it. Much that has been suggested in this article is theoretical, it has not been tried out, but the suggestions that are of value will be found out more quickly if those having occasion to make mill investigations will use them where they conveniently can, and will criticize the suggestions for the benefit of other operators and investigators.

With regard to the underlying theory of the crushing-surface diagram, Rittinger's law, I have sufficient experimental data to satisfy myself of its general correctness, which I hope to get into shape and publish within a few months.

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Revision of the Mining Laws

Washington Correspondence

Representative Taylor, of Colorado, has introduced a new form of bill providing for the commission to codify and amend the general mining laws. In his bill he calls for a commission of five members to be selected "because of their recognized experience in or knowledge of the mining industry and mining law, who shall serve without compensation. The Edmonds bill, introduced about the same time, calls for a commission of three members, all mining engineers, one of whom shall have had extensive experience in coal mining, a second in oil production, and a third in metal mining. A considerable batch of bills on this subject is now before Congress. Most of them differ only as to the composition of the proposed commission, and most contain about the same essential provisions as to what the commission is to do, which are substantially as follows:

It shall be the duty of the commission to prepare for the information and use of the President and Congress a tentative code of laws providing for the location, development, and disposition of mineral lands and mining rights in the United States, as in the opinion of the commission are best adapted to existing conditions and will correct defects or supply deficiencies in existing general mining laws.

The commission shall hold public hearings in the principal mining centers in the western United States and Alaska, invite and receive suggestions and opinions bearing upon or relating to existing mining laws or desirable amendments thereof, and may also consider the laws and experience of other countries with respect to disposition and development of mines and minerals.

Within one year after the passage of this Act at which time the said commission shall expire, it shall submit to the President a full report as to its operations, conclusions, and recommendations, including in or transmitting with said report a tentative code of mineral laws, as provided in section two hereof, and within 30 days from receipt thereof the President shall transmit the same to Congress with his recommendations.

A Self-Cleaning Screen for Pump Intake

By J. E. Johnson, Jr.*

SYNOPSIS—A dependable water supply is an essential for blast-furnace installations. The stoppage of pump intakes by leaves and débris, carried by a stream during flood time, would have unfortunate results. To avoid them a screen that rotates automatically and keeps the pump suction always clean has been designed and is described.

In the development which has taken place in the last few decades in metallurgical works one of the notable features is the increased consumption of water. Only a generation ago, a blast furnace was in operation in Virginia, which had been located with so little attention to such supply that during dry seasons water was hauled up the mountain side in barrels by teams, and the operation was conducted in that way for a long time.

Owing to the development which multiplies water necessities, the question of intake for pumping systems is one of much importance. If the plant is located on a large lake or similar body of water, where but little rise and fall are to be provided for, and where no great amount of trash is found in times of flood, the problem is a simple one. But in the majority of cases, plants are located along rivers, frequently in mountainous districts where the flood rise is great, and the current at such times so swift as to carry large amounts of material in suspension. This material consists of mud, leaves, and every sort of detritus smaller than gravel which has found its lodgment in the river bed during seasons of slacker water.

In the ordinary design of intake, a well, whose front is made of screens, is sunk at the edge of the river. Sometimes there are two lines of screens, a coarser one outside and a finer one behind it. Sometimes these are arranged to be raised and lowered, usually one half at a time, for cleaning. But such arrangements do not always supply a satisfactory solution of the problem.

After going through a periodical fight to maintain a water supply at a plant located on a mountain stream, it occurred to me a good many years ago that if a screen could be built that would continuously present a fresh screening surface, many difficulties could be avoided. The obvious way to do this was to make the screen circular and revolve it slowly so as to present fresh surface to the water, and simultaneously clean off the surface which had become foul through use. Such a screen requiring outside power would be out of the question for obvious reasons. Finally the idea presented itself that the difference in level between the water outside the screen and that inside, which increases when the screen becomes foul, might be utilized to turn the screen directly.

To get rid of the dirt, the exterior surface of the cylinder must be presented to the incoming water, while utilizing the difference of water level to turn the screen, necessitated the discharge of the screened water through one or both ends of the screen cylinder. Later an occasion arose upon which a screen had to be designed for the intake of over 1000 gal. of water per minute from the bank of a large and sometimes violent mountain river which brought down, in times of flood, everything from leaves to wooden bridges. A screen of the type briefly described above was designed for this service, and in use has been sufficiently successful to justify description here.

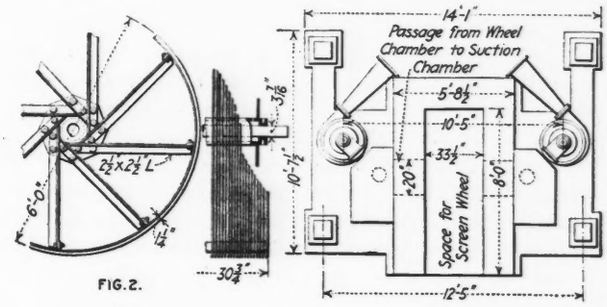

FIG. 2.

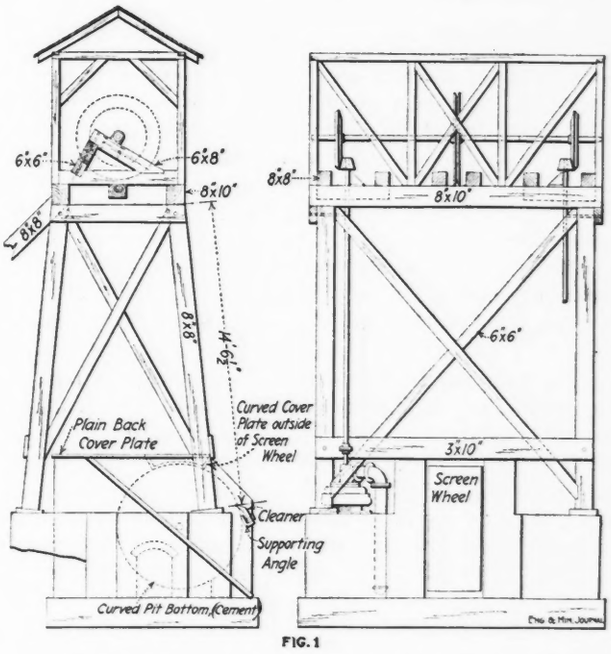

FIG. 1

Self-Cleaning Screen for Pump Suction

The general arrangement of the pumping plant as a whole is shown in Fig. 1. In order to provide for a 20-ft. rise, which might occur, and to provide for the necessity of having the pumping plant at a distance of ¼ mile from the works centrifugal pumps with vertical shafts were used for the pumping units. These were in duplicate throughout. The means of transmission was a wire rope, put in as being cheaper and more efficient than an electric motor. This proved false economy in the long run.

A single wire-rope drive was used, and on each end of the shaft of the driven sheave were friction clutches which could be used to throw in a large bevel gear.

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Through this a bevel pinion drove the centrifugal pump beneath it. All was mounted on a stout framework, well above high-water mark. The intake chamber with the two auxiliary chambers, one on each side of it, from which the pumps drew, were built of brick, less expensive in such small masses than concrete on account of the relative complexity of the forms required. Fig. 1 shows the general arrangement. The dotted circle in the two end compartments indicates the suction pipe from the pump. The passage from these suction chambers to the interior of the wheel chamber is shown in dotted lines through the 18-in. wall. The suction chamber was covered with cast-iron plates cemented in place, through which the suction pipe passed. The wheel chamber is in the center, with its front open to the river.

Turning now to the side elevation, the outside of the screen wheel is shown by the large dotted circle and the axis on which it revolves is indicated by a small dotted circle. The arched passage through the brick wall, which takes the water from the interior of the screen wheel to the suction chambers, is shown below and to the left of the center of the screen wheel. The bottom of this passage is not level, but is an arc of the same circle as the outside of the screen wheel. Considerations of detail can best be considered in connection with Fig. 2, which is a construction drawing of the screen wheel.

Screen Works Like Undershot Water Wheel

It is evident that for the screen to revolve by the difference in height between the water in the river and the water in the dumping chambers, it must act like an old-fashioned undershot waterwheel, and must therefore be provided with the equivalent of the paddles or buckets. The same structure, of course, must carry screen bars, and therefore the whole thing becomes an undershot waterwheel with the circular screen bars carried on the ends of the paddles. In order that the screen may be self-cleaning, it is evident that the screen bars must be plain rings evenly spaced.

No water must be allowed to flow under the bottom of the paddles of the wheel, or at least the only openings through which it can flow should be as small in size as the openings between the screen bars. Second, in order for the screen to operate when completely submerged, which it must do to secure the full benefit of the design, water must be prevented from getting down behind it, except screened water which has passed through the wheel.

A simple gate or lip at the bottom and top will not fulfill these requirements because at any time, except when the paddle was exactly in line with the lip, the water could rise from the bottom into the space between the two adjacent paddles which straddle the lip, and could similarly flow under the top lip into the space between the two paddles on each side of it. To overcome this difficulty the wheel pit is built to the curve of the wheel for a distance somewhat greater than that between the two adjacent paddles, and the cover for the top is a cast-iron plate, similarly curved. Back of this curved plate at the top an additional cast-iron plate seals the back of the wheel pit.

The construction of the screen wheel itself may be understood from Fig. 2. It is built up on an octagonal hollow cast-iron hub, with octagonal end flanges, to which, as well as to the hub, are bolted the eight pairs of angles which constitute the arms of the structure. Across each pair of these, runs a steel plate, the full width of the wheel, which serves as a paddle.

The screen bars are simply circles of bar iron, ¼x1½ in., bent edgewise to the diameter of the screen wheel, 6 ft., and welded together. They are spaced ½ in. apart, because it was thought that the centrifugal pumps would take care of any floating matter which would pass through a ½-in. opening. The rings are not held from turning, but are held to place radially and longitudinally by a bar of 2x½-in. steel with ¼-in. notches slotted in it ½ in. apart, and ¼ in. deep. They project about ¼ in. beyond the end of the ¼-in. plate which constitutes the paddle and of which the radial length is such that it just gives good clearance inside the screen bars.

In assembling, the hub, arms and paddle plates are all securely bolted together. The screen rings are put in places over the ends of the paddles, and the slotted block-plates are then pushed into place with their slots embracing the inner edges of the screen rings. In that position they are rigidly bolted to the screen plates.

The end rings were padded out by riveting supplementary pieces to the outside of them, so as to bring their outside surfaces flush with the general plane of the end of the wheel. The cast-iron hub, before assembling, had been bored accurately to receive a turned steel shaft, to which it was subsequently keyed.

Auxiliary Rotating Device

The bearings were plain cast iron, set in small, arched openings in the sides of the screen-wheel pit. These openings are bricked up around the bearings to prevent the admission of water during flood. On one end the shaft projected through and carried a worm gear, with which meshed a worm splined on a vertical shaft, running up to the operating platform above. This was so arranged that if the wheel failed to turn, the rotation of a hand wheel at the top of the driving shaft would rotate the gear, and with it the screen, while if the screen rotated freely the worm would be lifted up on its spline, and would not impede the rotation of the wheel.

The structure as a whole was so located that the suction of the pumps at normal water level was about 2 ft. This gave ample screen area with a sufficiently small lift for the pumps not to be objectionable, and at the same time put everything but the foundation of the apparatus above water level.

During one or two floods this wheel was entirely submerged, but either on account of its enormous screening area in comparison to its size, or because it really turned as intended, no difficulty was experienced in securing the water needed during the several days that submergence lasted.

There are several precautions to be taken to secure satisfactory operation of such an installation. In this case the pit was of brick like the rest of the intake, but it was not easy to have brick laid with the accuracy needed to keep the clearance down to ¼ in., or even ½ in., without exceeding the limit in one direction or fouling.

It would probably pay to have iron plates cast the same diameter as the screen wheel, have them faced off and bored, and mounted against the wall to act as the end abutments for the screen wheel. Similarly great care

should be taken to have the screen rings of the same diameter, within 1/8 in., and fully round, or else it will be found that some of them will not go down into the slots of the locking piece while others will rise clear above it without being held. This trouble could be avoided by making the screen rings somewhat wider and the slots in the locking space correspondingly deeper. But even with that improvement, reasonably good workmanship cannot be dispensed with. Modern two-stage centrifugal pumps are very different, not only in their capacity and performance, but also in their internal construction, from the old-fashioned centrifugal pumps which were guaranteed to pass anything smaller than a cabbage, but whose pressure capacity and efficiency were extremely low.

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Electric Drill Experience

The construction of the Catskill aqueduct and the deep tunnels in New York afforded admirable opportunity for the testing out of drills and the study of their economical operation. The Pittsburgh Contracting Co., whose contract embraces about 5¼ miles of pressure tunnel, had the courage to install electric drills, although it provided its several shafts with compressor plants in case the electric drills did not prove effective. (*Sibley Journ. of Eng.*, October, 1913). Several types of drills were considered and three were ultimately accepted and tried out, the Fort Wayne, the Pneumelectric, and the Dulles-Baldwin. The Fort Wayne is of the rotary hammer design, operated by an electric motor mounted on the frame of the drill proper. Its mechanism is well known, consisting of a revolving helve with two chambers, in each of which a hammer floats freely. As the helve revolves, the hammer is thrown outward by centrifugal force at each revolution, striking a blow upon the projecting head of an anvil block, which delivers the energy of the blow to the drill steel. The rotation of the steel is effected by means of a heavy worm-gear reduction driven from the helve shaft. This drill proved to be rugged and required practically no repairs, but it did not have power enough to cut the rock encountered and was soon eliminated.

The Pneumelectric drill was used in excavating 530 ft. of circular shaft and 301 ft. of tunnel in Manhattan schist. The drill is an electrically operated hammer machine. The power directly supplied to the hammer or drilling part is not electric, but compressed air, the electric motor mounted on the drill frame operating a compressor piston and the compressed air actuating the hammer. Water through the hollow steel cleans the hole; the steel is automatically rotated.

Considerable trouble was experienced with the motors, dripping water entering the casing and burning out the armatures. This trouble was eliminated when alternating current was substituted and induction motors used, but further trouble was experienced by the burning out of connections and the overheating of motors, the voltage being too low, due to small leads from the transformers. These troubles necessitated changing an average of one or two out of seven motors on a shift, but might have been eliminated by use of heavier leads and a waterproof connection at the motor.

The motor with 220-volt current is rated at 2½ hp., but the power actually developed is greater. The electrical power input as metered on several drills on vertical holes was about 4 hp. Assuming a motor efficiency of 80%, the developed horsepower was 3.2. The compression and expansion of the air is accomplished with little thermal loss; the strokes of the piston are rapid and expansion follows compression so quickly that the cylinder is not heated. Indicator cards show the compression and expansion to follow closely the adiabatic curve with the expansion curve close to the curve of compression. There is compressed 9 cu.ft. of free air per min. adiabatically to 1/8 volume, representing 1.63 hp. Of this, probably 1.5 hp. is actually expended upon cutting the rock. In a 3½-in. piston air drill making 360 6-in. strokes per min., with a 6-ft. drill steel, the power actually expended by the moving piston and drill steel striking the rock is 2 hp., the former consisting of 720 blows per min., of 70 ft.-lb. each.

The power consumption as metered for horizontal holes is 2.95 hp. and for vertical holes, 3.96 hp. The difference in power consumption is the difference in that required to rotate the steel. There is then an over-all efficiency of the motor and drill for vertical holes of 38% and for horizontal holes, 51%. The air consumption of a 3¼-in. air drill under working conditions is 150 cu.ft. free air per min., compressed to 85 lb. at the drill, or about 100 lb. at the receiver. To compress this air requires 30 hp. The over-all efficiency then of the compressor and air drill is less than 7%.

The actual rate of drilling per unit of power consumed is not so favorable to the Pneumelectric on account of frequent partial loss of compression, unskilled operation of the drill, and the use of the rose bit, which proved a slower cutter than the cross bit of the air machine. The average rate on vertical holes, including changes of steel and shifting drills, was 4.3 ft. per drill hour, or 1.1 ft. per hp.-hr. The average rate for horizontal holes was 4.0 ft. per drill-hour. The average rate for a 3¼-in. piston air drill in the same ground is 8.5 ft. per drill-hour, or 0.3 ft. per hp.-hr.

Troubles were found in the drill, due to structural weakness or faulty design; many such defects were corrected during the eight months that the drills were in use. The principal sources of trouble were the loss of pressure; breaking of dolly blocks; failure to rotate; stripping of gears and breaking of piston rods. These troubles were greatly reduced and finally were not serious.

The Dulles-Baldwin is a reciprocating drill with a 5- to 6-in. stroke and a speed of about 500 strokes per min. Power is transmitted from a 3-hp. motor to the drill by gearing and a connecting-rod, which gives a reciprocating motion to a steel cylinder. A piston and chuck move with the cylinder, the movement being cushioned by the compression of the air between the piston and the ends of the cylinder. The piston rod is slotted spirally to engage with a rotation mechanism at the drill head.

Measurements of 24 holes showed an average speed of 6.1 ft. per hr. The average over a period of five weeks, when the drills were working at their best, was 5.3 ft. per hr. A full shift of eight hours is required to drill a heading with five drills, for though some of the drills may finish in less time, it happened that one or two lost considerable time through breaking of parts. The average depth of shaft sunk per shift of eight hours was 0.8 ft. The power input at the motor is 4 kw. Allowing 80% efficiency for the motor, the power transmitted to the drill is 3.2 kw.

A large number of breakdowns was greatly reduced by improvements in design and change of material. It was necessary, however, to overhaul the drill each day. The principal sources of trouble were as follows:

Grounding of motors which occurred in shafts where there was water; burning out of armature due to excessive moisture, avoided by a new and improved insulation; short circuits in leads, eliminated by improved connections at motor; stripping or breaking of gear teeth when the steel stuck in the drill holes, one tooth perhaps breaking off and then grinding in the gears; shearing of stud bolts holding gear to crankshaft due to the same causes as stripping; breaking guide shells or drill case, eliminated by making these parts of cast steel instead of cast iron; breaking of cylinders, reduced by making cylinder and crank out of one piece; breaking of rotation mechanism, reduced to some extent by a new form of spring; loss of compression in cylinder, due largely to loosening of nut at end of cylinder and claimed to be due to a brass sleeve holding nut expanding more than the steel cylinder and allowing the nut to loosen; heating of drill, prevented by proper lubrication. The loss of compression and failure of the rotation mechanism were the chief causes of the trouble.

The results from the use of electric drills were a saving in the first cost of installation, the cost of manifold and air hose and connection to the drills; and an enormous saving in power. The net saving is, of course, dependent almost wholly upon the size of the tunnel. With a two-track railroad tunnel the relative cost of drilling under any condition would probably be not more than 50% of that of a single track, such as is being constructed for the aqueduct.

The comparison of power shows that on the average one 3¼-in. air drill will consume about 25 hp. On the other hand, an electric drill of equal capacity while in operation will require not more than 4 hp., and assuming that it is in actual operation not more than 60% of the shift, would mean that the actual power consumed would average 2.4 hp. It will be seen, therefore, that where it becomes necessary to use electric current for the compression of air, which is necessarily much more expensive than generation by steam under ordinary circumstances, the difference in power consumption is of great importance from an economic viewpoint.

Considerations other than drill efficiency and power consumption are of such importance as to make the air drill preferable to the slower-cutting electric drill for such work. These are especially, the impracticability of ventilating the heading while loading between shots and of quickly expelling the powder smoke after shooting, without compressed air, and the impossibility of drilling and shooting two rounds a day in each heading with the electric drill at its present rate of drilling.

In conclusion, it is but proper to state that the experiments were thorough and comprehensive. Everything that could be done to overcome the difficulties was done without regard to time or cost. The fact that after a year of most patient and persistent trial, the use of these drills was abandoned and the air drills installed at all shafts is evidence that the electric drills cannot successfully compete with the air drills on the kind of rock encountered in the aqueduct tunnels under the conditions that prevail in New York.

Copper Production of the World

In the accompanying table is given the estimate of the copper production of the world made by Messrs. Henry R. Merton & Co., of London, in accordance with their custom for many years. The total for 1913 differs by only a small percentage from the estimate given in our number of Jan. 10 last. The total showed a decrease of 19,735 tons, or 1.9% from the high figure reached in 1912; but a gain of 114,455 tons, or 13.1% over 1911. The more important gains were in Chile, Russia, Japan and Africa; the last named increase being from the Katanga mines. The heaviest loss last year was in Mexico. North America again reports by far the largest production, furnishing about 65% of the world's supply of copper, as it has for several years.

COPPER PRODUCTION OF THE WORLD
(In Long Tons)

	1911	1912	1913
United States	483,865	554,360	548,575
Mexico	60,905	72,455	51,980
Canada	24,930	34,710	34,365
Newfoundland	1,155	540	.....
Cuba	3,695	4,325	3,365
North America	574,550	666,390	638,285
Argentina	1,020	330	115
Bolivia	1,800	1,850	3,600
Chile	29,595	37,305	39,385
Peru	28,050	26,065	25,310
Venezuela	.....	1,340	1,250
South America	60,465	66,890	69,660
Austria	2,440	3,860	3,765
England	400	300	300
Germany	22,010	25,220	24,910
Hungary	85	100	305
Italy	2,600	2,300	1,600
Norway	9,425	10,980	11,610
Russia	25,310	33,010	33,240
Servia	6,885	7,240	6,275
Sweden	2,000	1,500	1,000
Spain and Portugal	50,930	58,930	53,835
Turkey	1,000	500	500
Europe	123,085	143,940	137,340
Japan	55,000	65,500	72,000
Australasia	41,840	47,020	46,580
Africa	16,980	16,370	22,510
Totals	871,920	1,006,110	986,375

What is a Mining Claim?

By A. L. H. Street

In determining that the Northern Pacific Railway Co.'s reservation of all minerals in lands granted to it by the United States and conveyed by the company, is taxable as an "interest in land" and is not exempt from taxation under the Montana constitution, which provides that "mines and mining claims," after purchase thereof from the United States, shall be taxed at the price paid the United States therefor, the Montana Supreme Court said in the recent case of Northern Pacific Railway Co. vs. Mjelde, 137 *Pacific Reporter* 386:

> While it is impossible for anyone to know with certainty what meaning the framers of our Constitution attached to the terms "mines" and "mining claims," . . . the application of . . . rules of construction . . . leads us to the conclusion that a mining claim, as therein used, indicates a tract of land to which the right of possession or title has been acquired pursuant to the acts of Congress relating to the disposition of mineral lands, including coal lands, and that a mine, independently of the surface, in the revenue sense as therein employed, is a mineral deposit, whether metallic or nonmetallic, developed to the point of production, and actually yielding, or capable of yielding, proceeds. . . . A mine upon a patented homestead is no less a mine because title from the Government was acquired under laws providing for the disposition of agricultural lands only; and an undeveloped body of ore is not a mine though title to it was secured under the mineral laws, but it is merely a part of the real estate itself.

Details of Practical Mining

Some Smithy Appliances

By A. Livingstone Oke*

The accompanying sketches illustrate a few appliances in the smith's shop at a mine in British Columbia. Fig. 1 is a circular forge made of light sheet-iron, and may be 4 or 5 ft. in diameter. Air is supplied by a large pipe a few inches lower than the top of the sheet-iron; there are three vents shown but only one is usually required, excepting for big heats. A sliding rest is shown at the back, consisting of a single piece of iron, bent to a U-shape, the two longer limbs passing into the side of the hearth and underneath the air pipe. At the side is shown a swinging arm which is also curved horizontally to lie close around the outside of the hearth when not in use. It is worth noting that whenever possible the air pipe at the side should be bent over and taken underneath the floor level, as this leaves the forge clear all around for working.

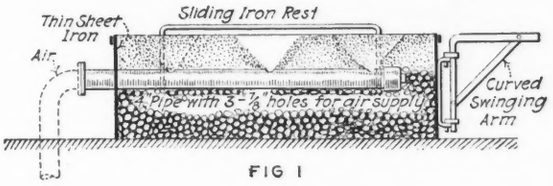


FIG 1

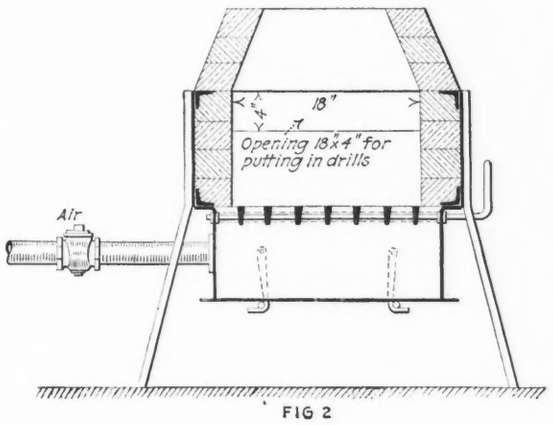
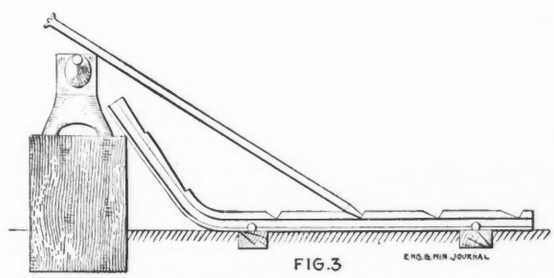


FIG 2



Simple Forges and Drill-Steel Rest for Mine Smithy

A small furnace for heating up drill steel, which inserted from both sides in the openings near the top, is shown in Fig. 2. The body of the furnace consists of sheet iron riveted to two rectangular frames, at top and bottom. Inside this body a firebrick lining is laid in and carefully fitted. The bottom of the furnace proper has a revolving grate, worked by a handle at the side. Below the grate is the air-box, which also receives the ashes and from which they are discharged through the hinged door, held up by the links as shown. There is a slightly conical cupola-top, through which the coke may be added.

A simple footing for holding drill-steel up to the anvil when swaging is shown in Fig. 3. It consists of a piece of 20- or 30-lb. rail, bent as shown and laid on two or more sleepers, with suitable notches cut in it to receive the ends of the drill steel. The top of the rail should be spiked to the timber under the anvil, as well, to assist in holding it solidly up to the work.

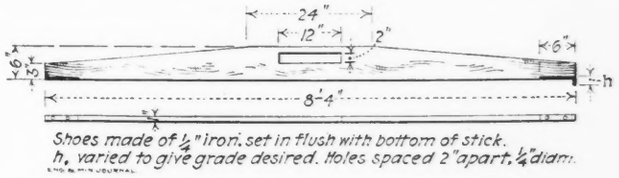
*Mining engineer, 3 Marine Terrace, Penzance, Cornwall, England.

Convenient Grade-Stick

By Edward H. Orser*

The grade stick shown herewith is a handy form of one of the most useful tools in the trackman's equipment.

It consists of a 1x6-in. board fitted with two iron angle shoes at the ends; the middle part of the top of the board is straight and true and parallel with the bottom. A handhole is cut as shown. The ends of the top are beveled off to reduce weight. The shoes on both ends are the same, but are placed in opposite positions, the short leg turning up in one case and down in the other. This short end is made of a length to give the exact grade desired; for example, if a 0.5% grade is wanted and the grade stick is 8 ft. 4 in. long, the length of the short leg of the shoe will be ½ in.



Iron-Shod Grade Stick for Mine Tracks

In use, the left end is kept ahead. When a new section of track is to be laid, the back end of the grade stick is set on one rail and a hand level placed on the flat top. The new rail is raised until the bubble is centered. If on straight track, the other rail is set by leveling across. If on a curve, the proper allowance for raise is made in

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the outside rail. If the level is out of adjustment, it should be reversed and the new rail lowered or raised so as to split the difference.

Mining Transit with Original Features

The mining transit shown in the illustration is of English manufacture and embodies many of the recommendations made by L. H. Cooke in a recent paper, published by the Institution of Mining and Metallurgy. The telescope is furnished complete by Carl Zeiss, of Jena; the transit is made by E. R. Watts & Son, of London. The telescope is of high quality, having a large field of view, sharp definition and remarkable light-gathering power. Its excellence permits a higher focused magnification than usual, namely, × 30. It is internally focused, so that except for eyepiece adjustments, it is of constant length outside, a considerable advantage. This method of focusing also permits a tighter construction and minimizes the difficulty of excluding dust. It is stated that the diaphragm stadia lines are ruled exactly to 1:100, so that no coefficient is required for reducing stadia readings. This would indicate that a glass diaphragm is used instead of spider web or platinum wire.

The horizontal circle and verniers are beveled somewhat flatter than 45°. The circle is 4⅝ in. in diameter at the reading edge and is graduated to read to 20 sec. The heads of the clamp and slow-motion screw for the lower motion are of different shape from those for the upper motion, tending to prevent confusion. The vertical circle is 4 in. in diameter and is also graduated to read to 20 sec. by opposite side verniers.

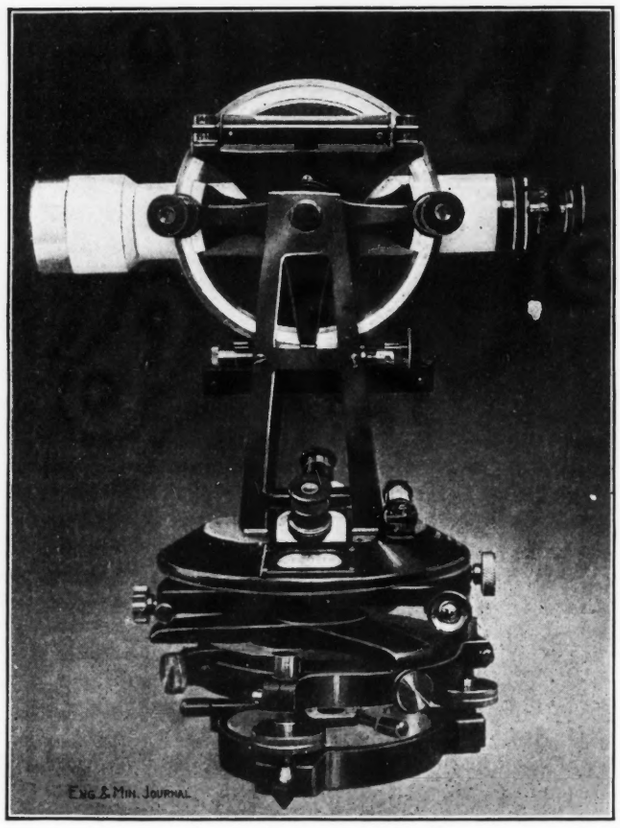
A trough compass is used with a 3½-in. needle; apparently this is attached to the standards, on the side opposite to the vertical circle. Two plate bubbles are used and a third bubble is set on the top of the vertical vernier arm. The telescope carries no bubble. The Cooke patent centering device is used. This permits a movement of 2¼ in. with a final adjustment by screws and has the additional advantage of permitting centering after leveling, without disturbing the level.

[The telescope for this transit would seem to be about the best obtainable in design and construction. Internal focusing is most desirable. If, as claimed, the stadia interval is accurate and constant at 1:100, it is an improvement on the common run of stadia-wire arrangements. The beveled horizontal circle, although not used in this country, would seem to offer the advantage of much faster reading. The greatest single advantage of the transit is its centering arrangement. If it is what it is claimed, it ought, at a guess, to save 25% of the time on every underground set-up.

In certain features, however, the instrument is defective. The position of the horizontal verniers on the sides is an awkward arrangement. The *A* vernier should be almost under the eyepiece where the transit is in normal position. This makes reading easier and faster and probably only 25% of the readings take place with the telescope plunged. The permanently attached reading glasses are hard to keep clean and are in constant danger of injury from their exposed position.

The vertical circle unprotected by even a guard is almost an invitation to bending or breaking; as a matter of fact, for mining work it should be wholly inclosed and protected as carefully as the horizontal circle. In many mines, the vertical circle is of almost equal importance with the horizontal. The objections to the use of attached magnifying glasses apply here with double force. A single edge-reading vernier is superior to those here shown, as being faster to read. The use of standards cast as a piece, the "U-standard," is in accordance with good practice, and the loss of the 360° compass is of no moment. The trough compass is a convenience, but its attachment in the position shown in this instrument is unwise, as it is too much exposed.

The third bubble mounted on the vernier arm cannot be considered in any way the equal of a long bubble attached to the under side of the telescope. The use of this instrument as a level would be impracticable. The small mine is usually equipped with a transit only, and for differential leveling in steep country, the transit gives results entirely equal to those of a level. Furthermore, this third bubble is exposed to knocks in a way wholly unnecessary.



Side View of the Transit

Perhaps the greatest defect in the transit, as here illustrated, is the lack of provision for using the auxiliary telescope. It is quite necessary that an all-round transit give sights at all angles up to vertical, and the only really satisfactory way of arranging this is by the use of the auxiliary. Furthermore, this should be capable of attachment to the top, bottom or either side of the main telescope. For ordinary steep-sight work, the side attachment is most satisfactory, but is unsuitable for giving line. For giving line, the top attachment is suitable, but

it does not permit of reading readily the vertical angle. A four-point attachment for an auxiliary telescope is an essential in any transit designed for general underground use.—EDITOR.]

A New Signal Apparatus

BY FRANCIS P. MANN*

The most recent improvements in electric apparatus are embodied in the new Adnil English devices shown in the accompanying illustrations. The first of these, shown in Fig. 1, is an apparatus for use in mines with audible and visual signals, and it is used for the transmission of signals for hoists for men and materials, giving a safe transmission of the different orders. An instrument which serves both as transmitter and receiver is placed at each of the mine levels and at the surface, while the winding-engine man has a receiver the signal No. 6 to be recorded on the dial of the engine-house receiver and the electric horn or bell to sound six times, while the pointers on all the other instruments all come back to zero. The signal thus given remains on the engineer's instrument until a fresh signal comes in.

Each instrument is provided with an indicator to show the level from which the order is being sent in; and by a special contrivance, it is impossible for a signal to be given from any other point than the one indicated. Should it be necessary, however, for a signal to be sent from another level different from the one seen on the indicator, this can be done by automatically altering the indicator by a special push which is fitted for the purpose. At the same time, as the alteration takes place, the bell or horn is sounded on each instrument, thereby drawing the attention of all to the fact of the alteration. This renders mistakes or malicious interference impossible, and there can never be any doubt as to where each signal is sent from.

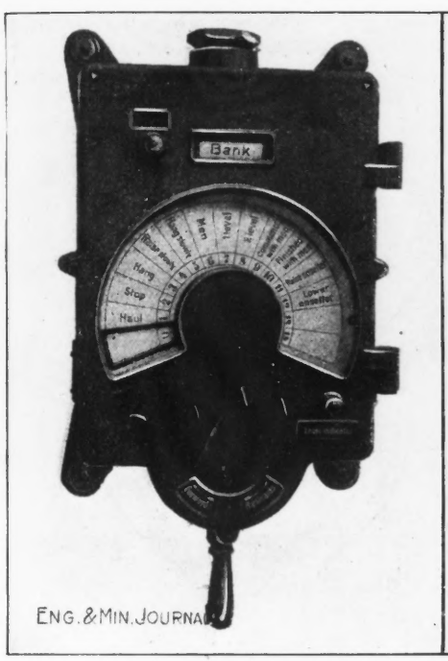


FIG. 1. RECEIVER

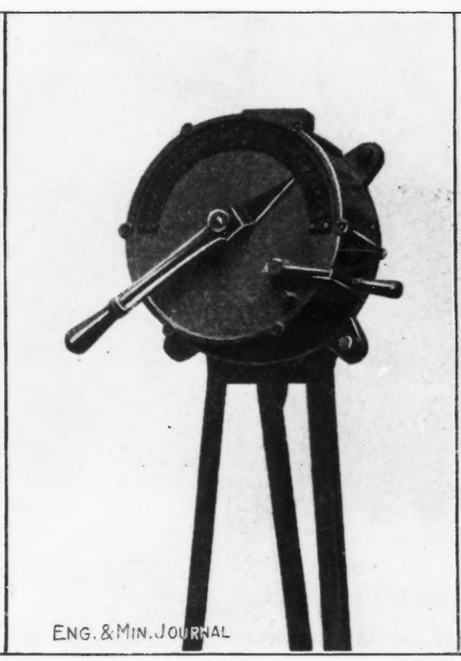


FIG. 2. TRANSMITTER

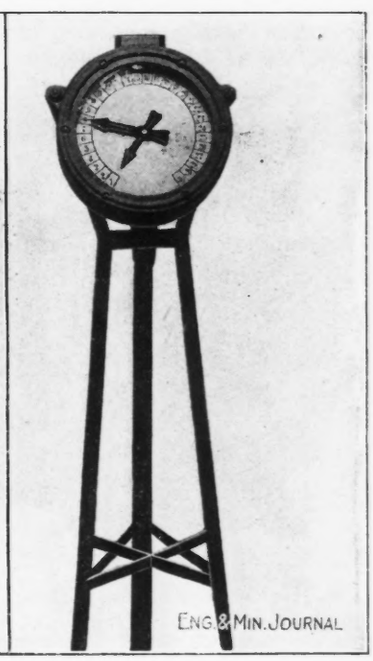


FIG. 3. TRACK SIGNAL

TYPES OF NEW MINE AND RAILROAD-YARD SIGNALING DEVICES

only, this latter somewhat resembling the first device. All these places have in addition an acoustic signal such as an electric horn or single-stroke bell. In the engine house is also placed the central contact apparatus to which all the instruments are connected.

The signals are sent in the following way. If a hoist signal is to be given from any mine level the miner moves the lever of his instrument around until the pointer is over the required signal, for instance, placing it over No. 6. This has the effect of placing the pointers of all the other instruments, the engine room excepted, upon signal No. 6. At the same time the acoustic signal is sounded at each point six times. When ready for the order to be carried out by the engine man, the man at the surface passes it on to him by merely pressing a "carry-out" push, not seen in the illustration. This causes

In case of pressing danger, another signal, differing in tone from the other alarms, can be given by pressing an emergency push, and this signal is sounded at the surface and in the engine room. The advantages claimed for the new device are simplest and quickest transmission from mine levels to surface, also the assurance that by a single pressure of a push, the banksman transmits to the engineer only the signal given from below. The level indicator makes known the point from which signals originate, and also prevents accident or interference. Centralizing of the more sensitive parts of the apparatus in the engine house instead of having them in the mine devices is another point, also the central contact apparatus which prevents the transmitters from getting out of step with the receiver.

Another device, shown in Fig. 4, is used for an improved lamp-signal system with visible and audible signals, being adapted for mines, railways, electric stations,

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etc. The combined transmitter and receiver comprises a cast-iron gas- and watertight case, which is divided into a number of compartments, each of which is provided with a glass panel front. Behind the panels are lamps, and besides each one is a push button. A special push for use in emergencies is also provided. For the engine room a similar device is used, except that it is fitted with an "acknowledging" push only. Any number of instruments can be connected in series. Electric horns or bells are employed at each point as audible signals. To give a signal the operator presses a push next the glass panel carrying the signal he desires to send, and this has the effect of lighting the lamp behind the corresponding panel in all the instruments, and at the same time the bell or horn is sounded until the push is released. The lamps, however, remain lighted until the engineer depresses the acknowledging push, whereupon all the lamps go out again.

Another useful apparatus, shown in Figs. 2 and 3, is mainly intended for railroad yards for signaling train numbers in making up trains or otherwise handling trains or cars, and the present instruments are suitable for any

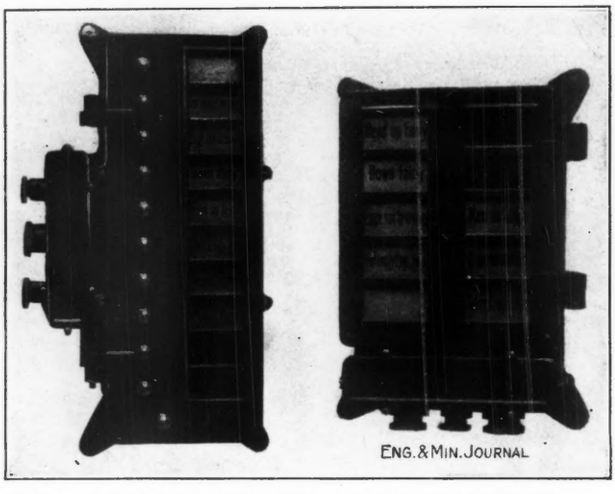


FIG. 4. ANNUNCIATOR SIGNAL TRANSMITTER AND RECEIVER

number of signals, while using only five conductors between transmitter and receiver. The power expended in moving the handle of the transmitter is transferred to a strong spring, which causes the current impulses to be sent over the line to the receiver at a uniform rate, so that no matter how quickly the transmitter handle is moved, it is impossible to throw the two devices out of synchronism. The receiver may be also fitted with a second and short pointer, as shown, which registers the next to the last signal. For instance, in the receiver illustrated the last signal given was No. 8, and the previous one No. 1. On a fresh signal, say No. 24 being given, the short pointer would immediately fly to No. 8, and the long pointer to No. 24, at its ordinary speed. By using bells or horns, the signals can also be made audible.

Precautions against Mine Fires

The following changes in mining practice are recommended by the Bureau of Mines to reduce the number of fires in metal mines and loss of life and property from such fires:

(1) Substitute oil, carbide or electric lights for candles.

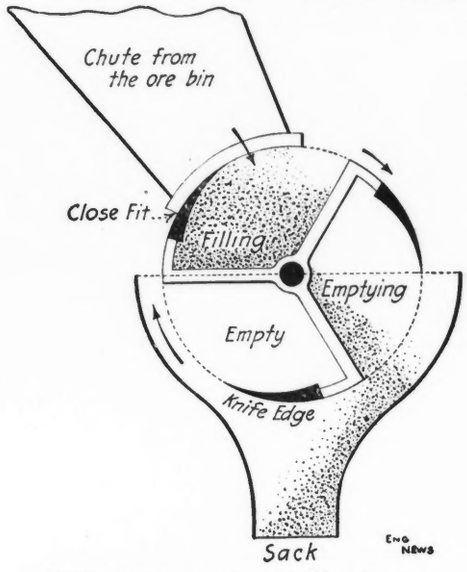
(2) Install mechanical fans for the purpose of regulating the air current in case of fire.

(3) Install fireproof shaft stations.

(4) Use a wire-rope or electric signal system instead of hemp rope.

Ore-Sacking Machine

A machine to be used instead of shovels for filling sacks with ore, is described in I. M. M. *Bull.* No. 113. The general construction of the machine is evident from the diagram; it consists of a drum divided into two parts by a partition at right angles to its shaft, each part further divided into three by radial vanes. The drum is fed from the ore-bin chute and discharges into a hopper with two spouts which project into the top of the sacks to be filled. The ore-bin chute fits snugly to the circumference of the drum and the six compartments are half closed on their circumferential sides, the closing portion being reinforced by a knife-edge of hard steel. A lever for turning the drum is fixed on a ratchet. As the lever is depressed, two full compartments empty into



CROSS-SECTION OF THE MACHINE

the sacks, the two just emptied move up part way to the chute and the other two move under the chute and are charged. The device could, of course, be arranged to fill more than two sacks at a time by extending the drum, but the size described will fill 360 sacks per hour with three men, a task which formerly required 15 men with shovels. The contents of the sacks furthermore are more accurately measured by this method.

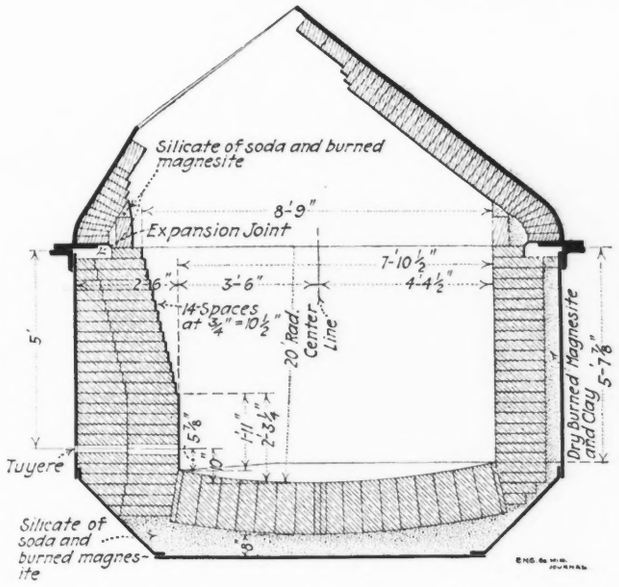
If the ore is wet, it will pack and delay the work somewhat; and it is advisable to cover the bin opening with grizzly bars spaced 1½ in., as large pieces jam in the machine.

For Getting Rope Over the Top of a Stack without calling on the services of a steeple-jack, a writer in "Power," Feb. 10, 1914, offers two suggestions. One consists of using a skyrocket inside the stack to carry up a light cord by which successively heavier weights of cord and rope can be hoisted. The other consists of using a crossbow in the same way. The necessity of getting a rope over the top of a stack may arise when it is required to paint the stack and the rope through the pulley at the top has fallen or been broken.

Details of Milling and Smelting

Lining Basic Converters at Cananea

The method of lining the 12-ft. upright electrically operated converters at Cananea is shown in the accompanying drawing. The converters are 12 ft. in diameter, the month of the converter being 5 ft. in diameter; the body is made of 1-in. steel plate, and the cap is of cast steel. Most of the converters at the Cananea Consoli-



LINING 12-FT. UPRIGHT CONVERTERS AT CANANEA

dated Copper Co. are lined with a distance of 10 in. between the tuyeres and the bottom, though in several converters this depth has been slightly increased. A 3-in. expansion joint is left at the top of the lining of the cylindrical portion of the converter and the dry, ground magnesite and clay in the space in the half circle of the body, opposite the tuyeres, is filled in loosely to allow for expansion. In lining, it is important to use as little water as possible for the reason that the magnesite bricks are liable to absorb moisture and disintegrate when a moderately high temperature is attained. Of course, care must be used in the storing of magnesite bricks, as this expensive product may readily be rendered worse than useless by absorbing moisture and later disintegrating after the bricks are in place.

Zinc Hydrometallurgy

Anson G. Betts, in U. S. Patent No. 1,066,245 (July 1, 1913), says that he is able to leach roasted zinc ore with dilute sulphuric acid and obtain a solution free from iron by adding a small quantity of a peroxidizing chemical to the dilute sulphuric acid. A chromate, or chromic acid, or a permanganate, or permanganic acid, is suitable. A very small quantity is sufficient. Mr. Betts says that he is "not at present able to offer any chemical explanation of the action of the oxidizing agent in preventing the solution of the iron in the ore, but can only state that it accomplishes the desired result, even in the presence of an excess of sulphuric acid." He recommends the use of a slight excess of acid in order to dissolve as much of the zinc as possible.

Ore-Classification Slide Rule

BY B. G. PATTERSON*

In order to compare the estimated smelting recoveries and costs of certain classes of ore with the estimated concentrating recoveries and costs, for varying recoveries of both gold and copper, and at the same time to avoid tedious calculations in making these comparisons, the device here illustrated was recently adopted by the Mount Morgan Gold Mining Company.

The principle on which it is constructed is simple. If perpendiculars *CA* and *BD*, Fig. 1, be erected at either

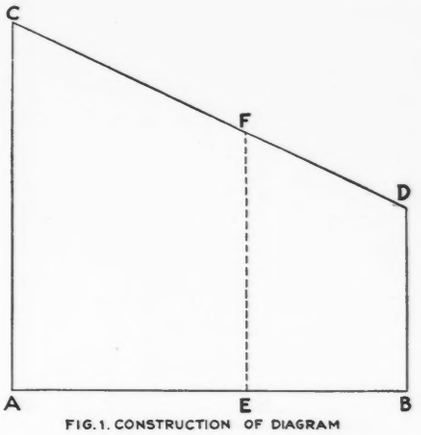


FIG. 1. CONSTRUCTION OF DIAGRAM

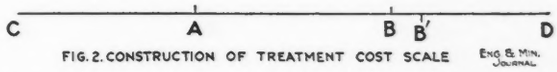


FIG. 2. CONSTRUCTION OF TREATMENT COST SCALE ENG. & MIN. JOURNAL

end of a base *AB*, and if *BD* be made equal to half *CA*, then if *CA* represents, on any scale, the value of the metallic contents (either gold or copper) of a ton of ore, *BD* will represent, on the same scale, the value of the same metallic content with a 50% recovery and any line *EF* parallel to and between *CA* and *BD* will represent the value of the same metallic content for a recovery of $(50 + \frac{BE}{BA} 50)$ %.

If *CA* be taken of such a length as to represent, on some convenient scale, the number of shillings contained in, say, 10 dwt. of gold and *BD* be taken at half this length and if the lines *CA* and *DB* be divided into 100 (or 50) equal parts and corresponding points be joined, the result is a continuous diagram graduated in tenths

*Mine statistician, Mount Morgan Gold Mining Co., Ltd., Mount Morgan, Queensland.

(or fifths) of a pennyweight, from which can be scaled the value of the recovered gold for any recovery between 100% and 50%.

The base line *AB* may be graduated to represent the recoveries between 100 and 50, but if the recoveries to be considered are known, it is more convenient to dispense with the base-line graduations and mark lines across the diagram to correspond with these known recovery figures.

A similar method can be followed in making a continuous recovery diagram for the copper content of ores. be used in this case, as it is the Mount Morgan practice to take always the one figure for the market value of copper in making such calculations as this.

In Fig. 3, it will be noticed that a second series of lines is drawn (yellow on the original), parallel to the base line, across the copper diagram. These lines enable the percentage of recovered copper to be read off, as well as the value. The line cut also shows the recovery lines marked across the diagram, but does not show that they are drawn in two colors. One set of lines is for smelting recoveries, the other for concentrating recoveries The latter are, however, arranged to show the recovered value after allowing for smelting loss on the concentrate, e.g., the line marked "90" on the copper diagram actually shows recovered values with a concentrating recovery of 90% and a smelting recovery of 88%. An engine-dividend $^{40}/_{80}$ scale was used to read off the recovered values. the 80-scale graduations serving conveniently as a scale of 8s. to the inch.

To determine the estimated cost of treatment of the ore, either for smelting or concentrating, it was considered sufficient to take fixed figures—i.e., it was not

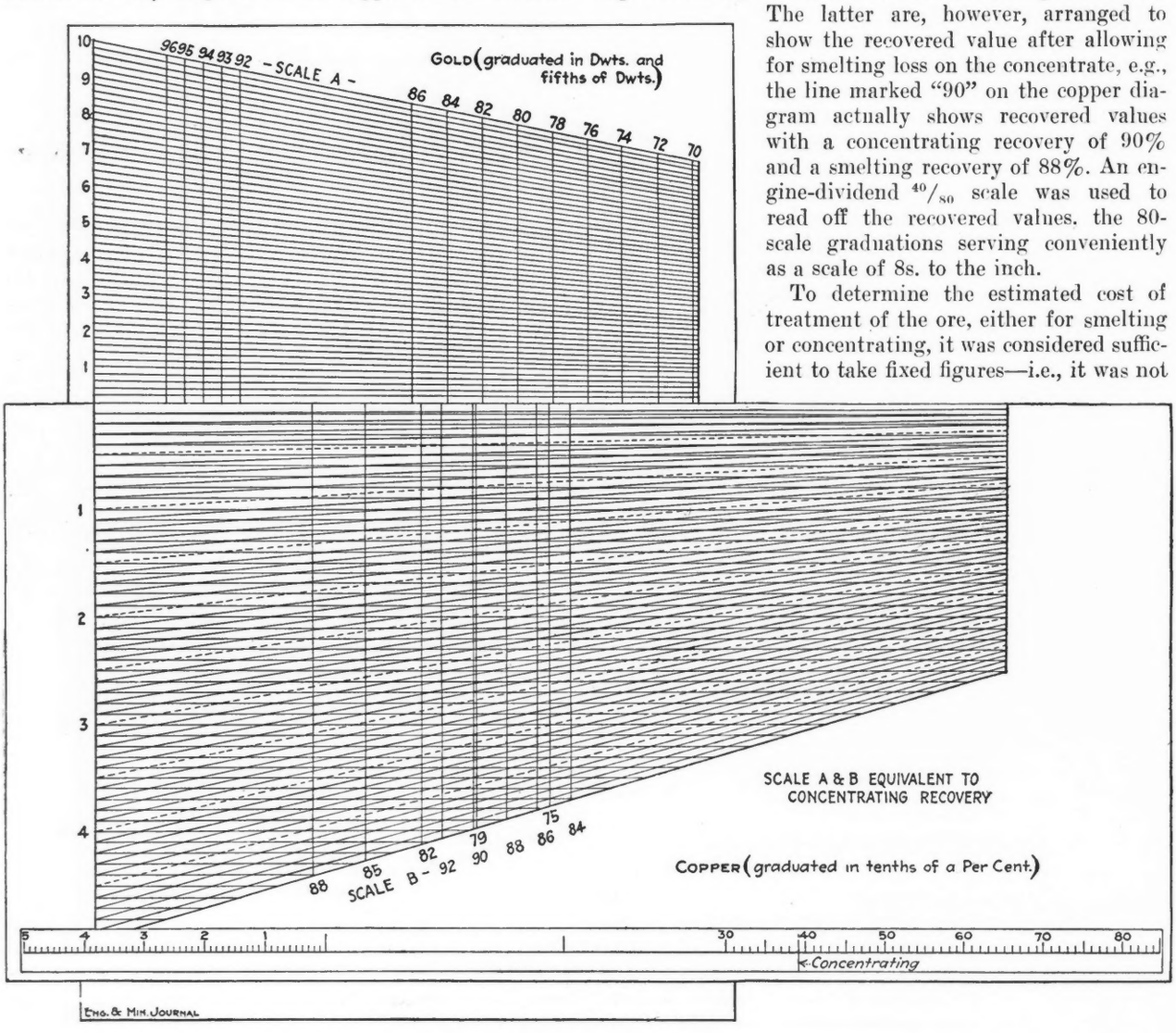


FIG. 3. THE DEVICE IN USE

If the second one be made to read to the same scale of shillings as the first, and if the two be placed base to base, and can be moved so that any point on the base of one can be brought up to any point on the base of the other, then it is possible to set the diagrams so that the total recovered gold and copper content per ton of any ore for any recoveries of gold and copper can be measured off at one reading.

It should be noted that the copper diagram can not allow for variations in the market value of the metal. This does not matter for the purpose for which it is to

required to construct a diagram to read treatment cost with varying figures for the amounts making up the total cost, although this could easily have been done if it had been necessary.

It was assumed that this cost could be determined closely enough as follows. The cost of treating any ore can be taken to be made up of: (1) A charge which does not vary with the composition of the ore, but is the same for high- and low-grade and high- and low-silica ore (mining and basis smelting charge); (2) a charge which varies with the recovered copper contents

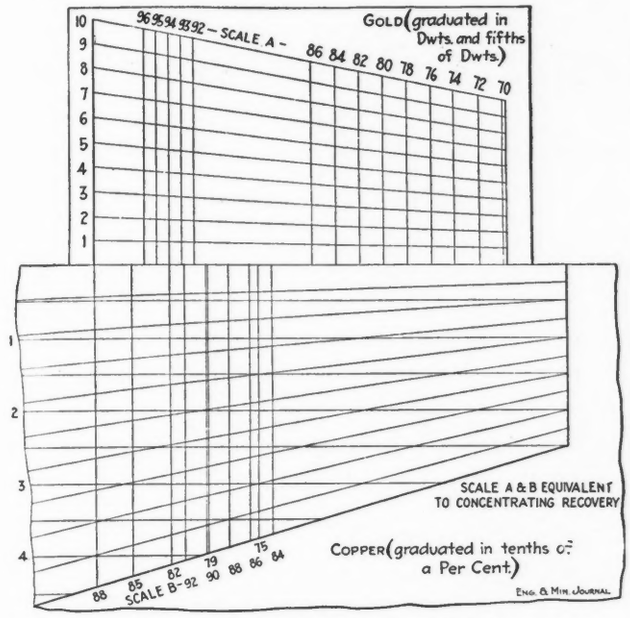


FIG. 4. DEVICE SET FOR 94% AND 82% SMELTING RECOVERY

of the ore (converting, refining, realization charges, etc.); (3) a charge which varies with the silica contents of the ore; or rather per unit increase over a certain silica content for which the charge for smelting can be taken as constant.

Using a scale of 4s. to the inch, the 40 side of the $^{40}/_{80}$ scale, a length *AB*, Fig. 2, was measured off, equal to the cost of mining and delivering ore to the bins, plus the constant smelting charge. *AC* was measured off equal to the converting, realization, fixed charges, etc. on 5 recovered units of copper. *BD* was measured off equal to the added cost of smelting 50 units of excess silica, the unit increases being taken from 30%. Divide *AC* and *BD* into 50 equal parts; the graduations of *AC* representing each per cent. and tenth of a per cent. of recovered copper from 0 to 5% and those of *BD* each per cent. of silica from 30% to 80%. Mark off also *AB'* equal to the cost per ton of ore for mining, delivering and concentrating the ore (including royalty) and for smelting the concentrates.

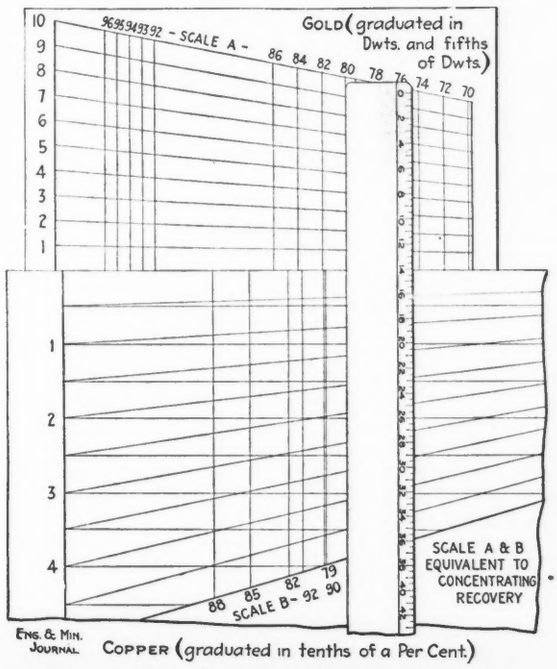


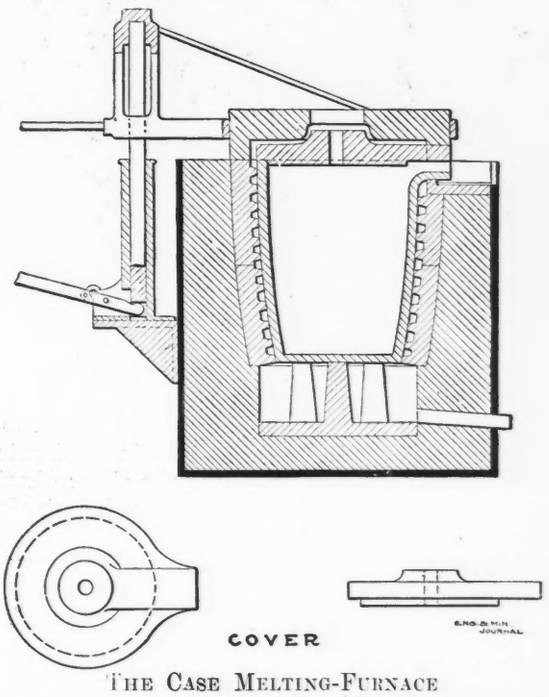
FIG. 5. DEVICE WITH MEASURING SCALE

To read off the treatment cost: Place zero of the measuring scale at the mark on *AC* representing recovered percentage of copper, as determined by the above described yellow lines, then the point on the measuring scale at the mark *BD* representing the silica content of the ore will read the total treatment cost for smelting; for concentrating read the point at the mark *B'*. Fig. 3 shows this treatment-cost scale drawn in at the bottom in pencil, in order that it may be erased and drawn in afresh when it is desired to alter the cost figures.

Fig. 4 shows the device set to read recovered values with a smelting recovery of 94% gold and 82% copper and Fig 5 shows it with a concentrating recovery of 80% gold and 89% copper. The latter also shows the measuring scale placed with its zero at 8.2 dwt. per ton of gold.

Case Tilting Furnace

Some improvements have been made to the Case tilting furnace for melting precipitate. The improvements consist of a crucible of unique form, which can be used



THE CASE MELTING-FURNACE

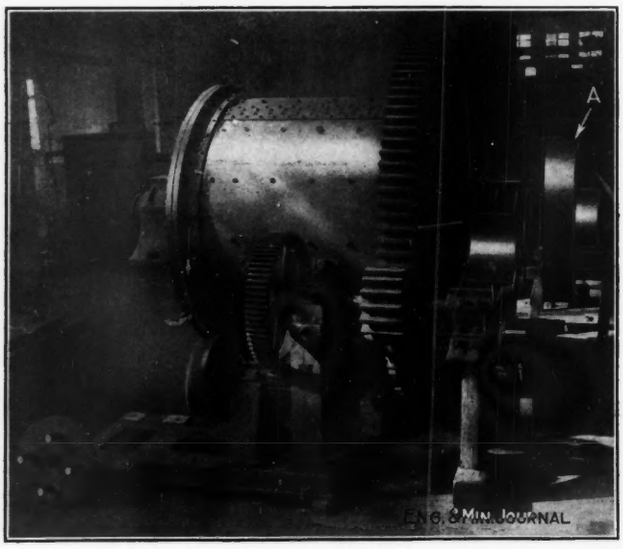
either as a crucible or as a retort. The spout of the crucible is brought out at right angles to the major axis, and is practically semicircular in section. A special cover is designed for the crucible, which fits down inside of it, and has a projection which covers the protruding spout. The object is to prevent overcharging of the crucible. If it is overfilled, the excess runs out through the spout instead of slopping over into the furnace. It also affords safety against dust losses while melting is going on. The device is covered by U. S. patent No. 1,085,540, granted to W. W. Case, of Denver, Colo. The accompanying drawing shows a furnace with the improvements added.

Mining & Metallurgical Machinery

The Short-Tube Mill

Among manufacturers and users of fine-grinding machinery, the so called short tube mill is today receiving a great deal of attention and consideration. While it may be said to be still in the experimental stage, certain steps have already been taken in its development, and its future growth and changes will undoubtedly be followed closely by those interested. The manufacturers who are working along these lines believe they are on the right path.

A good example of the short-tube mill, in its present stage of development, is the one now manufactured by the Traylor Engineering & Manufacturing Co., Allentown,



A 6x7-Ft. Short-Tube Mill

Penn., and shown in the accompanying illustration. These mills are built in sizes ranging from 4 ft. to 7 ft. in diameter and 6 ft. long, the ones in the illustration being 7x6 ft. The drive used may be either direct-connected motor, or belt. From a mechanical standpoint, the aim in designing has been to provide a strong and durable mill, one that will stand up satisfactorily under the hard conditions incident to grinding work.

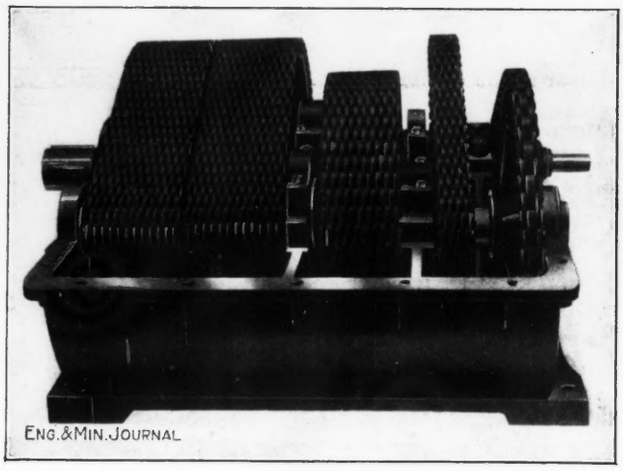
The shell is of ½-in. material, and the ends are spherical and of ribbed construction, to enable pebble linings in cement to be placed in them, if desired. The spherical shape of the ends also imparts strength and tends to insure against breaking. The boxes, shafting and gears are extra heavy and well machined.

An extra-large scoop feed, shown at *A*, is placed on the mills by means of which the pebbles are carried above the center of the mill. The trunnion, through which the screw feed runs, is arranged for water cooling, if desired, the trunnions themselves being extra heavy and polished to increase the ease of running. The gears which take the power from the motor are cut cast steel, whereas the other gears are cast iron. One of these mills, 7x6 ft., taking a feed of six mesh, grinding wet and operating on 50 hp., is claimed to treat 200 tons per 24 hours to 40 mesh.

An 8x6-ft. mill, shown in the illustration, has been shipped to Wilfley & Mears, Silverton, Colo., presumably for competitive tests. Also, a mill of the same size and type as that shown, but arranged for belt drive instead of a direct-connected motor, has been placed in the concentrating mill of the Hercules Mining Co., at Wallace, Idaho, where it will undergo competitive tests with another well known mill of a somewhat different type, under working conditions. An 8x6-ft. mill has been shipped to the North Washington Power & Reduction Co., at Republic, Wash. The results of these tests are expected to be of great interest and perhaps of considerable importance to users and manufacturers alike.

A Compact Reduction Gear

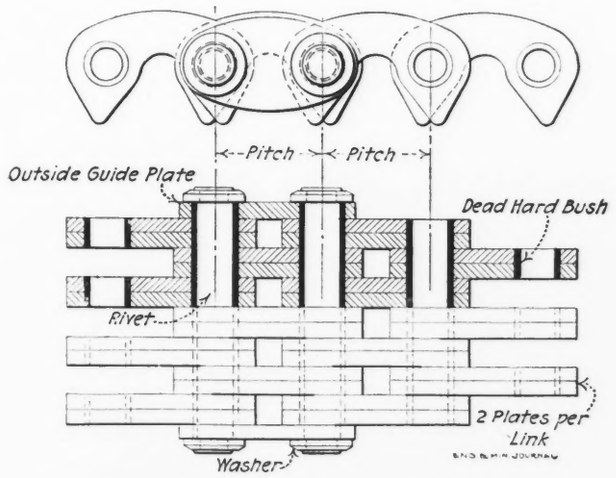
An extremely compact form of reduction gear which has been adopted in Great Britain in connection with electric drives, is here illustrated. The figure shows a quadruple-reduction box for the transmission of 25 hp., the initial or motor speed being 675 r.p.m., the final being 5 r.p.m., a ratio of 135:1. The gear was con-



Gear Box with Cover Removed, Showing Chains and Sprockets

structed by the Coventry Chain Co., Ltd., of Coventry, England. A special type of chain is adopted, constructed as shown. In the profile of the link, care is taken to see that its working angle is correct and the holes are drilled and reamed with great accuracy. The links are arranged in pairs, held together by a dead-hard bushing forced into the reamed holes of each link, thus ensuring stationary and hardened bearings where most of the wear will inevitably take place. This produces strong and rigid chains reducing the liability to loose bearing surfaces. The double links are assembled alternately to form the various widths in combination, they are all kept together and work on hardened steel rivets provided with

washers at their extremities. All the wearing surfaces of the chains are dead hard. There is no sliding friction between the links and the teeth during the time of engagement. When new the chains lie compactly between the teeth, but as the elongation of pitch, due to inevitable wear, shows itself, the chain automatically accomodates itself to the teeth of the wheel and hence the load is equally distributed between all the teeth that may at any moment be between the points where the chain enters and leaves the teeth. It is claimed that with this type of chain, extremely high speeds can be obtained, without setting up undue noise; 1400 ft. per min. is the



MANNER OF ASSEMBLING THE LINKS

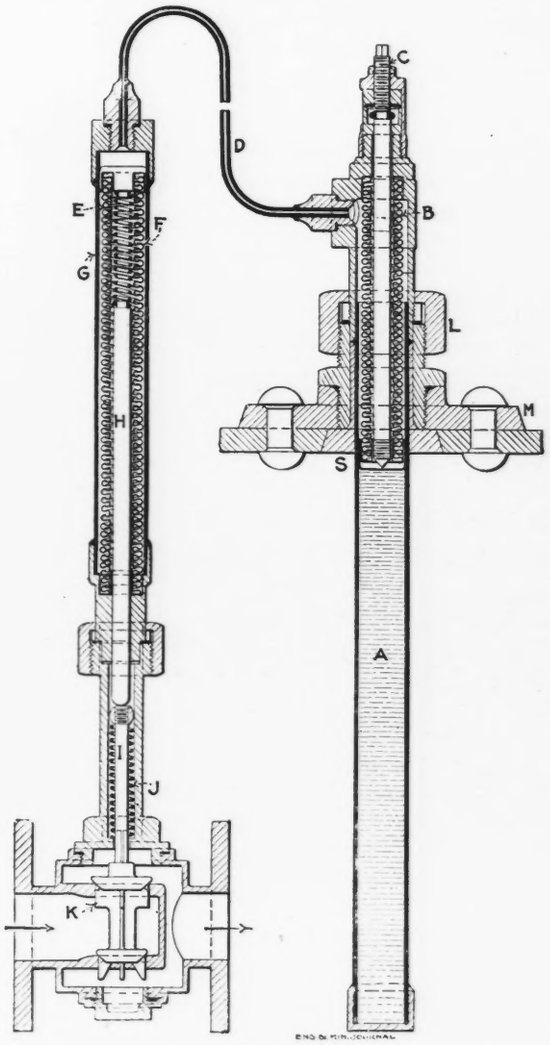
usual maximum provided, but if the driver is entirely inclosed in an oil case, a higher speed may be permissible. The compactness and simplicity of the arrangement combined with its remarkable running qualities, render this transmission a matter of more than ordinary interest and is therefore mentioned as being of interest to engineers who are faced with the problem of adapting electric drive to low-speed machinery with the minimum of intermediate gearing.

Electric Mine Lamps

There seems to be some specific instances in which good use could be made, in metal mines, of portable electric lamps, one place where they are apparently of unquestioned value being in the equipment of the mine-rescue apparatus, which many mines now possess. The Shannon Copper Co., Clifton, Ariz., advises that it is using several such lamps for this purpose, the type of lamps in this instance being that made by the Hirsch Electric Mine Lamp Co., 314 N. 12th St., Philadelphia, Penn. This company makes the lamps in both the portable hand and cap types, the current in each case being supplied by a storage battery. The batteries can be recharged with direct current, one charge sufficing for 12 hours' light. When not continually in use, the recharging should be done at least every six months. The Hirsch lamp is well known in the coal-mining fields, where it is being extensively used by many companies. The Franklin Institute of the State of Pennsylvania has recently awarded the Edward Longstreth Medal of Merit to H. H. Hirsch, president of the company, for his miner's electric safety lamps.

Sarco Temperature Regulator

A temperature regulator, working on the thermostatic principle used in the Sarco steam trap is put on the market by the Sarco Engineering Co. The diagram showsthe method of operation. The regulator is made of three principal parts: *A*, the thermostatic element which is insterted in the boiler or tank; *G*, the controller element, and *K*, the valve. *A* is a tubular receptacle containing a heavy hydrocarbon oil into which is inserted a piece of



SECTIONS OF THE PARTS OF THE REGULATOR

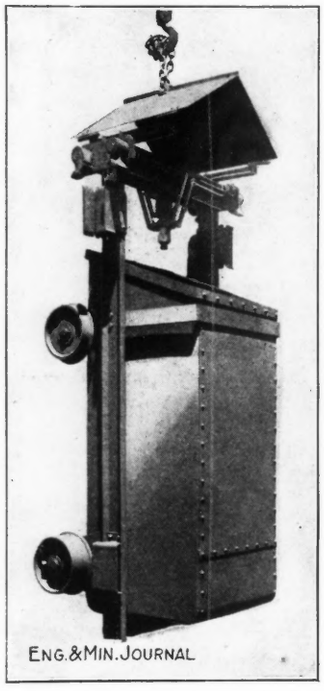
corrugated copper tubing; the length of this is increased or reduced by turning the regulator head *C*. From this thermostatic element a piece of fine copper tubing *D* passes to the controller *G*, which also contains a piece of corrugated tubing capable of compression when an increase of temperature causes the surrounding liquid in *A* to expand. The thermostatic element *A*, the connecting copper tube *D*, and the controller *G* form one hermetically closed chamber. When temperature increases in *A* the pressure increases and is transmitted to *G*, causing a compression of the copper tube *F*, which forces out the piston *I* and tends to close the valve. Spiral springs *E* and *J* operating in the opposite direction tend to keep the valve open.

The device is suitable for controlling the temperature

of liquids in tanks and in the natural-gas districts it may be applied in conjunction with various burners to regulate the flow of gas and maintain an even temperature.

Skip with Novel Bail Attachment

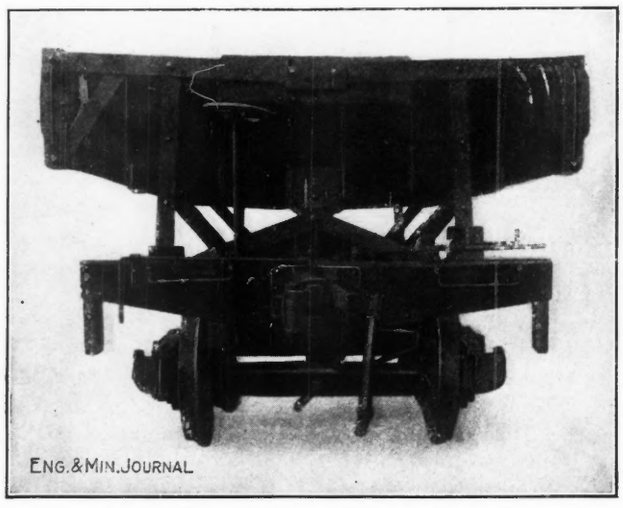
The skip illustrated is one built by the Denver Engineering Works for the Commonwealth Mining & Milling Co., of Pearce, Ariz. An unusual feature is the fastening of the bail so that it is practically hinged, by an extension, to the rear axle. This arrangement eliminates all strains on the guides when the skip is dumped. Another feature is the band connected to the bail on both sides and extending around the skip so as to prevent the skip from turning backward in certain positions. The capacity of the skip is 60 cubic feet.



NOVEL BAIL ARRANGEMENT FOR SKIP

Steel Hand-Dump Car

The contractors' dump car here illustrated is built entirely of steel with wood floor planks. The ends are of steel plate reinforced by six heavy gussets riveted to the long beams. The doors are of steel plate inside with wood filler beams, thus combining the elasticity of wood with the strength of steel. For the side chains, an automatic looking device is substituted, consisting of heavy cast-steel hooks, one at each bolster, which engage downward-projecting links on the car. Both hooks on each side of the car are operated by levers placed on the end sill at diagonally opposite corners. When the car is again brought to the upright position, it locks automatically.

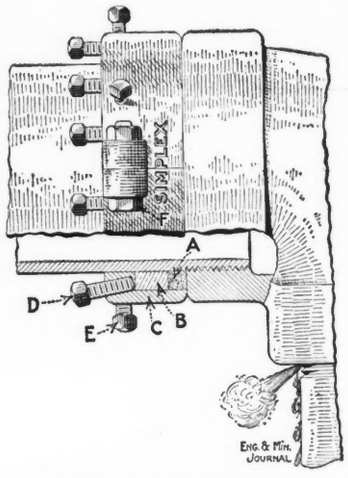


END VIEW OF CONTRACTORS' DUMP CAR

The underframe and end sills of the car have been made especially heavy to conform with the Interstate Commerce Commission requirements, so that the cars can be shipped anywhere on their own wheels in trains of heavy standard-gage equipment without danger of being injured. The car is made by the Orenstein-Arthur Koppel Co., of Pittsburgh, Penn.

Clamp for Leaky Pipe Joints

Perhaps nothing is more annoying nor untidy around a mine or mill than a leaky pipe joint, and such leaks are undoubtedly a source of loss. The loss so incurred may not at first be evident, but if unattended to, it is bound to make itself felt in time, and through various channels, principally the coal pile and the labor account. It is not always convenient to put in a new pipe length or to shut down the line, unscrew the joint and attempt to fix it in that way. In many cases it would be more convenient and economical to put off applying the real remedy for a few weeks, bridging the interval with a temporary repair of some sort.



CLAMP FOR LEAKY JOINT

A device to fit just such a need is made by the Yarnali-Waring Co., 1109 Locust St., Philadelphia, Penn., and is sold under the name of the "Simplex Pipe Clamp." It is simple in design and application, being readily attached by one man in from 10 to 20 min. Referring to the sketch, *A* is a square packing ring to be forced against the leaky joint, and *B* is an inside ring, which in turn is forced against *A* by the screws *D*. An outside ring *C*, which is bolted around the pipe by the bolts *F*, and secured by the setscrews *E*, prevents slipping when adjustment is made by screws *D*.

Someone has figured that in a steam line at 150 lb. boiler pressure, a leak of $\frac{1}{32}$ in. costs $8.45 per year, and when increased to $\frac{1}{8}$ in., the cost has leaped to $135.20 per year. Whether or not these figures are accurate, it is certain that leaks cost money, and that if not attended to, both the leaks and the cost increase. The price of these clamps are moderate. Special clamps are made to order, and all clamps are sent on 30-days' trial, returnable if not satisfactory. The manufacturers state that over 8000 are in use, and that the users report excellent results.

The A. Harvey Manufacturing Co., Ltd., Detroit, Mich., is marketing a new pipe wrench, that is described as being instantly adjustable with one hand. The three working parts are said to pivot on each other, without using a rivet or pin at the pivotal point. Among other advantages claimed, are lightness, strength, and special adaptability to close places. The price varies from $1 to $2, depending on size.

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TESTS OF PERMISSIBLE EXPLOSIVES. By Clarence Hall and Spencer P. Howell. Pp. 213, illus. Bull. 66, U. S. Bureau of Mines, Washington, D. C.

A PRELIMINARY REPORT ON URANIUM, RADIUM AND VANADIUM. By Richard B. Moore and Karl L. Kithil. Pp. 101, illus. Bull. 70, U. S. Bureau of Mines, Washington, D. C.

COAL-MINE ACCIDENTS IN THE UNITED STATES AND FOREIGN COUNTRIES. By Frederick W. Horton. Pp. 102, illus. Bull. 69, U. S. Bureau of Mines, Washington, D. C.

ELECTRO-THERMAL METHODS OF IRON AND STEEL PRODUCTION. By John B. C. Kershaw. 5½x9, pp. 233, $3. D. Van Nostrand Co., New York.

HOW TO BUILD UP FURNACE EFFICIENCY. A Handbook of Fuel Economy. By Joseph W. Hays. 5x7¼, pp. 126, illus,; $1, paper. Published by the author at Chicago, Illinois.

METAL STATISTICS, 1914. 4x6¼, pp. 287. American Metal Market Co., New York.

LABORATORY MANUAL OF GLASS-BLOWING. By Francis C. Frary. 7¾x5, pp. 60, illus.; $0.75. McGraw-Hill Book Co., New York.

THE NOATAK-KOBUK REGION, ALASKA. By Philip S Smith. Pp. 167, illus. Bull. 536, U. S. Geological Survey, Washington, D. C.

FUEL-BRIQUETTING INVESTIGATIONS, JULY, 1904, TO JULY, 1912. By C. L. Wright. Pp. 277, illus. Bull. 58, U. S. Bureau of Mines, Washington, D. C.

THE BASINS OF NELSON AND CHURCHILL RIVERS. By William McInnes. Pp. 146, illus. Memoir No. 3, Canada Department of Mines, Geological Survey, Ottawa, Canada.

THE GEOGRAPHY AND INDUSTRIES OF WISCONSIN. By Ray Hughes Whitbeck. 6¾x9¾, pp. 94, illus. Bull. XXVI, Wisconsin Geological and Natural History Survey, Madison.

THE JOURNAL OF THE IRON AND STEEL INSTITUTE. Vol. LXXXVIII, No. 2, 1913. Edited by George C. Lloyd, Secretary. 5½x8½, pp. 783, illus. Iron and Steel Institute, London, England.

HYDRAULIC MINE FILLING: ITS USE IN THE PENNSYLVANIA ANTHRACITE FIELDS. A Preliminary Report. By Charles Enzian. Pp. 77, illus. Bull. 60, U. S. Bureau of Mines, Washington, D. C.

ANNUAL REPORT ON THE MINERAL PRODUCTION OF CANADA DURING THE CALENDAR YEAR 1912. John McLeish, Chief, Division of Mineral Resources and Statistics. Pp. 339. Canada Department of Mines, Mines Branch, Ottawa, Canada.

METAL MINES AND SMELTERS IN CANADA. Compiled and issued by the Mines Branch of the Department of Mines of Canada. Ottawa, Ont., December, 1913.

This is a list of the metal-mine and smelter operators in Canada, classified under the ore produced and then according to the location of the mine or works. It is not intended to be a complete list, being published primarily for the purpose of obtaining corrections and additions to the list on file. It will, nevertheless, be found very useful for reference.

ONTARIO BUREAU OF MINES, TWENTY-SECOND ANNUAL REPORT, 1913. Vol. XXII, Part 1. Pp. 300, illus. Ontario Bureau of Mines, Toronto.

Contents: Statistical review; mining accidents; mines of Ontario; the Whiskey Lake Area; the Massey copper-mine area; Hudson Bay exploring expedition, 1912; the Lake of the Woods and other areas; the West Shining Tree Lake area; glacial phenomena of Toronto and vicinity; moraines north of Toronto.

L'ANNUAIRE DU BUREAU DES LONGITUDES POUR L'ANNEE, 1914. 6x3¼, pp. 502 plus 192, illus., paper; 1 fr. 50c. Gauthier-Villars, Paris, France.

Besides the astronomical constants which one naturally expects in an ephemeris, this book contains lengthy tables on densities, vapor tensions, specific heats, heats of fusion and evaporation, solubility, thermo-chemistry and many other subjects. It is of good size to carry around, and in daily use we have found it of more service than many more pretentious works have been.

OIL PRODUCTION METHODS. By Paul M. Paine and B. K. Stroud. 6¼x9½, pp. 239, illus.; $3. Western Engineering Publication Co., San Francisco, Calif.

This is a real book by authors who really know how. Both of them are superintendents of oil companies in California. Naturally, they are strongest in California practice.

MINE SURVEYING. By Edward B. Durham. Pp. 391, illus.; $3.50. McGraw-Hill Book Co., New York.

This is an excellent and useful handbook on an important subject. Its author is associate professor of mining in the University of California. His book is as good as anything we know of on its subject, which, of course, is not a new one. In many respects it is better than anything that has been done before it.

INDUSTRIAL CHEMISTRY. By Allen Rogers and Alfred B. Aubert. Pp. 854, illus.; $5. D. Van Nostrand Co., New York.

This book is designed to be a manual for the student and manufacturer. One of the authors is in charge of industrial chemistry in the Pratt Institute, Brooklyn. The other was formerly professor of chemistry in the University of Maine. They have been assisted by 34 collaborators, specialists in their respective subjects. The result has been a good and useful book.

THE ELECTRIC FURNACE. By Alfred Stansfield. Second edition, revised, enlarged and reset. Pp. 415, illus.; $4. McGraw-Hill Book Co., New York.

This is a new edition of a well known book, and as stated on its title page, it has been revised and enlarged. The revision has, in fact, been complete and the enlargement has been extensive. Doctor Stansfield, who is professor of metal-

lurgy at McGill, is practically experienced in his subject. His book is the best thing on the subject that we know of, it is satisfactory, and it is confidently to be recommended to all interested in electric furnaces, their operation and uses.

THE CURIOUS LORE OF PRECIOUS STONES. By George Frederick Kunz. 6¾x9, pp. 406, illus. J. B. Lippincott & Co., Philadelphia, Penn.

This interesting book, by a distinguished authority who needs no introduction as an author, is a collection of curious miscellanea about precious stones. It is almost unnecessary for us to say that it is well done, inasmuch as Doctor Kunz always does his work well. The paper, printing and engravings, many of the last being in color, are superb. However, it is a book for the general library rather than the technical library.

MAGNETITE OCCURRENCES ALONG THE CENTRAL ONTARIO RAILWAY. By E. Lindeman. Pp. 22, illustrated with maps. Mines Branch, Canadian Department of Mines, Ottawa.

The iron-ore ocurrences covered by this report are situated along the Central Ontario Ry. between the Central Ontario Junction and the village of Bancroft, a distance of 60 miles, including the Bessemer, Blairton, Coehill and other mines, some of which have been worked intermittently for many years, generally with disappointing results.

The magnetites of the district may be divided into two groups. (1) Magnetite occurring along or near the contacts of limestones and schists with igneous rocks, and (2) Titaniferous magnetite associated with gabbro eruptives. The latter are regarded as of little economic value.

AUSTIN BROOK IRON BEARING DISTRICT, N. B. By Einar Lindeman. Pp. 15, illustrated with maps. Mines Branch, Canadian Department of Mines, Ottawa. Government Printing Bureau.

This report embodies the results of a magnetometric survey covering an area of about two square miles in the Austin Brook iron-bearing district of New Brunswick, commenced in 1906 and subsequently extended. Several ore deposits not previously known were discovered and are described.

The orebodies lie in three main groups. So far the development work done has been very slight hence the data for estimating the ore tonnage are only meager; nevertheless, an attempt has been made to calculate the probable area of the orebodies. The estimate, which largely depends on the evidence furnished by the few diamond-drill holes put down and the magnetometric survey, and does not pretend to be anything but a rough approximation, gives the total probable ore area as 314,000 square feet.

QUANTITATIVE ANALYSIS BY ELECTROLYSIS. By Alexander Classen. Translated from the Fifth German Editon by William T. Hall. 6x9¼, pp. 332, illus.; $2.50. John Wiley & Sons, Inc., New York.

The present edition of this classic may be regarded as practically a new book, since it has been entirely revised to conform to latest electrochemical and physical-chemical theories, as well as to represent uptodate practice. There are 97 pages of theoretical and historical matter, and of description of electrolytic apparatus. Following this come 93 pp. of electro-analytical determinations: Copper, lead, cadmium, bismuth, silver, mercury, antimony, tin, arsenic, gold, platinum, palladium, rhodium, molyhdenum, vanadium, iron, zinc, nickel, cobalt, manganese, uranium, thallium, indium, chromium, aluminum, barium, calcium strontium, the halogones, the alkalies, tellurium and nitric acid. The separations of copper, cadmium, lead, silver, mercury, antimony, gold, platinum, molybdenum, iron, cobalt, nickel and zinc from other metals are given in great detail in 61 additional pages, after which follow special analyses: Bronzes, mattes, white metals, etc., and electrochemical tables.

THE PSYCHOLOGY OF MANAGEMENT. By L. M. Gilbreth, 8x5, pp. 344; illus.; $2. Sturgis & Walton Co., New York.

The subject and purpose of this book is perhaps best explained by the sub-title which is "The Function of the Mind in Determining, Teaching and Installing Methods of Least Waste." The author is a thorough believer in the systems of scientific management devised by Dr. F. W. Taylor and the book combines explanation and laudation of the Taylor methods and plans. The object throughout is to show that these methods, however they may work out in their physical results, are really based upon the mind, not only for the manager and planner, but for the men who carry out the final operations. It is also an especial point that efficiency in management is based really on the man, rather than the work, and that the best results are secured by placing the emphasis on the man and modifying the equipment, materials and methods to make the most of him. It is recognized that the man's mind is a controlling factor in his efficiency, and that by teaching the man can be brought to make the most of his powers. Consequently, the teaching element is a very large part of management, and to apply properly a knowledge of psychology is imperative. A knowledge of the underlying laws of management is a most important asset and cannot be attained without the study of psychology. Taking this view, it is evident that the psychology of management is really the important part of efficiency, as it is defined by the modern engineer. To all who are interested in the new systems and notably in the Taylor system, this book will be found exceedingly interesting and worth careful study and preservation.

LAVORAZIONE RAZIONALE DELLE SOLFARE VIRDILIO E MINTINELLA. By E. Cimino. 9½x14, pp. 152, illus., paper. Libreria Internazionale A. Reber, Palermo, Italy.

This work prepared by the technical director of the sulphur mines Virdilio and Mintinella, in the district of Naro, Sicily, is a noteworthy addition to studies on sulphur industry and combines experience, with careful preparation and clear language. The author who studied in Sicily and subsequently in Berlin, has for a number of years superintended work in various sulphur mines and gives now the results of this experience.

The first part of the volume contains the description of the mines Virdilio and Mintinella, compared with those existing in Louisiana, also to other mines in Sicily, and finally establishes important principles of general nature. Especial consideration is to be given to the part referring to the theory of the origin of sulphur and to the genetic conditions of the caverns, which subjects the author will review more extensively in a later work. The second part contains the history of the first period of the operation of the mine Virdilio and its ruin, which occurred in 1886.

In the third part he reviews the plans for work underground and opencut of the sulphur extracted under the two different systems of work; with costs per ton of rock and per cubic meter of mineral.

The fourth part relates to the various methods of operation underground, giving the respective advantages for isolating and extinguishing fires; gives information on the cost of preparatory works and the price per unit for sulphur, according to the different systems of operation.

The fifth part is given to mine safety. Of special interest is the comparison both general and detailed of the accidents occurred in coal mines in France, Belgium, Great Britain, Prussia and the United States of America, which proved fatal, with those occurred in Sicily for the period from 1898 to 1907, the calculation being based per 10,000 laborers. After this there are proposals worthy of consideration concerning the payment of insurance premiums for sulphur mines.

THE COAL RESOURCES OF THE WORLD. An inquiry made on the initiative of the executive committee of the Twelfth International Geological Congress. Canada, 1913. Edited by W. McInnes, D. B. Dowling and W. W. Leach of the Geological Survey of Canada, 3 volumes, 8⅜x11¼ in., in all 1360 pp. with atlas, 13½x19½ in. with 175 maps and figures of which 19 occupy two pages. The reading volumes also contain several maps. Morang & Co., Ltd., Toronto, Can. Paper boards. Price, $25.

This monograph which is a companion to "Iron Ore Resources of the World," is a remarkable piece of work, of which the International Geological Congress may well be proud. In the main body of the text, there are reports on 64 countries, varying in length from 100 pages down. Of these reports three-fourths are in English, 10 in French, and six in German but these are summarized in English in the first volume. The greater part of the information is from data furnished by Geological surveys and governments, although occasionally papers are given by unofficial specialists, a notable example of such a case being that of Dr. Noah Drake, who writes on the coal resources of China.

Owing to lack of uniformity in the usage of different countries in the classification into anthracite, bituminous and lignite, it was found necessary to adopt an arbitrary classification, based on heating value and composition. The total reserves of the world are computed at 7,397,533,000,000 tons of which about 4,000,000,000,000 are bituminous, 3,000,000,000,000 brown coals, and 500,000,000,000 are anthracite. Although these are tremendous figures as compared with an estimate that the total coal mined in 1910 was 1,145,000,000, nevertheless in certain individual countries the end is thought to be in sight.

Volume I contains reports from Oceanica, including Australasia, the Philippines, Dutch Indies, and the Antarctic Continent, and Asia. Volume II contains reports on Africa, North, South and Central America, and part of Europe. Volume III covers the remainder of Europe. The book is finely prepared, and must be seen to be appreciated.

THE JOURNAL OF THE CANADIAN MINING INSTITUTE. GENERAL INDEX Vol. I to X inclusive (1898-1907). Compiled by H. Mortimer-Lamb, Secretary. 8x5 in. 488 pages. Montreal; published by the Canadian Mining Institute.

Probably all of us know by experience the difficulties in hunting up references to subjects which have been treated in

the scattered papers read before a scientific society. Even in cases where such proceedings have been more or less properly indexed, it is often impossible to tell without searching through the different volumes whether the reference given is of importance or otherwise. The proceedings of the Canadian Institute contain many valuable papers and much information which cannot be found elsewhere, and Mr. Lamb has undertaken a most useful work in making them easily accessible to readers. His index is prepared on a rather unusual plan, which seems to us to contain some new elements which make it especially useful. From it, we can learn under each heading, not only the paper to which reference is made but we can find also whether the subject referred to was treated briefly or in an extended fashion; and also whether references can be found in the discussion. The index is both by subjects and authors, and so far as we have been able to make comparisons, has been very carefully and thoroughly done. Under the plan adopted, it is easy to ascertain at a glance whether it will be desirable to hunt up the papers or discussions, or whether they can be passed over, and in this way, all who use it will find it a very great time-saver. Of course, this method involves a great deal of cross-indexing, but as most people who have occasion to hunt up information know, cross-indexing is an advantage which most compilers neglect. We do not hesitate to say that this is the best and most thorough work of the kind that we have ever seen, and such examination as it has been possible to give it, supports this impression. In addition to the index, 150 pages are devoted to brief abstracts of papers in the different volumes. These abstracts, necessarily, condensed as they are, are not intended to obviate the reading of the paper itself, but to indicate to the searcher its general character. If on a mine or a mining district, the abstract tells us whether the topic treated is the geology, the metallurgy, methods of mining, etc., and this plan is carried on throughout. This index of papers will be found a very useful feature of the book. This volume should be in the possession of everyone who has a file of the "Transactions" and it is to be hoped that it will be carried forward through successive years on the same plan, as an essential part of the records of the Institute.

A TREATISE ON THE AMERICAN LAW RELATING TO MINES AND MINERAL LANDS, ETC. By Curtis H. Lindley. Third Edition. 5½x9, pp. 2813, illus., buckram, three volumes, $25. Bancroft-Whitney Co., San Francisco.

It is 17 years since the first edition of Mr. Lindley's work made its appearance, taking rank at once as the leading authority on the subject of which it treated. At that time, the U. S. mineral land law, substantially in its present form, had been in operation 25 years, yet only a few of the many difficult questions arising under it had been clearly and finally settled by the U. S. Supreme Court, and a large part of the book was devoted to the discussion of such questions, in the light of judicial opinions not complete or conclusive, obiter dicta, and, above all, the author's own study of the text and principles of the statute, and his critical sense of fitness and justice in their application. It was the candor, lucidity and forceful suggestiveness of these passages which caused the work to be recognized immediately and on all sides as much more than a laborious compilation. It was a helpful summary and guide, alike intelligible to laymen and instructive to lawyers and judges.

The book, not having been stereotyped, was "out of print" after three years; and it was characteristic of the author that, instead of meeting the constant demand for it by republishing the first edition, with a suitable supplement of later information, he revised it thoroughly, rewriting many parts of it, and blending the new material with the old, while retaining the original numbering of the sections, so that the two editions could be easily and instantly compared, and not only the latest decision, but the preceding history, of a given question of interpretation or application could be seen at a glance. Moreover, the new edition spoke throughout from the standpoint of its date, instead of expressing, in some places, the author's earlier views and arguments, and contradicting or modifying them in other places, to suit later developments.

This second edition, being thus fully uptodate, the publishers stereotyped it, in order to be able to meet the continuously growing demand for it. But three years later, the conflagration attending the San Francisco earthquake of 1906 destroyed the plates of the book, as well as the stock of copies on hand; and in the same catastrophe, Mr. Lindley lost his own law-library. Under these circumstances, he certainly would have been justified if he had accepted the proposal of the publishers to reprint the second edition as it stood. But, although it was only three years old, the author was not willing to have it reproduced without revision; and what "revision" meant to him had been already demonstrated. Probably he was influenced in his decision by the circumstance that many important questions under the mineral land law had been adjudicated since 1903, and that many others were in process of adjudication. But, above all, there were signs of an approaching change in the government policy regarding the public domain—a change already indicated, and soon to be further expressed, in statutes altogether new.

So he spent eight years in the preparation of a third edition—truly an imposing magnum opus—which will be, no doubt, the monument of his fame. He cannot perform the colossal task again; and he may well rest content with this achievement. The history of the three editions; as sketched above, culminating in the comprehensive and classic excellence of the third, is a record that should satisfy any human ambition. And the time of publication is just the right time; for it seems to mark the beginning of a new epoch in legislation, so that Mr. Lindley closes his life-work as an author with the close of the chapter to the interpretation of which it was chiefly devoted. His most important service has been connected with the intricacies and difficulties of the "apex-law," that is, the law regulating the possessory occupation and the sale of public mineral lands containing ore-deposits classed as lodes, and defining the nature of title to such lands and deposits conveyed by the deed of the United States. With a few more or less important exceptions, the principles and the construction of this law have been at last settled by the U. S. Supreme Court; so that Mr. Lindley's treatise, appearing at this time, is likely to remain a safe record and guide for years to come, if the law remains what it is. On the other hand, if the law should be repealed, this book will be even more valuable as a summary of its judicial interpretations; for the mining titles acquired under it during the last 42 years will be vested rights, which no subsequent legislation can defeat; and no lawyer now living will see the day when "Lindley on Mines" will have ceased to be necessary for the preparation of a brief or the argument of a case involving such rights.

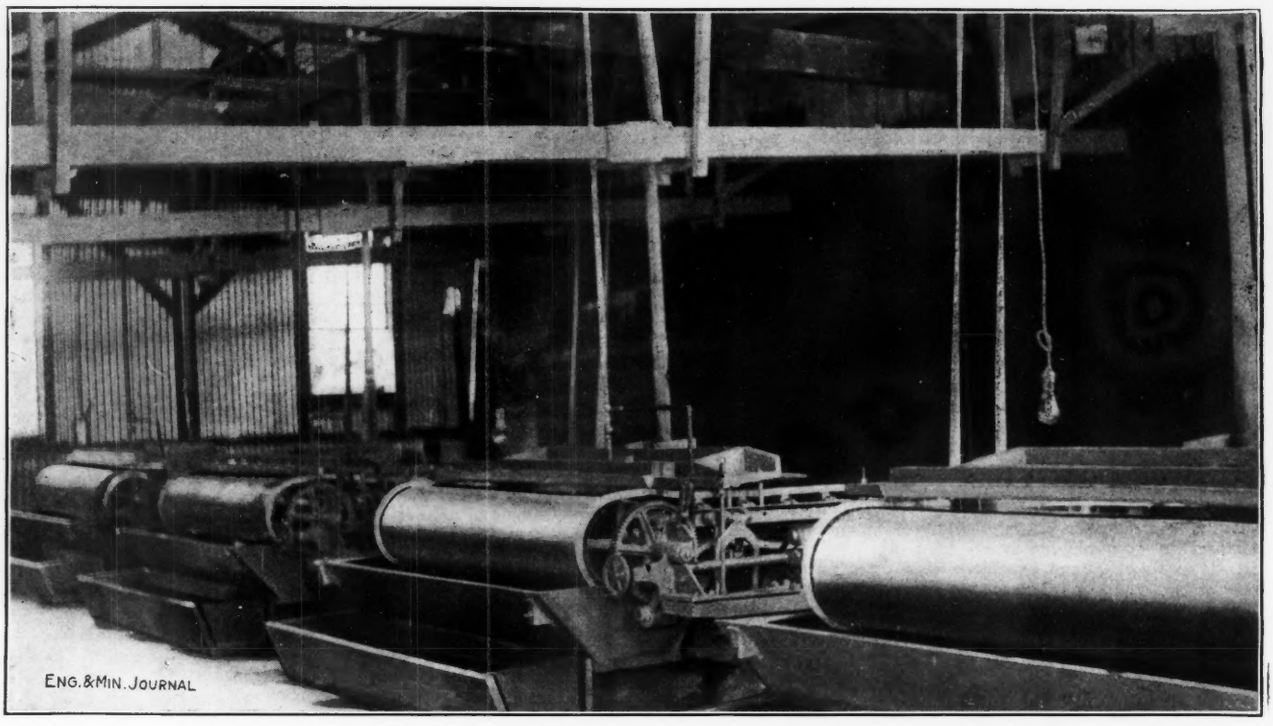
Of course, Mr. Lindley, in his successive editions, has had less and less to say concerning the deficiencies and ambiguities of the old Act of 1872. The decisions of the U. S. Supreme Court are now a part of the law; and his purpose was always to state the law as it is, rather than to declare what he thought it ought to be. While I think that he sympathized long ago with my adverse criticism of the "apex provision," I fancy, reading between the lines of his latest utterance, that he does not favor its abolition, after so many years of gradual interpretation and administrative adjustment. Those of us who do not accept that view must appreciate its force nevertheless, especially when we reflect that the movement for the amendment of the U. S. mineral land laws which we earnestly favor might easily go much further than we desire.

In all Mr. Lindley's editions, he has considered the original title of the United States to the public domain (apart from sovereignty, which would cover the lands of private citizens also) as an absolute ownership in fee simple. This view has been universally taken by historians; and it was quite valid as to all Federal legislation contemplating the administration of the public lands with the purposes of selling them outright to citizens of existing or prospective states, and thus ultimately making them part of the taxable resources of such states. But, little by little, the notion has gained ground that the "national resources" of the "public domain" are unconditionally the property of the United States as a whole, and may be—indeed, ought to be—held as such in perpetuity, and administered (preferably under a system of leasing) for the benefit of the Federal treasury, of scientific progress, of "conservation," of "social equity," and of the paternal control of the Federal Government through the various executive departments and bureaus. In my judgment, this proposition is not true as to the original public domain, which was ceded to, and accepted by, the United States on definite conditions, and for definite purposes only; and, on the strength of an early decision of the U. S. Supreme Court, I doubt whether it is true as to the vast territory embraced in the "Louisiana Purchase." So far, this is a legal question. I have elsewhere argued it, with regard to all the public domain, as a question of statesmanship and equity; and into that field I could not ask Mr. Lindley to enter. But I wish that he had, in Title II Chapter II of his first volume, quoted and discussed in his characteristic acute and comprehensive way, the conditions of the trust accepted by the United States with regard to its first public domain.

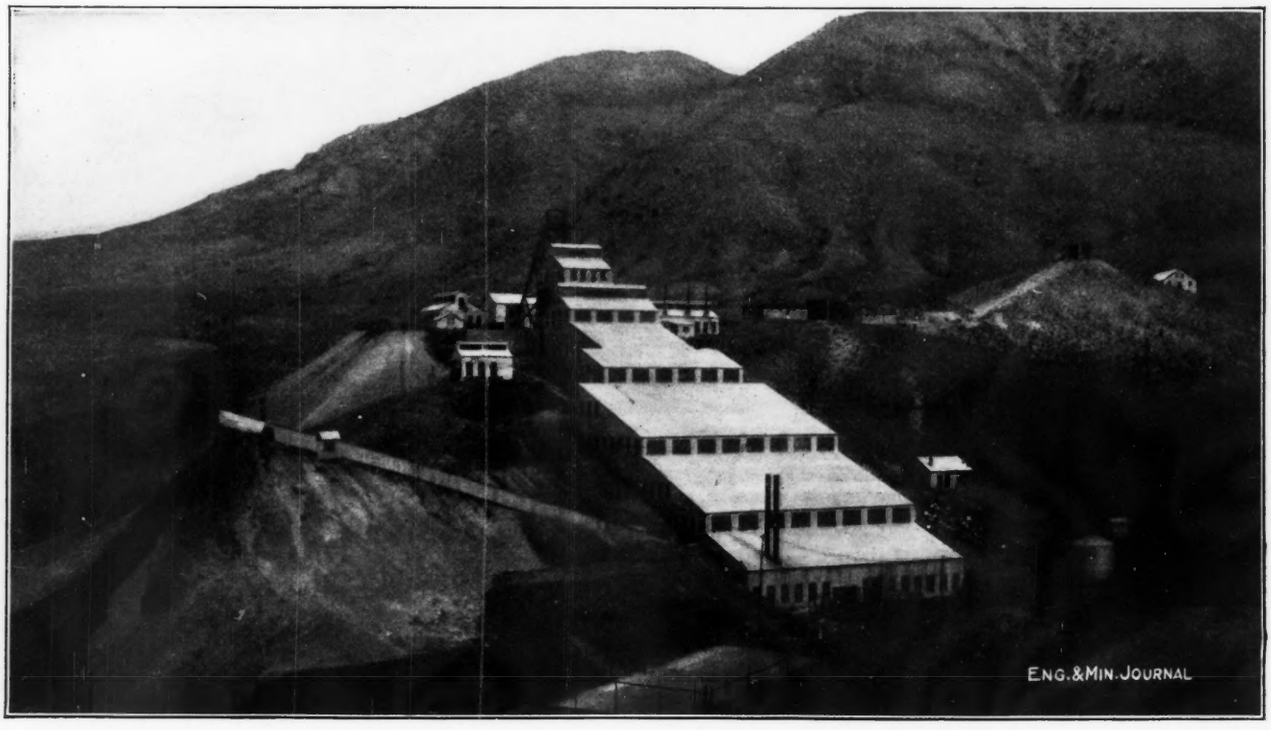
This is the only criticism—if, indeed, it may be called a criticism at all—which I have to make upon Mr. Lindley's magnificent treatise.

R. W. RAYMOND.

Photographs from the Field

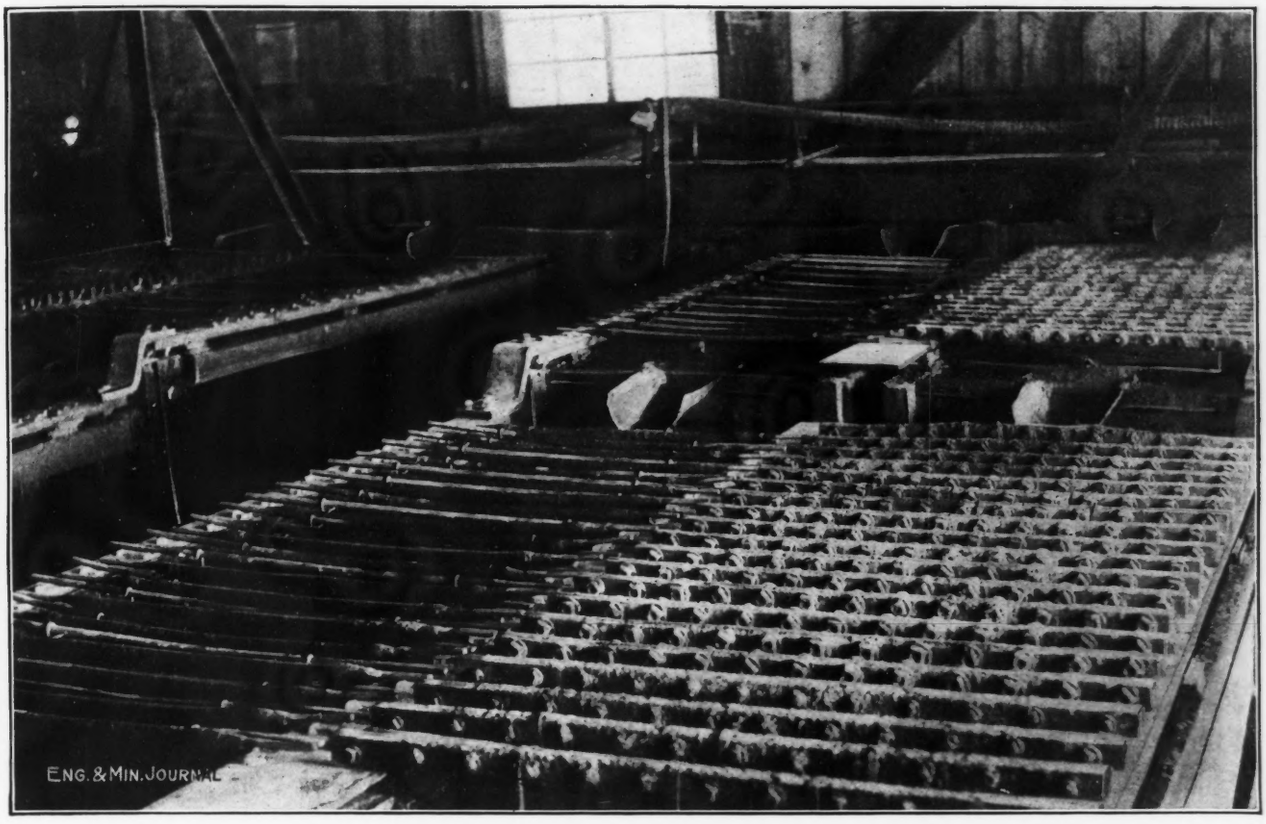


PACIFIC VANNERS, EAST EUREKA MINING CO.'S MILL AT POUNDSTONE MINE, AMADOR COUNTY, CALIF.

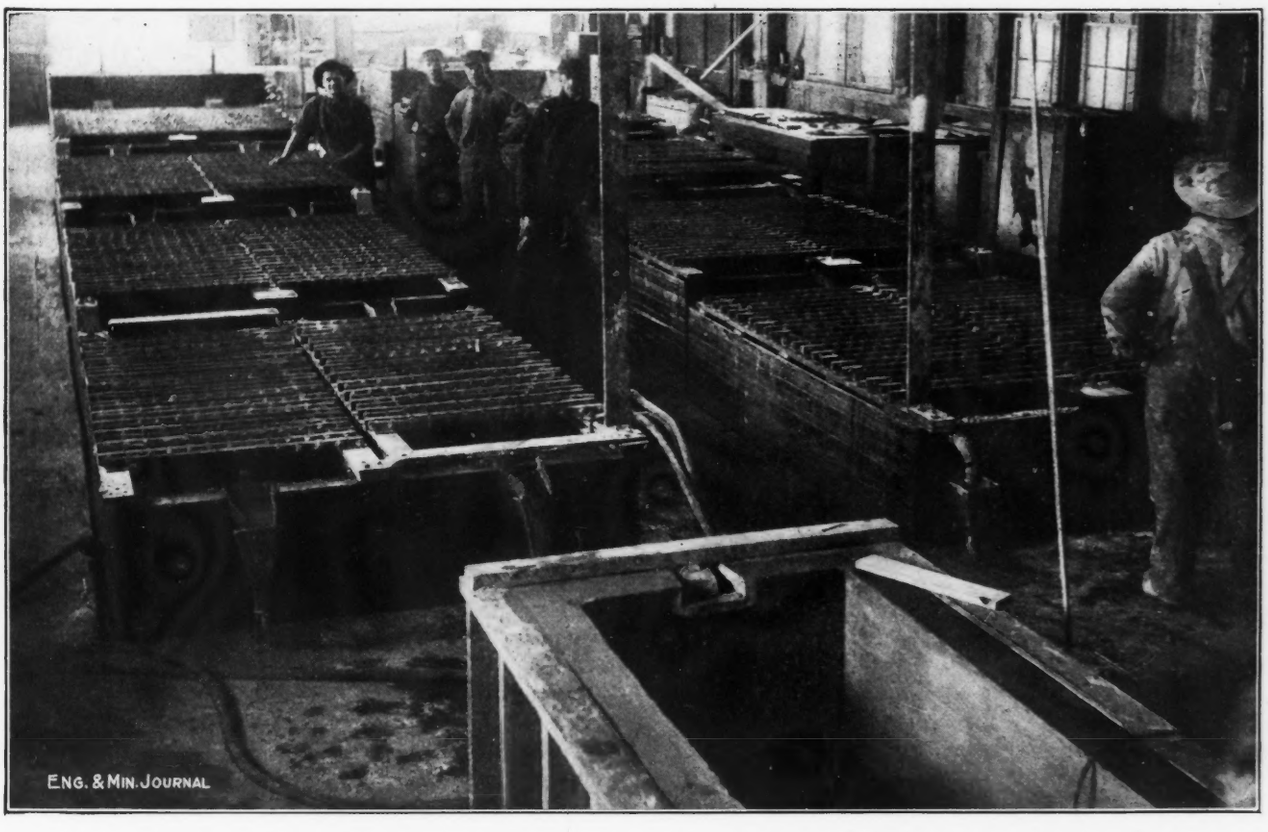


NEVADA HILLS MINING CO.'S 20-STAMP MILL AT FAIRVIEW, NEV.

Webber shaft at head of mill, transformer house to left, lime house just above transformer house, machine shop just above lime house, hoist house behind headframe, refinery to right of head of mill, office to right of refinery, boarding house at extreme right, assay office to right of lower end of mill.



CELL ROOM IN BUTTE DULUTH MINING CO.'S COPPER-LEACHING PLANT AT BUTTE, MONT.
Showing anode and cathode arrangement.



BUTTE DULUTH CELL ROOM SHOWING AN EXPERIMENTAL CONCRETE CELL IN FOREGROUND
Copper is precipitated electrolytically from sulphuric-acid solution with which ore is leached.

Laying Out Lines and Computing Yardage

By W. H. Wright*

The method of laying out and prospecting the land and computing the yardage by the Ashburton Mining Co.'s No. 2 dredge at Folsom, Calif., may interest some of the Journal readers. The system followed by this company was inaugurated by R. E. Cranston, then manager, at the beginning of the operation of No. 2 dredge in January, 1908. A large progress map of the property, embracing about 200 acres, was prepared to the scale of 1 in. equals 40 ft. This map was made in 100-ft. cross-sections, numbered at 200-ft. intervals, from west to east, and lettered at the same distance from north to south as shown in the accompanying drawing, Fig. 1. On the ground, 4x4-in. stakes were placed at the corners of each 200-ft. square, and numbered to correspond with the intersecting lines at that point.

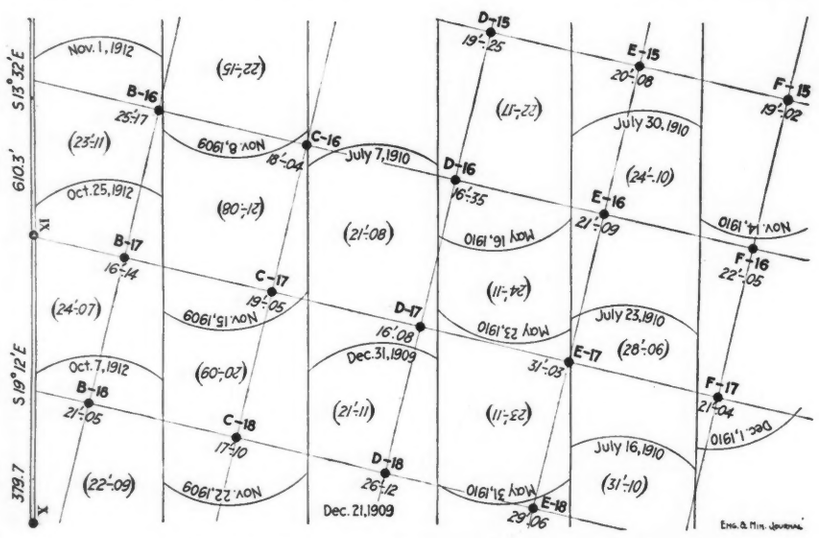
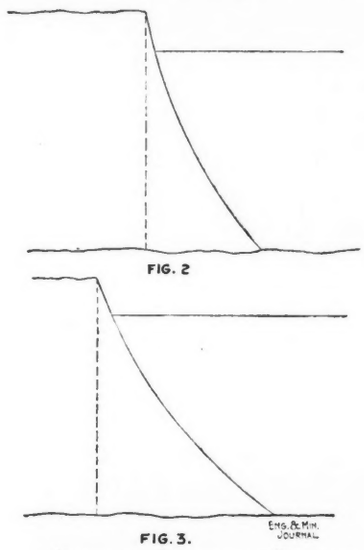


Fig. 1. Progress Map of Dredging Property



Digging Curves of Dredge

A No. 3 Keystone drill followed the surveyors and test holes were put down at each stake. A careful log was kept of these holes, giving the value per cu.yd., the depth of the holes, the character of the core and the bedrock, as well as the time spent in repairing, moving, drilling, etc., also the distribution of the gold was marked. The value and depth of the ground was noted on the map at the proper places. The log sheets were kept on file for future reference. After the land was drilled, the course to be followed in dredging was laid out for the full life of the property.

This method of laying out the cut lines has proved successful and well worth the expense. Long periods of extremely rich or extremely poor digging were avoided. The operator could look ahead and plan a large job of repairs without getting some of the dreaded red ink on the reports. Areas of profitless dredging were avoided, and check on values recovered and the general operation of the dredge was had. But the greatest advantage was the saving of time and yardage, due to the regular and systematic cuts. As nearly as possible all cut lines were laid out parallel. These lines were staked out on the ground in front of the dredge, as they appeared on the map, and were strictly followed. Of course, some variations were necessary, but they were made only at the direction of the manager or superintendent.

In computing the yardage of gravel dug, the average depth of all step-ups between cleanups was used. The cleanup man would set his transit on any three convenient stakes and locate the digging spud from these stakes. The location was indicated on the map, and with the digging radius of the dredge known, the arc of the cut was drawn between the cut lines. A planimeter was used to find the area, and this was multiplied by the average depth.

When a cut into new ground was made an amount, depending upon the depth, had to be subtracted. Fig. 2 shows the section of the digging curve at right angles to the cut lines. A factor was calculated from this, to be used for each foot of depth. In returning alongside a cut, it was not necessary to use this factor if the depth was approximately the same. What was gained in the first cut, or first cleanup period, was compensated for in the second. But care had to be taken to swing out into the old pond far enough to clean up the bottom. The winchmen were given the proper distance according to the depth. However, an experienced man can tell whether or not he is digging virgin ground. Fig. 3 shows the section of the digging curve of the dredge on a line through the digging spud and lower tumbler.

*Superintendent, Ashburton Mining Co., Folsom, Calif.

Forfeiture of Mining Claims in Alaska

By A. L. H. Street*

One who has located a mining claim in Alaska, but who has failed to do the assessment work required by the Acts of Congress governing such claims, cannot avoid a forfeiture of his rights by a resumption of work prior to the intervention of other parties, according to the recent decision of the United States Circuit Court of Appeals in the case of Ebner Gold Mining Co. vs. Alaska-Juneau Gold Mining Co., 210 *Federal Reporter*, 599.

*317 Commercial Bldg., St. Paul, Minn.

Correspondence and Discussion

The Work of Crushing

I have been contributing to the JOURNAL some articles which deal with the comparative aspects of crushing and grinding, during which I have maintained the truth of Rittinger's law and based calculations on it. A recent paper before the A. I. M. E., by Arthur F. Taggart, criticizes the analysis in my original article,[1] and expresses lack of confidence in Rittinger's law, and adherence to that of Kick.

Our difficulty lies in not understanding just what occurs at the so called "elastic limit." Up to this point the energy applied to the body is absorbed by it uniformly in proportion to volume. At the so called elastic limit the first break occurs some place within the body, releasing the energy locally absorbed at the point and allowing a further deformation without a proportional amount of energy being absorbed. The cause of the first break within the body is that the ultimate strength of a single crystal, or of the bonding material between crystals, was exceeded. A series of these local breaks occurs in consequence throughout the body until at some point several of them lying close together so weaken it that the remaining crystals and bonding material are unable to resist further, and the section fails, a fracture being the result. And except as energy has been absorbed in making these breaks and any heating of the material has caused radiation losses, the individual crystals of the rock are allowed, upon release of the pressure, to return to their original form (in conformity to Kick's law, if I understand it aright), and in so returning to this original form they return the energy they contained.

How is this energy returned? Either in pushing (or pulling) back the crushing faces, or in accordance with a more universal law of nature, attacking the weaker part of the organization and completing the breaks upon the parts that have increased load put upon them by breaks alongside them.

I can conceive of a condition in a body in which a few individual or groups of crystals are so interlaced that when the body is deformed by external pressure and that pressure is released, these few crystals are so held that they are unable to return to their original shape. And Kick's law would apply to these, but the effect of the energy absorbed by these few crystals would have no appreciable effect upon the total of energy absorbed when actual crushing takes place.

I consider that the above reasoning applies to bodies in tension, shearing or compression; it can be shown, I believe, that these three phenomena reduce to the same thing, the breaking of crystal or molecular bonds. I am quoting no authorities in support of my arguments as it seems we have to be our own authority at times.

In his criticism of my arguments in "The Crushing-Surface Diagram," Mr. Taggart might have analyzed, by Stadler's method, the two crushing-surface diagrams given as Figs. 4 and 5 in my paper. (Somehow, the two cuts were transposed, and certain boxed areas were not marked thereon, although referred to on the cut.) A statement in my original copy that was edited out, suggested such analysis by the members of the Stadler school. Provided my work was honest and reasonably accurate, a comparison of "E. U's" per foot-pound applied would be illuminating.

Answering Mr. Taggart, I do not presume to say that crushing takes place in commercial machines between offset faces, as shown in the theoretical diagram I used to show the application of the law of Rittinger. I might have amplified it further by showing how the cracks actually occur in the breaking rock and how the broken pieces assume their original volume in accordance with Kick's law. But my paper was written with the purpose of explaining a new tool for mill operators, and I was hardly prepared to take at that time the full burden of the defense of Mr. Rittinger. I did what I could, and as I review that argument now, it looks pretty good to me.

The place to prove whether either law applies to crushing operations is in the laboratory, and there upon machines which will enable us to determine the energy absorbed by the rock, not in commercial crushing machines.

Some data of this kind I have at hand, I may say that it is all very favorable to the law of Rittinger, and it will be submitted to the Institute shortly.

It is my belief that one theory is as good as another until one is proved correct by facts. As I have been charged with being a theorist, I may state that my paper upon "The Crushing-Surface Diagram" was not published until I had experimental proof, reasonably satisfactory to me, of the application of Rittinger's rather than Kick's law to the work of crushing. The later paper, appearing in this issue, was not written until I had corroborative experimental proofs of the same thing.

A. O. GATES.

Lafayette, Ind., Feb. 27, 1914.

[1]Eng. and Min. Journal, May 24, 1913.

Magnetite Lining for Converters

Relative to "monolithic magnetite linings" in converters, the formation of a coating of magnetic iron oxide on the inner surface of a basic-lined converter is inherent in the process and cannot be avoided unless the converter is run at a temperature much too high for the good of the magnesite-brick lining and with a high-silica slag. The temperature in a basic-lined converter is highest at the tuyeres, where oxidation is most intense, hence the greatest damage to the lining is found at and above the ends of the tuyeres.

In a converter of the barrel type, like the Peirce-Smith converter, the process takes place in a confined space, due to the roof. In a converter of the upright type, like the Great Falls converter, the gases pass away upward unhindered by a roof, hence the damage to the lining above the tuyeres is less in this type of converter.

If the temperature at the tuyeres is run low enough in the Peirce-Smith converter to eliminate the gradual wear on the lining above the tuyeres, it would be too low at distant points in the converter and accretions would form that would rapidly fill up the converting vessel.

Should the lining in the Great Falls type become damaged by overheating, the magnetite formed by blowing a charge without flux could be deposited on the damaged spot by completely inverting the converter, so that the magnetite mush would stick over the tuyeres while in a plastic condition.

With the Peirce-Smith type this is not possible, due to the limited sector of revolution allowed by the drive, which will not permit of a position where this mush could be deposited over the tuyeres.

Salt Lake City, Utah, Mar. 2, 1914. H. C. MERTON.

Fine Grinding in Pans

I read with interest the communication of E. E. Wann in the JOURNAL of Dec. 20, 1913, commenting on an article in which I described the development of the present grinding-pan practice at our mill. It does not surprise me to learn that the idea of a forced central feed for grinding pans did not originate with me. The necessity of such a feeding device should occur to any one who carefully watches the work of a pan, but I did not think that it had been used as long ago as in 1880.

Mr. Wann draws some conclusions from my article, which are not in accordance with the facts. I did not state that a pan is a better and cheaper slimer than a tube mill, but only pointed out the excellence of the pan for the special work required of it at our mill. Since I wrote the article, our equipment has been increased by two more grinding-pans, which are used in other sections of the plant on different material, and I have found no reason to change my favorable opinion of them as slimers. For reasons which have nothing to do with the cost or the quality of the grinding in the pan, a 4½-ft.x 72-in. Hardinge mill will be installed in near future to perform the same work which is at present being done by the pan described in the article referred to. I shall then be able to form a definite opinion of the advantage of one of the two machines above the other. It would be mere guess work if I asserted that the grinding pan works cheaper than the tube mill before having given the other machine a fair trial.

The iron which enters the pulp through abrasion of shoes and dies, is mostly fine enough to overflow in the Dorr classifier, and is thus eliminated from the circuit.

Mr. Wann seems to have inferred from my article that I discharge my pans by an overflow device. I do not believe in such devices because the centrifugal force invariably brings the coarsest grains to the periphery. If baffles are used in the pan, and the pulp can return to the shoes and dies, it is best to discharge through holes directly behind a baffle-plate. If the center of the pan is closed, and the pulp is meant to pass only once under the muller, it is immaterial how the discharge is effected. I cut a 4x4-in. hole in the side of the pan body at the required level and fixed a spout to it. There is no necessity of keeping 20 in. of pulp above the muller as in the case which I described, but where the channels between the shoes are open, it is better not to discharge through the plug hole in the bottom. If there is a certain quantity of pulp in circulation at the periphery of the pan, it exercises a back-pressure on the pulp, moving in the shoe channels. This diminishes the velocity and must give better grinding as I have pointed out before. If, on the other hand, the channels are closed, as in Mr. Wann's pan, there is no reason for keeping any pulp above the muller. Another advantage of discharging at some height above the bottom is the minimum loss of mill-height. I agree with Mr. Wann that there is no need of a thick pulp, if the only possible discharge is at the grinding periphery between the shoes and dies, and must admit that this is an advantage of Mr. Wann's pan arrangement over mine.

There are several features of the pan deserving consideration on which I have not been able to experiment, namely, the best form of channels between the shoes, the desirability of using corrugated shoes and dies, and the maximum weight which can be given to the muller. If all these points are well studied, it is probable that a highly efficient sliming pan will be constructed. Thus far, I have obtained satisfactory results with mullers of ordinary weight, and can, therefore, not agree with Mr. Wann's statement that the ordinary pan muller is too light to be a good pulverizing device. But it should be remembered that I do not want to grind large quantities. Mr. Wann's figure of 240 tons per 24 hr. ground by one small pan from 30 mesh to pass 100 mesh is astonishing and speaks in favor of the heavy muller, but today we want to grind to a 200-mesh screen, and the difficulty in fine grinding begins just about at the 100-mesh size.

In the cut representing Mr. Wann's pulverizer, I cannot find a device for regulating the height of the muller. Such a lifting device is an essential feature of the grinding pan, because it cannot be started with the whole weight of muller with shoes resting upon the dies.

M. G. F. SÖHNLEIN.

Machacamarca, Bolivia, Jan. 24, 1914.

Magnetite Lining for Converter

I have read with interest W. H. Howard's communication relative to magnetite linings, at Garfield, Utah, published in the JOURNAL, of Mar. 21, 1914. I mentioned in my letter of Feb. 13, 1914, that during the early part of 1912, I visited a number of smelting plants and stated that the highest output per basic lining was 4400 tons. This was at the Garfield works.

According to Mr. Howard's letter, he was three years in obtaining this tonnage on a large Peirce-Smith converter. At that time our small type of converter had produced 12,000 tons and was still in operation. I personally gave these figures to A. E. Wells, metallurgist at the Garfield works, who was astounded and wondered how we managed to obtain such an output per lining with such a small converter.

Why was our life of lining so much greater? I will leave that to your imagination. In passing, I might state that Dr. Edward Weston's comment in the "By the Way" column, Mar. 14, 1914, is timely, viz.: "There are three stages to an invention. In the first, competitors say, 'It's theoretically impossible.' In the next, 'It can't be done, mechanically.' In the third, 'We did it ourselves three years ago.'"

MILO W. KREJCI.

Great Falls, Mont., Mar. 25, 1914.

Editorials

The Plight of the Zinc Smelters

We have in several articles during the last six months or more referred to the sorry plight of the zinc smelters of this land. The American zinc industry has ever experienced a succession of feasts and famines. As between the miners and smelters one party sometimes has its inning, the other party at another time. Sometimes they both get fat together, as in 1911-12, and at another time, they both starve together, as in 1913-14, with the smelter apt to be the worst sufferer, he having the more capital tied up.

Now comes the American Zinc, Lead & Smelting Co., with its report for 1913. This is one of the largest concerns in the business and one of the most comprehensive, it having mining interests in Missouri, Wisconsin and Tennessee, and three smelteries. Also, it is the only zinc-smelting company which makes public reports, the others being mainly close corporations. The American Z., L. & S. Co. tells its stockholders that in 1913 it failed to meet its operating expenses by about $90,000, largely for the reason that there was no operating margin between the price of ore and the price of spelter. Other smelters have experienced the same thing, but they do not have to publish it.

There is an awkward situation in the spelter market at present. Stocks at the beginning of 1914 were larger than ever known before in the United States. We guess they increased still more during the first quarter of 1914. The smelters have to take in ore all the time to keep their works running and produce spelter that they can't sell at the present price, although that price is low. The leading lead smelter in a similar situation in that metal cut the price to a figure where consumers became interested in buying it. The consumers of spelter seem to be expecting similar plums to drop off the spelter tree, but the producers are quite indisposed to shake it. The whole situation is so complex that any prophecy of what is to come would be hazardous. The only thing that we feel sure of is that spelter around 5@5⅛c. is cheap. Probably it is the same feeling that makes the smelters so stiff.

Radio-Obscurity

One of the striking properties of radium is the fogging of photographic plates by its emanations. Of equal rank with this, although we have not seen any lengthy mention of it, is a rapid fogging of Governmental intellects, when confronted with radium problems. An example of this is found on p. 794, in this week's JOURNAL, in the report on the recently introduced Walsh bill, which provides that the Government loses its rights over domestic radium ores when it refuses to purchase carload lots of radium ores of sufficient value to be merchantable.

What is the dividing line between merchantable and unmerchantable? And what is the penalty against the private person or corporation for dealing in unmerchantable ores? In other words, what happens if the Government refuses to buy what its representatives say are unmerchantable ores? Private enterprise might take a different view. Why say "merchantable" ore, anyway? And is the small miner who cannot produce in carload lots to have no rights? We consider that an investigation of the question of radio-obscurity in Washington would yield some interesting results—we would almost say illuminating—but radio-obscurity, we understand, defies illumination.

At the next meeting of the New York Section of the Mining and Metallurgical Society, the subject of discussion will be radium. Some common sense about this interesting and political element will doubtless be unfolded. It would be a good plan if the Congressional committees on Mines and Mining should be invited to attend.

The Copper Statistics for March

Previous to the issue of the last copper report, everybody was expecting a decrease in the stock, the exports during March having been extraordinarily large. Estimates ranged from —5 million to —15 million pounds. The reduction proved to be nearly the latter and larger figure. Exports were about 90 million pounds, which was much less than the custom-house returns, but this was expected inasmuch as a "carry-over" from February was surmised, and the common guess was that C. P. A. figures would show an exportation of about 90 million. Production proved to be larger than anybody expected, but even more so was the domestic delivery.

We consider the expansion in the domestic deliveries to be the really important feature of the March statistics. Their low ebb during several months previous was highly disconcerting and led pessimists to talk as if American manufacturers were soon going to cease using any copper; a visitor from Mars might have obtained the impression even that they were going out of business. The March statistics demonstrate that it is not so.

As to the big exports of the last quarter, there has been a variety of lurid hypotheses, e.g. (1) Producers have been shipping on consignment to themselves; (2) copper arriving in Europe has been checked out of the visible supply and put into private warehouses; (3) copper has been put into ships and shuttled back and forth across the Atlantic. The last hypothesis would have been more ingenious if the copper had been put into cargo boats that might be tied up at Rotterdam, Hamburg, etc., and crews discharged, which would save coal, wages, etc. We dismiss any idea of sinking the boats in mid-ocean and collecting from the underwriters, on the ground that such would be barratry, or some other nautical crime, and too dangerous even for a copper baron.

The rational explanations of the big shipments to Europe are, we are inclined to think, that European consumption continues very large, that an increasing pro-

portion of her non-American supply is going to her via American refineries, and that her consumers are stocking up on the theory that copper is cheap. We have no doubt that there has lately been an increase in the invisible supply of copper in Europe, but we fancy that it is chiefly in the consumers' storehouses. If they consider that copper is likely to appreciate in value, it is simply forehandedness to buy early and, of course, they can finance stocks just as cheaply as the producers can.

Placer Prospecting and Yields

In the drilling of placers, extreme care is required to secure a correct sample from the drilling operation and even if the samples be theoretically correct, the valuation of the area is at best only an approximation. When a property has not been closely drilled, a season's yield often shows a wide variation from the average estimated content of the gravel. This may signify insufficient prospecting to determine an average grade, or it may be simply the normal variation in the distribution of gold in the property.

An example of the latter type, apparently, was the 1913 yield at the Pato property of the Oroville Dredging Co., in Colombia; that portion of the tested area dredged during the latter half of the year, averaged nearly 75c. per cu.yd., and at times reached $1.23 on an average drill sheet of about 31.3c. It is well known that engineers who drilled the Pato ground discounted a number of holes that ran $1 or over, and it is natural that dredging should have been begun in that portion of the property that would give possibilities of the richest returns. The Pato yield to date has been remarkable, and highly satisfactory to shareholders. What the rest of the tested area is going to yield is the question now confronting Pato shareholders, who probably do not expect these abnormally rich returns to persist indefinitely. Engineering evidence points to a gradual reduction to approximately the figures of the drilling.

In dredging its poorest gravel first, a well known Colorado company inverted the usual history of placer companies. During the first two years, a return of only about 11c. per cu.yd. was secured, while in the last few years, the yield approached 20c. For several years, this company was popularly considered as not fulfilling expectations in the failure to return the average estimated for the property. However, an examination of the drilling records showed that the yield—except where a few rich feeders were passed—corresponded closely with the results to be expected in the various sections of the property. When differences from the average grade are on the right side of the ledger, they are highly gratifying to stockholders, but an equal divergence below the supposed average grade sometimes has disastrous consequences.

The question arises as to whether closer drilling might not be done to advantage at some of these placers. Usually, after a placer has been sufficiently drilled to induce capital to equip it, the company feels that any gold in the gravel will be recovered by the dredge anyway, and further drilling is merely an expense to satisfy the inquisitive. Sampling in general is often viewed in this light, and all goes well until the yield fails to equal the cost. Then after the company is in difficulty, sampling again has its inning, and in many cases, has shown how the lean area might have been left and more profitable ground worked. The two companies, above mentioned, have been successful, but many of the discrepancies between drilling and dredging have resulted in the failure of enterprises in a field of mining that has been popularly regarded as one of the safest.

Sampling dredging ground by pits, or by a small prospecting dredge, while highly desirable, is too often out of the question; the engineer must ordinarily turn to drilling, notwithstanding its handicaps and the feeling of insecurity some experience in having to depend upon its results. Even after a correct core is obtained by the drill, it is merely assumption that this small area represents the area shown on the drill map, and this is particularly the case where the gold is coarse or where there are spots of uneven richness. Ground showing any important variation in the drill holes must be closely drilled in order to have drilling results that can be depended upon. While the drill is best adapted to gravel in which the gold is finely disseminated, it is important even in such ground that the prospecting be done systematically, and that low holes be not arbitrarily dismissed.

In the case of a certain Peruvian placer company, shares in which are now being offered to the public, the map in the prospectus does not show regularity in the test pits selected as a basis for estimating over one hundred million dollars worth of gold. Moreover, the 185 test pits were selected for this purpose from 3412 pits. Most of the pits were not sunk to 18 yd., as we are led to suppose by a statement in the prospectus. According to a report submitted at the recent annual meeting, the 185 pits were between 16 and 18 ft. deep. It is evident that more data are needed to form a satisfactory estimate of the great quantity of gold this gravel is alleged to contain.

Many of the discrepancies between prospecting and operating results in placer work have doubtless been due to inadequate sampling. It would be of much value to those interested in placer enterprises if the details of prospecting estimates and actual yields were more often published, so that better coördination in this respect may be obtained. In the last few years, results have in many instances, been wide of the mark. Eventually, this should lead to more prospecting than has been the case in the past, else it will be difficult to inspire public confidence in the financing of such enterprises.

A New Branch of Cyaniding

Improvements in cyaniding have been principally mechanical during the last few years, and more recently attention has been directed toward the chemical side of the question, through which gains have been made and more expected. Notwithstanding the general turn to chemistry for betterment, there is one mechanical improvement being worked upon which seems promising and which amounts to almost a new process. This system consists of careful concentration of the ore and cyanidation of the concentrates. Obviously, it would not be applicable to certain ores in which the valuable metal is disseminated so that a satisfactory percentage cannot be had by concentration, but on the other hand, there are many ores in which the metal occurs in a single mineral, which might conceivably be almost entirely separated from the ore mass.

The success of a system of this sort depends upon extreme efficiency in the concentrating process, and high percentage recovery in the cyanide department. The first requirement is not easy to obtain, but may possibly be reached through special processes, with some improvement, and with ores suited to such work. High cyanide recovery is readily obtained on high-grade material with careful treatment.

The success of such a process is, of course, problematical at this time, but it has been made the subject of some experiment. Its apparent advantages are that the valuable metal is cheaply put into small bulk, upon which especially effective cyanide methods can be used, the whole resulting in a reduced charge for metal recovery. It seems to be worth trying.

BY THE WAY

One is inclined to wonder if the "nonferrous metallurgist," mentioned by the Bureau of Mines, is related to the "ferruginous blonde" slipped over by our compositor not long ago.

⁂

A remarkable electrical freak is reported by the *Placer County Herald,* as happening in February's big electrical storm. "In one of the Doctor Wight Co.'s mines, near Cool, Eldorado County, Calif., a water can left standing on some ore was found to be electroplated with gold. In various places on the can, the gold showed quite plainly. Who can explain the why and wherefore of such a process being done on a pile of ore?" We can't, anyhow.

⁂

The following dispatch from Berlin seems to indicate Brothers Moyer and W. B. Wilson are missing a good bet in Africa. The Colonial Diamond Mining Co. of German Southwest Africa is probably the world's biggest dividend payer. It "reduced" its 1913 dividend to 2500%, having paid 3800 for 1912. In 1910, 2400 was paid, and 2500 in 1911. The company's capital is only $2500. Its managing director and chief shareholder, named Satuch, was once a humble railway official. Now he is a multi-millionaire, and will soon be made chairman of the German Imperial Diamond Administration.

⁂

Two mill men of the "practical" kind had studied up on amalgamation and the character of mercury until they knew all about it. Then they invented a system for amalgamating silver, but were confronted with a large loss of quicksilver. Bending all their energies toward solving the problem, they consulted a chemist, who informed them that a chemical change had taken place through which all metallic characteristics were lost. The inventor was nonplussed, but only for a moment. "Don't it carry its atomic weight with it?" he asked. He was assured that it did. "By George," he said, "if it carries all of its atomic weight with it, we can save it!"

⁂

There is a garnet mine at Wrangell, Alaska. The deposit, we understand from the *Minnesota Almuni Weekly,* is the only one of "almandine" garnet in this country. We presume "almandite" is meant. This is an iron-aluminum garnet and one of the gem varieties. Whether the material is to be mined for purposes of adornment, or of abrasion, is not stated. Nothing remarkable in all this, but the garnet company is the only one in the world officered and conducted by women. The president is Miss Lettie M. Crafts, graduated by the University of Minnesota in 1881, formerly librarian of that institution. Not only are all the officers women, but most of the stockholders also; as to the miners, we are not informed. Thus another forward step in the triumphant march of feminism! May the base metals at least be spared us to be mined by base man! The mine is at Wrangell—we trust there is nothing in a name.

⁂

According to an article in the January number of "Technik und Wirtschaft" by Prof. Matchoss, the "Harpener Bergbau A-G.," one of the largest coal mining companies in Westphalia, employing 28,000 odd hands and 998 salaried officials, has gone into the hog-raising business in order to be able to furnish cheaper meat to its employees. It went about systematically in first making a farm by purchasing and improving a large tract of moorland (about 2500 acres) along the line of the Dortmund-Ems canal which could be had cheap as compared with prices ruling nearer to the mines. The company was led to this scheme by the observation that the prices of food stuffs would invariably advance whenever wages were raised and, that by eliminating the stock growers with their attendant army of middlemen, a large sum of money could be saved. The scheme has been an eminent success and the Krupp Co. is reported to contemplate the advisability of following the example.

⁂

Some of the correspondents of our esteemed contemporary, *Engineering News,* have been waxing warm in a discussion of the low salaries paid to young engineers. One of them relates the following incident of Panama Canal days:

> In quarters with one of the steam-shovel men (initial wages $210 per month) the fellow presumed to become familiar. He had the audacity to give me, an engineer with two degrees and once honored by Associate Membership in the Am. Soc. C. E., this conundrum: "Do you know why the Isthmian Canal Commission pays you fellows $125 and $150?" Perplexed to the point of forgetting my dignity, I asked for the answer and it came: "Because they are ashamed to pay you less!"

Another correspondent remarks:

> The tendency, it seems to me, is for engineers to consider that inasmuch as they have graduated from a technical school and seen some service, they are a little better than the men who have "just worked." They forget that it is energy, perseverance and determination as well as education that is necessary and that men may make themselves valuable without the education of a technical school if they have the other requisites.
>
> The clerk and other office men handle the income and expenditure of the organization amounting to thousands of dollars and are specially competent for the work. Expert steam-shovel operators and construction foremen are also the result of strenuous experience. Rodmen should not feel underpaid if they receive less than the other men above mentioned. The rodman is paid for doing elementary engineering work regardless of his education.

Our notion is that one reason why young engineers earn relatively so little is that the supply of them is greater than the demand, while the supply of steam-shovelers, bricklayers, plumbers, etc., is short of the demand, maybe by reason of union restrictions, maybe some other. Anyway, we know that the scattering of the engineers until lately employed in Mexico has certainly exhibited the play of the law of demand and supply in the engineer market.

American Zinc, Lead & Smelting Co.

According to the 1913 report of the American Zinc, Lead & Smelting Co., it lost $91,656 from operations; spent $44,380 for additions and betterments to property; added $5576 to a reserve fund for betterments, etc.; paid $77,418 for interest on bonds and notes, and a dividend of $85,600; making a total of $304,630 charged against surplus account for the year. Referring to the combined balance sheet and making a comparison with the 1912 balance sheet, current assets have changed as follows:

At Dec. 31	1912		1913
Current assets	$1,238,731		$1,088,392
Current liabilities	480,681		1,243,084*
Balance, assets	$758,650	Liabilities	$154,692
Total decrease in current assets, including property purchase payments			$913,342

*Includes $90,000 deferred property payment.

Property account was increased by $629,744; investments by $1001, and an insurance fund of $12,807 was created. Capital stock was increased $64,000 by the conversion of debenture bonds. Outstanding convertible bonds now aggregate $720,000. Deferred charges to operations were decreased $16,457 during the year and now stand at $98,921. The total loss for the year, as shown on the balance sheet, was $219,030 from surplus account before deducting dividends.

The poor showing, as indicated by the financial statements, is attributed to the conditions of the zinc industry during 1913. On Jan. 1, 1913, the price of spelter at St. Louis was 7.15c. per lb., in June the average was less than 5c. and on Dec. 31, 1913, it was 5.15c. per lb. The Caney and Dearing smelting plants were operating at 83% of capacity in January, 1913, and the new Hillsboro smelter had just started. The falling off in the demand for spelter caused an accumulation of spelter stocks at all smelteries, so that in June the Caney and Dearing plants were closed to one-third capacity, the balance was closed down in December. It was necessary to write down the value of ore stocks acquired during higher prices, this resulted in a heavy loss.

The Joplin mines were operated only at part capacity owing to the low grade of the ore and prevailing low prices for ore; however, during normal prices for ore these mines are expected to yield a good profit. The Wisconsin properties were operated continuously and made a fair profit, owing to the grade of the ore being higher than at Joplin. New purchases in this district are being developed.

Operations were started at the Tennessee properties in June, and No. 1 mill exceeded its rated capacity of 1000 tons a day during the last quarter of the year. Costs were necessarily high, but at the end of the year had been reduced to about the estimates made by the engineers. An average, from several reports, of the estimated tonnage developed, indicated from 3,500,000 to 4,000,000 tons of ore, ranging from 4.5% to 5% metallic zinc. The end of the orebody has not yet been determined in either direction. A shaft has been started at Mine No. 2 to develop the Evans orebody, which drillings indicate to be 1% higher than No. 1 mine. A profit is expected to be made from the sale of tailings for ballast and construction work. The company has arranged for the services of Allen H. Rogers and A. K. McDaniel as consulting engineers in the mining department and Lewis B. Skinner, of the Western Chemical Co., in the acid department.

Copper Production in Russia

SPECIAL CORRESPONDENCE

The production of copper in Russia for the year 1913 is officially reported as follows: Ural region 1,055,000 poods; Caucasus, 611,000; Siberia, 345,000; chemical and refining works, 84,000; total, 2,095,000 poods, or 75,650,450 lb. The production for eight years past has been reported as in the accompanying table:

RUSSIAN COPPER PRODUCTION

Year	Lb.	Year	Lb.
1906	21,849,300	1910	49,759,580
1907	31,957,350	1911	56,476,040
1908	37,265,520	1912	73,917,170
1909	40,948,740	1913	75,650,450

The production has grown rapidly during the years given, exploration and mining having been stimulated by the imposition of a high duty—5 rubles per pood, or 7.13c. per lb.—on metal imported. The production of 1913 was 3.46 times that of 1906. Gain has been shown in all the districts, but was largest in Siberia. The comparatively light increase in 1913 over 1912 was due to the fact that some large works in the Ural were undergoing reconstruction during 1913. This will result in a larger output this year. The greater part of the production in Siberia is from the Spassky, the Atabassar and other enterprises controlled by English capital.

Pyrites and Sulphuric Acid in 1913

The production of pyrites in the United States declined slightly in 1913, the domestic output being reported by the U. S. Geological Survey as 341,338 long tons, as against 350,928 in 1912. As already noted in the JOURNAL, the imports of pyrites showed a marked decrease, only 850,592 tons having been brought in last year, as compared with 970,785 tons in 1912. In the domestic production there were slight increases in California and Wisconsin but decreased outputs from the leading states, Virginia and New York. The output of byproduct pyrites, obtained in connection with coal mining, also declined.

Sulphuric-acid production in the United States last year was equivalent to 3,538,980 tons of 50° acid, valued at $22,366,482, or an average value of $6.32 per ton. This is exclusive of the small production of fuming acid, but includes the byproduct acid produced by the smelting industry and represents an increase of about 660,000 tons over the output of 1912. The production from copper- and zinc-smelting works was slightly greater in 1913, amounting to 336,019 and 296,218 tons, respectively.

Automatic Fire Alarm

An automatic fire alarm was recently described by F. A. J. Fitzgerald, (*Journ. Franklin Inst.*, 1913, p. 575). Its action depends on the fact that the electrical resistance of *"thermitite,"* a preparation of silver sulphide, is remarkably sensitive to temperature. Thermoscopes con-

taining strips of the "thermitite" are inserted like electric lamps, in a circuit. If one of these becomes slightly heated, sufficient current passes to trip a relay and permanently close the circuit, which causes an alarm to sound on a gong. An important feature is that a slight rise in the air-temperature causes quicker heating of the thermoscope, so that the effect is self-intensifying.

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The Dinner to Charles F. Brooker

On Tuesday evening, Apr. 14, 1914, a dinner was given by the Copper Producers of North America to Charles F. Brooker, president of the American Brass Company, in order to celebrate and commemorate his 50-years' connection with the copper industry.

There were present, representatives of the most important copper producers and copper-selling agents; representatives of the principal copper- and brass-manufacturing concerns and some of the close business associates of Mr. Brooker in his various activities.

CHARLES F. BROOKER

John D. Ryan, president of the Amalgamated company, acted as toastmaster and helped to enliven the evening by his witty remarks. Cables were received and read—among others—from Mr. Fielding, chairman of the Rio Tinto company's board; from Aron Hirsch, senior member of the firm of Aron Hirsch & Sohn, and head of the Hirsch Kupfer & Messingwerke; Sir Charles Henry, head of the European selling organization of the United Metals Selling Co.; William Merton, chairman of the board of the Metallgesellschaft and associated companies; Mr. Moresco, representing the Italian copper manufacturing industry; and Sam Baer, head of the firm of Henry R. Merton & Co.

Mr. Brooker reviewed in his address the development of the brass industry during the last 50 years and paid tribute to the founders of the industry, of which he is now the head. He pointed out particularly that while in 1864 the copper production of this country was 17,000,000 lb. and the copper consumption 25,000,000 lb., in the year 1912 production was 1,600,000,000 lb. and consumption was 800,000,000 lb. Mr. Brooker dwelt on the marvelous development of the copper industry, which he partly attributed to the enormous growth of the electrical industry.

John D. Ryan, in his introductory remarks, stated that the concern of which Mr. Brooker is the head, had purchased during the past 50 years 2,500,000,000 lb. of copper. All the speakers praised Mr. Brooker's great business ability, strict honesty, great amiability and modesty, charming personality and his public-spiritedness, which was evidenced by his various connections with everything that was for the best of the country, for the best of his state, for the best of his party and for the best of the industry, with which he was prominently connected.

There was a long line of speakers, all of whom, in one way or the other, praised Mr. Brooker's eminent qualities, which have enabled him to make this great reputation. William H. Nichols presented a bronze representing a pilot to Mr. Brooker, as a token of the admiration of the Copper Producers. The other speakers were: Col. T. L. Livermore, formerly connected with the Calumet & Hecla Mining Co.; F. J. Kingsbury, of the Bridgeport Brass Co.; Howard Elliot, chairman of the New Haven; C. A. Coffin, president of the General Electric Co.; Jacob Langeloth, chairman of the American Metal Co.; Senator W. A. Clark; Charles MacNeill, representing the porphyry properties; Col. R. M. Thompson, connected with the International Nickel Co.; Melville Stone, of the Associated Press; and Rev. W. G. Lathrop.

It was the most representative gathering of men of the copper industry which ever came together in this city and the speakers pointed with pride to the achievements of the industry and to the high standard of morality among the men in charge of it. There were 178 present.

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Electric Winding Engines for the Rand

Electric winding continues to grow in favor and the East Rand Proprietary Mines, Ltd., is about to equip its Hercules shaft, 4000 ft. deep, with a hoist manufactured by the British Westinghouse Electric Co. The winder will raise 16,000 lb. of ore from 4500 ft. vertical at a speed of 2200 to 2500 ft. per min. The winding drums are direct coupled to the two driving motors and are conical 12 ft. to 21 ft. in diameter and 9 ft. 3¾ in. between flanges. They are ground for a 2-in. diameter rope and the hoisting capacity is 160 tons per hour.

Each of the driving motors can exert 1900 b.hp. They are placed at opposite ends of the two drums. They are direct-current motors and are supplied from a motor-generator set controlled on the Ward Leonard system. The generator is 5000 hp., three-phase, 25 periods and 3000 volts, running at 490 r.p.m., supplied with current from the company's large generating station. The brake and clutch engines are driven by compressed air.

PERSONALS

D. C. Jackling is expected in New York about the end of April.

Pope Yeatman has returned from Chile, and is going to Nevada about the end of April.

W. E. Porter has been appointed assistant chief smoke inspector of the city of Pittsburgh.

L. D. Davenport is now assistant chief engineer of the Oliver Iron Mining Co., Hibbing, Minnesota.

Edwin J. Collins is examining mining properties in Colorado and Utah. He will return to Duluth early in May.

C. B. Lakenan, general manager of the Nevada Consolidated Copper Co., has been visiting New York, but has now returned to Nevada.

S. W. Traylor, president of the Traylor Engineering & Manufacturing Co., sailed from New York Apr. 14 for Europe, where he will spend several weeks.

Edwin Higgins, district engineer in the Lake Superior district for the U. S. Bureau of Mines, has been detailed to Washington, D. C., on temporary work.

Henry S. Fleming is acting general manager of the Canadian Collieries (Dunsmuir), Ltd., on Vancouver Island, B. C., taking the place of W. L. Coulson, resigned.

Charles Camsell, of the Canadian Geological Survey, will this summer explore the area between Great Slave Lake and Lake Athabasca, a practically unknown region of great extent.

Lawrence Addicks, who has been superintendent of the Chrome refinery of the United States Metals Refining Co. for the last eight and connected with it for about 10 years, has resigned.

David Tod, president of the William Tod Co. of Youngstown, and for years prominent in the iron industry of Eastern Ohio, has announced himself as a candidate for governor of the state.

George H. Garrey, until recently chief geologist for the American Smelting & Refining Co., and allied companies, has opened an office as consulting mining geologist at 115 Broadway, New York.

Hon. John Munro Longyear delivered the Class Day address to the graduates of 1914 at the Michigan College of Mines at Houghton, Apr. 16. His special topic was "Mining above the Arctic Circle."

Dr. A. J. Lanza, of the U. S. Public Health Service, will undertake for the Bureau of Mines an investigation of occupational diseases among metal miners; directing especial attention to pulmonary troubles.

Edgar Palmer, president of the New Jersey Zinc Co., has given to Princeton University $300,000 for a stadium of athletics in memory of his father, Stephen S. Palmer, former president of the New Jersey Zinc Co.

H. L. Austin, for 10 years past auditor of the American Sheet & Tin Plate Co., has been appointed assistant comptroller of the United States Steel Corporation. He is succeeded in his former office by George M. McGinnis, his assistant for some time past.

OBITUARY

Stanbury A. Jessup died in New York April 9, aged 80 years. He was born at Crompton, Penn., and educated as a chemist. From 1872 until old age forced him to retire a few years ago he was assistant in the United States Assay Office in New York.

Duncan Irvine died at Victoria, B. C., Mar. 16, aged 60 years. He was born in Scotland and after graduating from the University of Edinburgh, he was for several years engaged with the Geological Survey of that country. In 1886, he went to California and a few years later to British Columbia. For several years he was general manager of the Berry Creek Mining Co., which was engaged in hydraulic mining at Dease Lake in the Cassiar district. For four years past, he had been public works engineer for Vancouver Island.

Bradford H. Locke, a well known mining engineer, died at his home in Lexington, Mass., Feb. 22, at the age of 64 years. He was graduated from the Mass. Inst. of Technology in 1872. After a short professional career in California, he settled in Colorado, where he became interested in mining operations, especially in Gilpin County. During his last years he resided in New York, where he devoted his time in developing the Locke electric drill. He was well known at the Engineers' Club, where he made his home. In previous years Mr. Locke traveled extensively, the most notable of his journeys being an exploration of Abyssinia in the interests of Sir Ernest Cassel.

Frederick W. Weyerhaeuser, the multi-millionaire Minnesota lumberman, died at Oak Knoll, near Pasadena, Calif., on April 4, at the age of 79, from pneumonia and other complications. He dominated the lumber industry of the United States for many years, and at the present time his interests control an immense acreage of mineral and agricultural land, particularly in Northern Minnesota, from which the timber has been cut. Born in Germany in 1834, he came to Northeast, Penn., at the age of 18. In 1856 he went to Coal Valley, Rock Island County, Ill., and began his lumbering career as a fireman in the sawmill of Mead, Smith & Marsh. In 1860, together with a brother-in-law, he secured control of a small mill, from which time he came forward rapidly. While he was primarily a lumber man, and his land holdings were acquired for the timber standing on them, it was customary to acquire the fee to the lands. Much of this acreage has since become of considerable value for mineral. Particularly is this true in Minnesota, Wisconsin and Michigan. On the Cuyuna Range, Minnesota, the Weyerhaeuser subsidiary, the Pine Tree Lumber Co., owns a large acreage of mineral rights of good prospective value.

SOCIETIES

Mining & Metallurgical Society of America—A meeting of the New York Section will be held at the Engineers' Club, New York, on Thursday, April 23, at 8 p.m., preceded by the usual informal dinner at 6:30 p.m. The subject of discussion will be "Radium."

Technical League of America—This society has been formed by the consolidation of the Technical League of Engineers and the American Society of Engineer Draftsmen. The officers are C. W. Weick, president; Wm. B. Harsel, vice-president; Walter M. Smyth, general secretary, 74 Cortlandt St., New York.

Colorado Scientific Society—The 302nd regular meeting was held in the Boston Building, Denver, April 4. Benedict Shubart delivered an address on "Conveying Machinery and Methods of Handling Materials." This was illustrated by numerous stereopticon views and proved an instructive and valuable address.

Lake Superior Mining Institute—It is now almost certain that a trip will be made to Detroit at the time of the next annual meeting in August. The meeting is scheduled to take place on the Marquette range, where one or two days will probably be spent, and then the members will board a boat for Detroit. The members favor such a plan and the Marquette range committee will make the necessary arrangements.

Lehigh University—The Senior miners and geologists of Lehigh University visited the mine of the Cornwall Ore Banks Co., Cornwall, Penn., on March 28. Dr. Miller of the Geological Department, and Professor Eckfeldt, of the Mining Department were in charge, and the party consisted of 24 men. The day was spent in studying the mining methods used, and the geology of the district. This is the first of the Spring mine visits which the Lehigh men make each year. On April 4, the same party visited the mine of the Empire Steel & Iron Co., at Mt. Hope, N. J., where they were very courteously entertained by the officials of the company, especially Superintendent Roach and Chief Engineer Stoddard (Lehigh '09).

Colorado School of Mines—Dr. Rossiter W. Raymond has accepted the invitation of President W. G. Haldane to deliver the commencement address, May 29, at Golden. The graduating class numbers about 50. After the completion of all regular examinations, the class will devote more than a week to large-scale laboratory work in the school's new testing plant, determining the proper treatment for ore from the Stanley mine, at Idaho Springs. The usual senior trip begins Apr. 20 and, in its itinerary of four weeks, will include the principal features in metal and coal mining, metallurgy, power generation and geology at Colorado Springs, Cripple Creek, Portland, Cañon City, Glenwood Springs, and Shoshone, Colo.; Castle Gate, Midvale, Bingham, Salt Lake City, Tooele and International, Utah; Butte and Anaconda, Montana.

INDUSTRIAL NEWS

The Asbestos Protected Metal Co., of Beaver Falls, Penn., announces the removal of its Pittsburgh office to 1611 Bennedum-Trees Building. This company has begun manufacturing a complete line of prepared roofing and shingles, in addition to its asbestos-protected metal.

The Link-Belt Co., manufacturer of the Link-Belt silent chain drive for the transmission of power, elevating and conveying machinery, locomotive cranes, power-house conveyors for coal, ashes, etc., announces the opening of an office in Detroit, Mich., Room 911, Dime Bank Building.

The A. S. Cameron Steam Pump Works, 11 Broadway, New York, announces the opening of a branch office and warehouse in each of the following cities: Birmingham, Ala., American Trust Bldg.; Chicago, Ill., People's Gas Bldg.; Cleveland, Ohio, Williamson Bldg.; Duluth, Minn., Providence Bldg.; Houghton, Mich.; Knoxville, Tenn., Holston Nat'l Bank; Los Angeles, Calif.; Philadelphia, Penn., Arcade Bldg.; Pittsburgh, Penn., Farmers' Bank Bldg.; St. Louis, Mo., 300 N. Broadway; Seattle, Wash., Colman Bldg.

Andover Furnace, at Philipsburg, N. J., has been sold to the Pennsylvania R.R., which will build an embankment for its tracks thorugh the property. This construction will necessitate the tearing down of the stack and the dismantling of the plant, and arrangements now are being made to carry out the program. All the ore and other manufacturing materials on the furnace bank have been sold. The Andover furnace was the property of the Wharton Steel Co., and has been out of blast since 1910, nearly four years.

The American Emery Wheel Works, of Providence, R. I., has issued a chart, "Safety First—Help Prevent Grinding-Wheel Accidents," which it is distributing to grinding-wheel users all over the world. This chart was prepared by the Independence Inspection Bureau, of Philadelphia, and we consider it one of the most complete analysis of grinding-wheel accidents ever compiled. Widespread publicity of this chart will result to the benefit of every grinding-wheel user. These charts will be supplied to any grinding-wheel user on application, without charge or obligation.

TRADE CATALOGS

The T. L. Smith Co., Milwaukee, Wis. Catalog No. 300. New Smith mixer. 64 pp., Illus., 6x9 inches.

National Tube Co., Frick Bldg., Pittsburgh, Penn. Booklet N. T. C. Regrinding Valves. 14 pp., Illus., 6x3 inches.

Chicago Pneumatic Tool Co., Fisher Building, Chicago, Ill. Bulletin No. 150. Coal drills. 12 pp., illus. 6x9 inches.

The Richardson-Phenix Co., Milwaukee, Wis. Bulletin No. 57. Phenix sight-flow indicator. 8 pp., Illus., 6x9 inches.

The Lagonda Manufacturing Co., Springfield, Ohio. Bulletin. Automatic cut-off valves. 18 pp., illus., 8x10 inches.

Sparta Iron Works Co., Sparta, Wis. Catalog. Well drilling, prospecting machinery and tools. 96 pp., Illus., 6x9 inches.

Sprague Electric Works of General Electric Co., New York, N. Y. Catalog No. 329. Electric Fans. 36 pp., Illus., 10½x8 inches.

Stephens-Adamson Manufacturing Co., Aurora, Ill. Section 3, General Catalog No. 19. Belt conveyors, gates, chutes, feeders. 368 pp., Illus., 6x9 inches.

The Denver Fire Clay Co., Denver, Colo. Catalog "Case" Metallurgical Furnaces. 80 pp. Illus. 9x6 inches.

This catalog is devoted especially to the Case metallurgical furnaces and accessories. It is mainly devoted to the oil- or gas-fired types and contains data not only as to the furnace sizes, but also with reference to furnace performance. The catalog also describes and illustrates a series of muffle furnaces for coal, coke and wood.

H. W. Caldwell & Son Co., Chicago, Ill. Catalog No. 38. Elevating, conveying, power transmitting and general machinery. 798 pp., Illus., 9¼x6 inches.

This catalog is a complete list of elevating, conveying, and power-transmission machinery of all sorts. It is handsomely illustrated, and the descriptions are good, so that it could be used as a textbook in these subjects. In all respects we think this the finest catalog we have seen.

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.

ALUMINUM ALLOY. William A. McAdams, Bay Shore, N. Y. (U. S. No. 1,092,500; Apr. 1, 1914.)

BUCKET CONVEYOR. Myron A. Kendall, Aurora, Ill., assignor to Stephens-Adamson Mfg. Co. (U. S. No. 1,090,156; Mar. 17, 1914.)

CONCENTRATOR. Edward Pierce and William Pinkerton, Pleyto, Calif. (U. S. No. 1,091,440; Mar. 24, 1914.)

CRUSHING AND PULVERIZING MACHINE. Joseph E. Kennedy, New York, N. Y. (U. S. No. 1,090,216; Mar. 17, 1914.)

CRUSHING MILL. Thomas Joseph Sturtevant, Wellesley, Mass., assignor to Sturtevant Mill Co. (U. S. No. 1,092,185; Apr. 7, 1914.)

CYANIDING—Precipitation of Metals from Cyanide Solutions. Charles Butters, Oakland, Calif. (U. S. No. 1,092,765; Apr. 7, 1914.)

DRILL—Pneumatic Rock Drill. Thomas J. Barbre, Denver, Colo. (U. S. No. 1,092,237; Apr. 7, 1914.)

DRILL BIT-LOCKING MEANS. Daniel S. Waugh, Denver, Colo., assignor to The Denver Rock Drill & Machinery Co., Denver, Colo. (U. S. No. 1,091,263; Mar. 24, 1914.)

DRILLING—Hydraulic Drilling Machine. Soren C. Monberg, Leadville, Colo. (U. S. No. 1,092,075; Mar. 31, 1914.)

DRILLS—Chuck for Rock Drills. Charles C. Hansen, Easton, Penn., assignor to Ingersoll-Rand Co., New York, N. Y. (U. S. No. 1,091,510; Mar. 31, 1914.)

DRYING AIR—Process and Apparatus for Drying Air. Félix Adolphe Daubiné, Auboué, France. (U. S. No. 1,092,434; Apr. 7, 1914.)

ELECTRIC CRUCIBLE FURNACE. Daniel F. Calhane, Worcester, Mass. (U. S. No. 1,091,808; Mar. 31, 1914.)

ELECTRIC FURNACE for Metallurgical Purposes. Henry H. Buckman, Jr., Indianapolis, Ind. (U. S. No. 1,092,764; Apr. 7, 1914.)

FURNACE-DOOR-OPERATING DEVICE. George H. Gregory, Mount Carmel, Ill. (U. S. No. 1,091,060; Mar. 24, 1914.)

FURNACE LINING—Process of Lining Furnace. Byron E. Eldred, New York, N. Y. (U. S. No. 1,091,567; Mar. 31, 1914.)

GOLD-SAVING DEVICE. William C. Fox, deceased, by Lewis J. Fox, administrator, San Francisco, Calif. (U. S. No. 1,092,524; Apr. 7, 1914.)

HAULAGE—Rope-Grip or Jockey for Mechanical Haulage and the Like. George Tom Cannon, Johannesburg, Transvaal, South Africa. (U. S. No. 1,092,137; Apr. 7, 1914.)

HOISTING—Safety Brake Mechanism for Elevators and Hoisting Cages. John Ceserani, Butte, Mont. (U. S. No. 1,091,292, Mar. 24, 1914.)

MINE-CAR WHEEL—Self-Oiling Mine-Car Wheel and Axle. William H. Bines, Barnesville, Ohio, assignor of one-half to Andrew J. Baggs, Barnesville, Ohio. (U. S. No. 1,091,796; Mar. 31, 1914.)

MINE CARS—Means for Dumping Mine Cars. Henry V. Frye, Bickneil, Ind., assignor of one-half to Thomas Gillespie, Bickneil, Ind. (U. S. No. 1,091,826; Mar. 31, 1914.)

MINE DOOR. John K. Orr and Louis F. Jones, Zeigler, Ill. (U. S. No. 1,090,562; Mar. 17, 1914.)

MINER'S LAMP. John Van Liew, Chicago, Ill. (U. S. No. 1,090,250; Mar. 17, 1914.)

ORE DRESSING—A Process of Dressing Ores by Means of Gas. K. Takeda, Tokio, Japan. (Brit. No. 7272 of 1913.)

POTASH FROM FELDSPAR, Process of Obtaining. Harry P. Bassett, Catonsville, Md., assignor to The Spar Chemical Co., Baltimore, Md. (U. S. No. 1,091,034; Mar. 24, 1914.)

POTASSIUM AND SODIUM COMPOUNDS—Method for Extracting Potassium and Sodium Compounds from Silicates Which Contain Alkalies. Anton Messerschmitt, Stolberg, Germany. (U. S. No. 1,091,230; Mar. 24, 1914.)

REFINING—Process of Refining Metals. Albert Patton, McKeesport, Penn. (U. S. No. 1,091,588; Mar. 31, 1914.)

ROASTING—Furnace for Treating Ore and the Like. Knut Jakob Beskow and Arthur Ramén, Helsingborg, Sweden. (U. S. No. 1,091,182; Mar. 24, 1914.)

SALT—Method of Cleaning Salt. John Stauffer, San Francisco, Calif., assignor to San Francisco Salt Refinery, San Francisco, Calif. (U. S. No. 1,091,252; Mar. 24, 1914.)

SALT—Method of Transporting Salt. John Stauffer, Oakland, Calif., assignor to San Francisco Salt Refinery, San Francisco, Calif. (U. S. No. 1,091,251; Mar. 24, 1914.)

SKIPS—Limber-Pin for Mine Skips. Charles Henry Sawyer and James Bowditch, Newcastle, N. S. W., Australia. (U. S. No. 1,092,750; Apr. 7, 1914.

SLAG—Improvements in or Relating to the Manufacture of Porous Slag. C. H. Schol, Allendorf, Germany. (Brit. No. 838 of 1914.)

SODIUM—Improved Electrolytic Process and Apparatus for the Manufacture of Sodium and Other Alkali Metals. E. Marguet, Clermont-l'Herault, France. (Brit. No. 11,278 of 1913.)

SODIUM AND POTASSIUM SALTS, Process of Separating. Harry P. Bassett, Baltimore, Md., assignor to The Spar Chemical Co., Baltimore, Md. (U. S. No. 1,091,033; Mar. 24, 1914.)

SULPHURIC ACID—A Process for Manufacturing Sulphuric Acid from the Sulphur Compounds of Ammonia Freed Coal-Gas and Apparatus Therefor. J. Mackenzie, Middlesburgh, Eng. (Brit. No. 4770 of 1913.)

Editorial Correspondence

SAN FRANCISCO—Apr. 8

Zeila Mine in Amador County Has Been Closed Down—The engine, pipes, tracks and other underground equipment have been removed and the hoisting of water ceased Mar. 25. All the ore hoisted had been crushed and the mill shut down on the following day. The mill is being dismantled and the building will be removed. Whether the hoist will be immediately dismantled and removed has not been definitely stated. The mine was recently examined by Robert E. Cranston for Breitung & Co., New York, under a purchase option, and it is reported that engineers representing Salt Lake men also made an examination. The closing down of the mine and dismantling of the mill is not positive evidence that the mine will not be sold. Examinations have disclosed shoots of new ore at the lowest levels, and while it is generally understood that it is low grade there has been no definite statement as to the grade. Probably no one except Cranston and the engineer who assisted him know all the results of the examination. There has been much talk as to the failure to sell the mine, and opponents of the Johnson administration attribute it solely to drastic provisions of the workmen's compensation law. If the law were the sole cause or the chief cause it is not likely that Breitung & Co. would have gone to the expense of making the examination. The law was in operation before negotiations for the purchase of the mine were undertaken and the company had foreknowledge that the ore in the lower levels was not high grade. It is conceded that the compensation law is not conducive to investment or advanced development of deep mines; but the right kind of a mine on fair terms of purchase does not lack a purchaser merely because the laws governing mining are objectionable and their observance costly. The Zeila mine has been in operation for 30 years and only such improvements in methods and advancement in development have been undertaken as were actually essential to continued profitable operation of mine and mill. There is no doubt that the present owners strenuously maintain their opposition to the compensation law, and that this is offered as a reason for not continuing work and making essential improvements is not unlikely. But the real reason for failure to sell the Zeila should be looked for back of all this talk of compensation laws and low-grade ores. It is more likely that the refusal of the owners of the Zeila to make reasonable terms and place a fair price on the mine is actually responsible for the closing down of the property. The attitude of the management which will result in the practical destruction of the industry rather than make concessions involving only a fraction of the loss that will accrue from the closing of the property, is in keeping with the spirit of many of the old-time mine owners in California. There are several large mines in the state which were large producers in the early days of quartz mining now idle for practically the same reason that the Zeila is idle, that the owners would not adopt essential improvements or sell at fair prices and on reasonable terms.

DENVER—Apr. 9

A New Scheme for Mine Promotion is being tried in the Leadville district where a daily newspaper has started a column that lists "without cost to owners, the names, location and physical advantages of mining property in Lake and adjacent counties, giving terms of lease or sale; also any developing proposition that owners desire to promote." This is done "merely to voice the opportunities existing and which would not be known to miners and investors in any other way." The paper disclaims responsibility for the statements made and insists on publishing names and addresses of persons submitting proposals. Results of this free advertising will be watched with interest.

To Protest Against Proposed Legislation that would place coal and other nonmetal mineral lands under a Federal leasing system was the purpose of a mass meeting of significance to the mining men of the West held in the capitol, Denver, Apr. 6, in response to a call from Governor Ammons. It developed that the recently organized Denver branch of the Colorado Metal Miners Association fostered this protest. The state mine commissioner T. R. Henshen presided. The resolutions committee, all prominent men, reported strongly in opposition to the bills pending at Washington, making arguments that the segregation on nonmetal lands is a reversal of the policy of the homestead act, that development of any mining can best be accomplished by independent prospectors and capitalists, that the segregation places an undue taxation burden on other classes of property, that a leasing system will not interest prospectors nor investors. It was stated that there are 9,300,000 acres of land in Colorado affected. Colorado's congressional members are called upon to oppose the measures strenuously and it is planned to send a special committee to Washington.

BUTTE—Apr. 8

Reduction in Coal Rates Has Been Ordered by the Montana Railroad Commission on coal from Stipek, a station on the Sidney branch of the Northern Pacific, eight miles north of Glendive, to eastern Montana points, covering territory between Miles City on the west, and the Montana line on the east. The order was made upon complaint of the Gate City Coal Mining Co., which alleged discrimination. The reductions, which average about 15%, were based on the standard scale of mileage for coal rates promulgated by the commission in 1909.

A New Safety Device has been patented by J. Ceserani, a Butte miner, which he hopes in the future will avert many mine accidents caused by falling cages in shafts, due to parting of cables, runaway engines, etc. The inventor began work upon his idea about a year ago, directly after the accident at the Leonard mine in which several men were killed on a falling cage when the hoisting engine ran away. The device weighs 250 lb., and is attached to the cage, occupying a space 8x10 in. square. Two levers are used in its operation; one, with a pull of from 10 to 20 lb., releases wings, which thrust out laterally from the cage, stopping its rush: the other lever is designed to sever the electric wire near the guide, thus giving the engineer warning of trouble in the shaft by extinguishing a light near him. This second lever also may be used as a signal to the engineer when anything else goes wrong, such as a man falling off the cage, or the tearing out of guides, etc.

CALUMET—Apr. 11

A Referendum Vote will be taken toward formally calling off the strike in the Lake Superior copper country. Meetings have been held and the Federation officials have put the question to the men, that if they decide to remain out that their benefits would of necessity be cut owing to the fact that the funds that they were receiving from outside sources would be materially reduced. President Moyer of the Western Federation of Miners is reported to have expressed his approval of the move to be taken, stating that the local union decided on the strike and he would sanction its calling it off. A number of the strikers have made application for their former jobs. These applications are being filed and as soon as vacancies occur these men will be given preference. There is considerable feeling between some of the strikers and the local union officials and there may be trouble in the union ranks. [The vote Apr. 12 was in favor of calling off the strike.]

Results of the Elections held Apr. 6 evidently went a long way toward showing the strikers their real strength, for the Socialist and the Federation candidates were badly beaten throughout the district. Russel Smith, superintendent of the Ahmeek, was elected Supervisor of Allouez Township, where it was believed that the Federation had absolute control. James MacNaughton, general manager for the Calumet & Hecla Mining Co., was elected Supervisor of Calumet Township over his Socialist opponent by 2535 to 726 votes.

At the Mines all properties are practically full handed and back to normal, with the exception of some of the outlying mines, where it is hard to keep men while there is work in the larger localities. The Calumet & Hecla amygdaloid produced over 102,000 tons during the month of March; the largest in its history. The first quarter of the new electrolytic plant has gone into commission and the remaining sections will follow. The machinery is being rapidly installed at the No. 2 regrinding plant and will go into commission during the early summer. Construction work at the Ahmeek mill is progressing satisfactorily; the building is inclosed and the stamps are being erected. This addition will be ready to stamp rock in the early autumn, in ample time to take care of the increase in production from No. 3 and No. 4 shafts.

HOUGHTON—Apr. 10

Higher Costs and Lower Production were shown in practically every case in the recently issued annual reports of the Lake Superior copper mines. With the exception of the Allouez and the Superior the reports did not compare favorably with those of previous years. In these two instances improvement was notable because of the adverse circumstances attending operations during the year. Of course the labor disturbances aided to some slight degree by the lower price for the product, were responsible for the generally unsatisfactory annual reports. Allouez and Superior are accumulating surpluses. If it had not been for the strike both might have entered the list of dividend payers. But in practically all the other mines of the Michigan copper country the labor disturbances caused higher costs of copper. The strike has been expensive for most of the mines. They have been compelled to maintain a police force, to incur numerous heavy expenses in fighting the Western Federation of Miners, and in numerous cases these additional costs are still on the books. While the annual reports for 1913 showed high copper costs the shareholders must appreciate the fact that the present year, 1914, promises to show an improvement, but the cost of the strike will be noticeable in the reports next year. Wages are higher than ever before. Efficiency in labor will be improved. Further general efficiency and lower costs may come about through improved mechanical devices and methods. Operations have been resumed at the Oneco property. This is one of the smaller exploration properties that suspended when the strike was called and made no effort to resume operations while there was any semblance of difficulties. The force was small at best. Last week work on two drifts was started, one to the north from the third level and the other to the south from the twelfth level. Both are opening what is known locally as the Oneco lode. In diamond drilling that formation showed good copper. It is probable that further diamond drilling may be done in the near future on territory to the north of the shaft. There is every reasonable expectation, too, that the lode which the Oneco is opening is the same formation which has shown such strength on the Arcadian, as the Oneco property is in the same general mineralized zone, allowing for a comparatively slight swing in the Arcadian lode. The situation at the Isle Royale is encouraging in the opening of the West or Grand Portage vein. A year ago when this work was first started there was some doubt as to its advisability, but the management had excellent information relative to the characteristics of this formation as opened in the early workings of the old Huron mine and opening work was undertaken. A long crosscut was driven from No. 2 shaft. This crosscut went through the Isle Royale lode, then through a long offset and finally picked up the West vein. Its later development further east shows the Grand Portage in unusual richness. In fact the formation has so much of promise in it that six machines are working to get this lode opened and in position to ship mill rock. To date the milling from this formation has been practically nil. Such rock as has been taken from these openings in the course of developments has shown better copper than the Isle Royale lode. At present time Isle Royale is producing a daily rock tonnage of 1400 tons. This was the average daily shipment previous to the strike. It is believed that this amount can be increased to an average of 1800 tons within 60 days. This is the capacity of the stamp mill. As soon as the Grand Portage becomes a regular producer the rock shipments will show material increase without any necessary increase in the number of miners at work underground.

HIBBING—Apr. 5

Spring Activity on the Mesabi has begun, although not in as substantial a measure as in some former years. At Eveleth two shovels have started in the Adams pit, one in the Leonidas and one in stripping operations at the Fayal. All three pits are being enlarged. At Chisholm the Shenango Furnace Co. has a large crew of men at work preparing for the usual activities. At Virginia, Butler Bros., contractors, have put one shovel to work stripping the Sliver property, so called because of its long and extremely narrow dimensions. Stripping was started on this property a year or two ago, and one month's work is needed to complete it, when M. A. Hanna & Co. will begin removing ore. The company has bought a new steam shovel and two Baldwin locomotives for use there. Around Hibbing, the Oliver Iron Mining Co. will have an active season on the Great Northern leases. The Smith mine, northwest of Hibbing, which was stripped last season, will be operated. The Winston-Dear Co., contractors, have four shovels at work stripping the Dunwoodie mine at Chisholm, and at the Dean mine, Butler Bros. have two stripping shovels working. Both properties can produce ore this season if necessary. Among the other important mines held by the Steel Corporation on lease from the Great Northern may be mentioned the Walker, Fay, Leonard, Dale, North Uno, South Uno, Herald, Mississippi, Mace, Hill and North Star, mostly situated near Hibbing. The Herald was recently closed down for unstated reasons. In anticipation of a considerable activity, the Duluth, Missabe & Northern Ry. has sent out an inquiry for prices on 1000 cars.

BRAINERD—Apr. 8

American Manganese Manufacturing Co. contemplated organization has been the one feature of importance on the Cuyuna range during the last week. The project is a consolidation of the Cuyuna-Mille Lacs Iron Co., operating the Cuyuna-Mille Lacs mine, the Cuyuna-Duluth Iron Co., operating the Ironton mine, and the Dunbar Furnace Co., operating a blast furnace. and owning coal lands of ample tonnage for many years to come, and other subsidiaries. The directors of the two mining companies have approved the consolidation. The new concern will have a capitalization of $12,000,000, divided into $6,000,000 preferred 6% cumulative stock and $6,000,000 common, par $50. It is proposed to strip the Cuyuna-Mille Lacs mine, insuring an annual production of 200,000 tons of manganiferous iron ore, and increase underground work in the Ironton mine so as to enable an output of 150,000 tons. The furnace company is said to be equipped to successfully reduce such ores to pig iron, manganese pig, ferromanganese and spiegel. The terms upon which each of the concerns enter the deal are not announced, but the scheme is certainly unique in one respect, i.e., it is unusual for mining operators to go into the pig-iron districts of Pennsylvania to seek a combination with furnace interests; it is usually the blast-furnace operator who goes out seeking the kind of an iron mine his product may require.

VALDEZ, ALASKA—Apr. 2

Route of the Government Railroad is a subject talked of all over Alaska. Campaigns, which will count for little when the final selection of the route is to be made by the Government board, have already been started by several of the newspapers and commercial bodies of the coast cities of Alaska and while this will in no wise serve to influence the board it has already served to work up bitterness between the different sections involved and which will develop in a greater degree as the preliminary work of the choosing of the route progresses. The residents of Fairbanks are optimistic regarding the location of the road for it is felt that no matter what the route may be the ultimate terminal will be the Tanana Valley, but this cannot be said of the coast cities which have hopes of being designated the tidewater terminus. Seward is first in its contention for the tidewater terminal and considers its prospects as the best regardless of the fact that the possible route from that city to Knik Arm and thence through the Matanuska coal field to Fairbanks is 53 miles greater to the coal fields and over heavier grades than the route from the Portage Canal which is the shortest to the interior waterway. Skagway also lays claim to the terminal with the route starting at Haines Mission and which would undoubtedly open up a vast territory, but has the drawback of forcing part of the road into Canadian territory which practically precludes this as a possible route. Valdez believes that a road from that city through the Keystone Cañon following the line of the wagon road built by the Alaska Road Commission would best serve the entire territory. This city was selected by the Guggenheims as the terminus for their road from the coast to Chitina and Kennicott, but was abandoned when what was believed to be a better route from Cordova was found. From Valdez to the coal field is greater that either of the routes from Portage Bay or Seward. The Sheep Creek district supporters are of the opinion that a terminus on Cook Inlet would be the most desirable from the fact that from there through the Matanuska coal field and thence to Fairbanks is the shortest distance, but the fact that Cook Inlet is closed to navigation for a portion of the year on account of ice and the 60-ft. tide marks the Sheep Creek route as the most improbable. Since the failure of the test of the Bering River coal conducted by the Navy it is not thought likely that a route through this section will be considered at this time though a branch might be constructed if a second test proved that the coal would be desirable and the prospects of Cordova for the Pacific Coast terminus of the road are not bright. Each of the sections are honestly of the opinion that their particular claims to the right of having the terminal are the only ones to be considered and there will be disappointment and hard feeling when the final route is determined. In securing action on the passage of the Alaska railroad bill all Alaska was arrayed with one end in view of getting a Government railroad in the territory, but now that the issue has been carried to a successful conclusion it seems a "house divided against itself."

The Mining News

ALASKA

THREE IN ONE (Shoup Bay)—J. Devinney is in San Francisco purchasing a stamp mill and other machinery.

ALASKA TREADWELL (Douglas)—Production in February, from 61,866 tons, $2.87 per ton, or $175,890; net profit, $108,594.

CHATANIKA FLATS (Chatanika)—Charles Watson reached bedrock at 125 ft. with new shaft Mar. 1. Shaft was sunk by three men in 18 days.

ALASKA UNITED (Douglas)—February production Ready Bullion claim, 16,756 tons that yielded $1.96 per ton or $32,557, loss, $2431; 700 claim, 16,416 tons that yielded $1.55 per ton or $25,246; net profit $3145.

NEWSBOY (Cleary)—Mill ran 15 days in February, crushing 300 tons of ore; clean-up at end of month returned $3800. Lessees, who are working mine on a coöperative basis, had left slightly more than wages, after paying all expenses, including a royalty of 25% to Newsboy company. Mill will be run full-time from now on, as there is sufficient ore in sight for several months of continuous operation.

16 BELOW, CLEARY (Chatanika)—It is reported that pay has been discovered on a "second bedrock," 20 ft. below one that has hitherto been considered bottom of ancient valley. Lower pay-streak is richer than upper, running $4 per sq.ft. Second bedrock is 150 ft. from surface. It is thought that, at time placers were forming, a land-slide covered bottom layer of gravel, making a sort of false bedrock on which leaner pay was later deposited.

NO. 1 BELOW, CLEARY (Cleary City, via Fairbanks)—Al. Hilty has driven an adit 1800 ft. for drainage and is preparing for summer sluicing season. Claim was worked soon after discovery of pay on creek, but several large pillars were left, and considerable "side-pay" that was not rich enough to be attractive at that time. Claims immediately above, notably, Discovery and Nos. 1, 2 and 3 above were robbed in a similar manner. All adjoining workings were connected underground, and when Cleary Creek broke into No. 3 Above, it flooded claims below as well as No. 3. All efforts to recover gold left in haste of pioneer days have failed on account of excessive cost of pumping this water. It is thought that Hilty adit will make a large amount of "pay-dirt" available for mining on claims above as well as No. 1 Below. Some of this ground, especially that in pillars, is reported to run as much as $10 per sq.ft. of bedrock or $40 per cu.yd.

ARIZONA

Gila County

INTERNATIONAL SMELTING & REFINING CO. (Miami)—Foundations for reverberatory hearths are soon to be started at smelter. These furnaces, which will be 120 ft. long and 20 ft. wide, are to rest on slag bases. Slag will be obtained at Old Dominion smelting plant at Globe, whence it will be brought in slag pots and while still molten will be poured into foundation pits so that upon solidifying it will adapt itself to all minor irregularities.

REYMERT (Superior)—This mine is eight miles southwest from Magma. It is located on a large, well defined and continuous vein from which much silver-lead ore was extracted in early days. A 20-stamp mill remains on property. Vein is from 10 to 60 ft. wide. Ore is highly siliceous, and its open structure and its leached out appearance indicate an oxidized zone of considerable depth. For this reason development of vein wholly by hand steel has not yet been productive of definite results, but from general aspect of property examination leads to belief that there may be a large sulphide zone beneath. Shaft, a few weeks ago had reached a depth of 350 ft. and, because of vertical position of vein, material from lode was being taken from bottom. This vein material indicated that oxidized condition of surface virtually obtains unchanged at depth so far reached. Shaft is making 150 gal. of water per minute.

INSPIRATION CONSOLIDATED (Miami)—The 12-compartment flotation machine is nearly ready for operation, and tube mill will be installed as soon as received. An interesting test is to be made at experimental plant between this mill and Hardinge mill, as both are to be run on identical feeds and under similar conditions Machinery for hoist and compressor plant will begin to arrive at a rapid rate by Apr. 20. Among shipments recently made were 18 cars (328 tons) of Nordberg hoisting equipment and auxiliaries, and six cars of compressor machinery of Ingersoll-Rand manufacture. Neither of these shipments include driving motors which are to be furnished by General Electric Co. First two lots of an 8-car shipment of Symons 48-in. disk crushers are also en route as well as 50 tons of steel shelving for concentrator warehouse and 200 tons of Berger plate which is to be used for supporting and reinforcing concrete floors. Several men have been engaged for making excavations for a 150-ton set of Fairbanks railroad track scales. These scales will be near rock-crushing plant, about 500 ft. from west end of trestle approach to concentrator, and will be used for weighing in ore for mill. Scales are built in four sections having a total length of 50 ft. and are equipped with an automatic registering beam.

MAGMA (Superior)—Current from Roosevelt dam power plant should be ready for use within a few weeks. Mill being constructed should be finished within 60 days and aërial tramway being figured on by management should be decided upon in near future. Millsite is about 1000 ft. west of mine on point of a small spur of range containing mine. Tramway that has been erected for conveying ore to mill will have a capacity of 150 tons per 24 hr., but it has been so constructed that its capacity may be doubled at any time by a few minor changes in its equipment. Ore will be sorted on a conveyor belt and first treatment will be that of crushing it to 12 mesh. It will then be sent over roughing tables, from which middlings and tailings will be crushed to 60 mesh and sent over a second set of roughing tables and slimes from these tables will be treated by flotation. Flotation product will be treated in a Kelly filter press. Magma "waste" dump averages 4% copper. This dump contains 20,000 tons and will sometime be milled. First- and second-class ore are high in copper and mine ore runs better than 1 oz. silver to each 1% of copper. First-class ore runs from 50% to 60% copper, 75 to 100 oz. silver and about $2 gold. Second-class asays 16% copper and 25 oz. silver. Naturally there will be a large percentage of Magma's output sorted and sent direct to Ray smelting plant for treatment. That proposed tramway will be built to Miami, 14½ miles, if Magma company can get a satisfactory contract with International company at that place, seems a certainty. A movement now on foot at Miami to have separate county segregated from rest of Gila County may affect tramway project considerably as Superior and Miami districts are rather closely identified in mining interests.

Maricopa County

IN MESA MINING DISTRICT there is considerable activity in mining. Stamp mill at Mammoth mine is being enlarged by addition of 10 stamps. Large tanks are being installed at Bull Dog mine near Mammoth.

COPPER PROPERTY IN BIG HORN MOUNTAINS 30 miles southwest of Wickenburg which was under bond to U. S. Copper Co. several years ago has been bonded to F. C. Alsdorf, of San Francisco, by James Hauxhurst. Property is an old one and considered of much promise. There is a good wagon road to property from Aguila, a station on Arizona & California R.R. Aguila is 18 miles north of property.

MAX DELTA (Phoenix)—Sinking has been resumed since the installation of a new hoist and compressor.

GARCIA (Wickenburg)—Mill is being put in shape for early operation. Shaft has recently been unwatered, and active development will be resumed.

PHOENIX (Phoenix)—This mine above Cave Creek station is being sampled and it is probable that stamp mill on property will be put in shape for a trial run.

CALIFORNIA

Amador County

ZEILA (Jackson)—Mine is closed down, underground machinery removed, hoisting of water stopped, all ore extracted has been crushed and mill is being dismantled. It is understood that negotiations with Breitung & Co. for sale of property have terminated.

KEYSTONE (Sutter Creek)—Report of operations for quarter ended Mar. 17 shows that on 1200-ft. level in east and west crosscut, at 600 ft. from main crosscut, a cross-fault indicates presence of vein found on 900-ft. level. This vein is 6 ft. wide carrying ore assaying $6 per ton and 12% sulphides. Development on 2600-ft. level disclosed bunches of low-grade ore.

Eldorado County

BLUE GOUGE (Sly Park)—It is reported that U. S. Smelting, Refining & Mining Co. has taken an option of purchase. Ore is low-grade, but in large shoots.

ORO FINO (Shingle Springs)—It is reported that an option has been secured for Bewick-Moreing Co. This is a low-grade property formerly operated by Hayward-Lane interests.

Humboldt County

HORSE MOUNTAIN (Eureka)—A 100-ton concentrator has been contracted for. A large amount of development has been done in last six months.

Sacramento County

UNION DREDGING CO.—This company's property, including its 9-cu.ft. Bucyrus dredge, one of the newest in American River field, will be sold by order of court, at public auction, Apr. 28, at Folsom.

COLORADO

Clear Creek County

CORRY CITY (Georgetown)—Crosscut is presumed to be within 125 ft. of vein.

ALICE (Alice)—Mines and mills have been sold at sheriff sale to A. D. Bullis, of Idaho Springs.

GRAND CLEAR CREEK TUNNEL CO. (Empire)—Company has recently opened a wide vein of ore which may be treated in mill.

ALMADEN MINES CO. (Idaho Springs)—Lessees have recently opened a streak of rich ruby silver ore in a winze sunk from bottom level.

PITTSBURGH CONSOLIDATED MINING, MILLING & TRANSPORTATION CO. (Idaho Springs)—Annual meeting of stockholders will be held in Idaho Springs Apr. 30. A bond

issue, secured by mortgage on property, will be considered. An effort will be made to raise funds for additional development.

AVALANCHE (Freeland) — Systematic development work has been commenced. An adit is being driven on vein which is 4 ft. wide and contains a 12-in. streak of high grade lead-silver ore. Work is being done with new type of electric drill manufactured by Denver Rock Drill Co. It is reported that this drill is satisfactory.

TENNESSEE MINING, MILLING & TRANSPORTATION CO. (Idaho Springs)—This company, owner of King Solomon property on Chicago Creek, plans extensive development work during coming season. A new building has been erected at portal of crosscut tunnel to house machinery which has been ordered. Tunnel is now 1000 ft. long and will be advanced.

Dolores County

RICO CONSOLIDATED (Rico)—A body of copper ore similar to that in Wellington mine is being developed by drifting.

Eagle County

IRON MASK (Gilman)—Mine and mill are running full time with a daily production of 100 tons of zinc and lead concentrates. The hills north of Red Cliff are being prospected for orebodies similar to those on Battle Mountain three miles west where formation is same. It is rumored that a gold find has been made in Elbow Park, about one mile from Horse Mountain where Lady Belle and North Dakota mines are situated.

Gilpin County

COLORADO-CARR (Central City)—New electric fan has remedied long-standing trouble from foul air.

OLD TOWN (Russell Gulch)—Shipments have been recently made by five sets of lessees, asays range from $20 to $90.

CLAY COUNTY (Black Hawk)—English interests have purchased this mine that has been idle for years. In its early history, surface or oxidized quartz "plated" as high as 60 oz. per cord.

FIFTY GOLD MINES (Black Hawk)—Negotiations are under way in Denver looking to sale of this large group and it expected that various mines—Cook, Bobtail, Gregory, etc.—will be busy this summer.

GUNNELL (Central City)—Terminal Mining Co., working through Newhouse tunnel, is shipping to Argo mill at Idaho Springs. A vein of mill ore is developed, while a streak of chalcopyrite, of smelting grade, has also been opened.

SQUARE DEAL GOLD MINING CO. (Central City)—Main shaft of Notaway mine has reached a depth of over 900 ft. Development on new 850-ft. level has been satisfactory. Vein is pay over a width of 2 ft. Drifting is in progress in both east and west headings on this level. On 750-ft. level both east and west headings are being advanced in pay ore. A raise is being made from 750-ft. level to connect with bottom of a winze sunk from 650-ft. level for development and ventilation. A small gasoline engine recently has been installed in shaft house to operate a blower for ventilation.

Lake County

PROGRESS MINING & M LLING CO. (Leadville) — This new corporation proposes to acquire mining property and erect a mill for custom treatment.

WESTERN ZINC MINING & REDUCING CO. (Leadville)—New smelting plant is being rapidly erected. All material for buildings is on ground and equipment is being received.

PINGERY MINES & ORE REDUCTION CO. (Leadville)—This new company has taken over Leadville district mill and will operate it on custom basis, while exploiting mining properties.

Ouray County

STENOGRAPHER AND CABINETMAKER (Ouray) — Ouray-Michigan Mining & Development Co., with headquarters at Battle Creek, Mich., has acquired these claims on Oak Creek and will develop as soon as snow leaves. These claims have reputations for remarkably rich free-gold specimens but have never been systematically worked.

San Juan County

MAYFLOWER (Silverton)—It is reported that property has been sold to Guggenheims and that ores will be treated in Silver Lake mill, as soon as tramway connections can be made. It is also stated that mill will be operated on a custom basis, ore schedules to be made public in a few days.

San Miguel County

WELLER GOLD MINING CO. (Telluride)—A pocket of rich gold ore has been opened in main tunnel of this company's Ballard Mountain property. Some fine specimens of leaf gold in rose quartz have been found. Main drift on Ballard vein has recently cut a cross-vein. Beyond this crossing vein has widened to 5 ft. and has improved in grade.

JUNTA CONSOLIDATED GOLD MINING CO. (Telluride)—Development work will be done on Orion and Wasatch mines. As soon as snow has melted sufficiently to permit construction work, tramways will be built connecting these properties with upper terminal of Jim Crow tramway which connects with company's mill in Bear Creek gulch.

Teller County

ROOSEVELT TUNNEL (Cripple Creek)—James F. Burns, formerly president of Portland company, and recently appointed a committee of one to arrange for extension of tunnel to eastward, has been getting contributions for this work, and his list has been headed by John T. Milliken of Golden Cycle with $10,000. Inspection of tunnel has been hindered by "bad air," so Apr. 4 a crew of oxygen-helmet men, headed by F. L. Smale, manager of Portland, and E. P. Arthur, Jr., representing Burns, made a trip of inspection to breast of tunnel, and found no serious difficulties in way of resuming work at once.

IDAHO

Cœur d' Alene District

HERCULES (Burke)—In March this mine took second place in tonnage production among operating mines of Cœur d' Alenes outstripping Bunker Hill & Sullivan and falling only 700 tons short of amount produced by Federal company's Morning and Last Chance mines. Production was 7300 tons.

VIRGINIA (Wallace)—Shipments will begin from this lead-zinc property on Sunset Peak, as soon as roads are in condition. A satisfactory contract with smelters is said to have been secured, and it is planned to forward consignments as rapidly as ore can be gotten to railway at Wallace, nine miles from mine.

MICHIGAN

Iron

CARPENTER INTERESTS (Greens Siding)—Longyear & Hodge, drill contractors, have discontinued work. Three drills that were used in work have been shipped to Iron River. No report has been given out as to results.

JONES & LAUGHLIN CO. (Ishpeming)—Drilling was discontinued on lands under option to south of Greenwood this week but results have not been made public. Three drills were used and it was known several months ago that about 500 ft. of formation had been drilled through.

REPUBLIC (Republic)—Due to uncertain condition of iron ore market management laid off 50 miners and reduced working time to four days per week, Apr. 1. This leaves mining force at 400. Republic is one of the finest properties on Marquette range and it is seldom that it has been necessary to reduce working force, ore always finding a ready market. It is believed on range that it will not be long before other mines will start to curtail unless there is a decided improvement in market.

MINNESOTA

Duluth

ON THE ASHLAND, WIS., DOCKS, a new type of engine has been adopted for ore haulage, with capacity of 75 carloads, present type hauling 58 carloads from mine to dock.

MOVING PICTURES OF MINE OPERATIONS at Oliver Mining Co.'s pits and underground mines, etc., will be shown at celebration of Norway's independence at Christiana next summer. A substantial exhibition will also be on display, gathered together through coöperation of Oliver company and leading Norwegians of Northern Minnesota, of whom approximately 1000 have signified their intention of going to the celebration. Moving pictures consist of eight reels, and deal with economic and sanitary conditions at mines, as well as usual routine operations.

CURTAILMENT IN IRON-ORE PRODUCTION from the non-bessemer mines on the Mesabi, and probably the Cuyuna ranges, will be made in 1914 unless iron ore conditions improve, which does not seem likely at this time. A reduction in the 1914 prices of ore would result in non-operation of many of the underground properties. In fact a number are now idle, and have been idle since last autumn, with little or no stockpile accumulation. Among such are the Woodbridge, Whitesides, Seville and Scranton. However, labor situation is much improved on Mesabi range, which fact may have a tendency to counteract market conditions to some extent. Another counteracting feature is necessity, on part of Steel Corporation, to ship or pay for a heavy tonnage from Great Northern leases, which will expire by cancellation Jan. 1, 1915. It is said that 6,000,000 tons will go forward from these leases, regardless of market conditions or price of ore. Carmi A. Thompson, general manager of Great Northern properties, states that his company will be prepared to deliver 3,000,000 tons of iron ore next season, which he, as well as other Great Northern officials, maintain will be sold in market and not utilized by any furnaces or steel plants owned or subsidized by Hill interests.

U. S. STEEL CORPORATION—Company will make a large exhibit at Panama-Pacific Exposition, having been allotted 41,970 sq.ft. in Mines & Metallurgical Building. Of this space, Oliver Iron Mining Co. will occupy a large part, having a working model of a pit mine and an underground mine, also a model of the city of Duluth with famous aërial bridge in action. Relief maps of Mesabi range will also be shown, as well as a complete collection of mineralogical specimens of district.

Cuyuna Range

DULUTH-BRAINERD (Ironton)—Shaft now down 127 ft. Company expects to hoist some ore before close of present season; product, manganiferous iron ore.

ARMOUR NO. 2 (Crosby)—About 900 tons of ore are being loaded into cars daily, to be sent forward as soon as navigation opens. Over 100,000 tons on stockpile.

MISSOURI-KANSAS-OKLAHOMA

Joplin District

COÖPERATIVE PUMPING in North Webb City, Mo., field was tested last week with satisfactory results. Heavy rains failed to flood mines. Operators coöperate in maintaining big pumping station at Providence mine, permitting operating many properties.

NEW ENGLAND ZINC CORPORATION (Klondike, Kan.)—Company will have a concentrator operating.

SCHERL LAND (Spurgeon, Mo.)—Shaft is being sunk to develop zinc and lead run found from 50- to 115-ft. level.

WOODCOCK & CO. (Granby, Mo.)—New shaft is being sunk to 75-ft. level, where good orebody is known to exist.

BURKE & CO. (Joplin, Mo.)—Small concentrator may be erected soon to treat production now reaching 30 tons of zinc ore weekly.

AVONDALE LAND (Carl Junction, Mo.)—Three good drill strikes have been made on Jubilee Smith lease of this tract. Lease is near Gauger property, which is highly mineralized.

GAMBLE & CO. (Joplin, Mo.)—This company has taken over 20-acre lease of Morning Hour and Big Three tracts and will operate chiefly in former's workings. Recent development work has opened up good ground.

BRADLEY (Neck City, Mo.)—New concentrator proved satisfactory at trial run and will be kept in continuous operation. Is on Reliance land, where S. L. Bradley sank shaft and opened zinc-ore veins, confirming drill record. Good ore found from 75- to 140-ft. level.

MONTANA

Silver Bow County

BUTTE MINERS' UNION—A circular letter was received by local union containing a fervent appeal for a continuation of strike assessment for Michigan miners and for prompt payment of funds to strike committee. Letter brands as a malicious falsehood all reports that Michigan miners were going to take a referendum vote on ending strike. Up to date Butte miners' union has contributed $150,000 to strike fund.

MEETINGS OF COMMITTEE IN BUTTE, recently appointed by Butte chamber of commerce and miners' union respectively, have been held to discuss plans to reduce living expenses, foremost among them rentals. Plans involved proposal of Anaconda company to effect that it would furnish miners land on which to build homes, also building material, lumber, hardware and other material at a price which miners would consider reasonable but that miners furnish labor. C. F. Kelley, of the company, explained to delegates of miners' union that company would not go into business of building and renting houses to its employees. That anything savoring of company-control system must be avoided as it would inevitably give rise to vexatious questions and that company did not care to help creating such conditions in Butte. At meeting chamber of commerce committee suggested that miners should have a voice in affairs of other labor unions in Butte inasmuch as latter were a factor in high cost of living for miners and that proposal was made on that basis to assist them in a reduction of living expenses, notably rentals. A request of Chairman Duffy, of miners' union committee, that a special meeting of union be called to act on proposition made by chamber of commerce committee through Mr. Kelley, was voted down almost unanimously. Miners refused to take any further action in matter, so question will probably not be brought up again.

TUOLUMNE COPPER CO. (Butte)—On Mar. 1 company was out of debt with a cash balance on hand of $22,000. This will permit sinking of shaft to 2800-ft. level as authorized by directors at last meeting.

BUTTE & PENSACOLA COPPER MINING CO. (Butte)—Holdings of this company in Carbonate mining district, 45 miles southwest from Great Falls, were recently enlarged by purchase of six additional claims, adjoining 20 now owned. Ore contains copper, gold and some silver. New properties on southeastern slope of a mountain will be developed through old workings of company which are on more accessible northwest slope.

BUTTE-ALEX SCOTT (Butte)—New development work in lower levels has been promising. Recently discovered No. 1 vein on 2000-ft. level does not appear on any of the upper levels. It is now being developed east and west of shaft with prospects of opening up new oreshoots. No. 4 vein, principal vein of this property, is being worked east and west of shaft on 2000-ft. level and shows no falling off in quality of ore which so far has all been first-class.

MONTANA POWER CO. (Butte)—To 90,000 hp. developed by this company there will soon be added 80,000 hp. now being developed on Missouri River and 40,000 hp. at Thompson Falls on Clark's fork of Columbia River. At other sites owned by company there can be developed 130,000 hp. whenever market is ready for it. Contracts for 99 years have been made for electrical operation of 440 miles of main line of the Chicago, Milwaukee & St. Paul Ry. Fully 2000 miles of transcontinental railways are within easy transmission distance of power plants. These will all eventually be electrified.

DAVIS DALY (Butte)—Calling of a third assessment has given rise to various rumors as to affairs of company. W. L. Creden, consulting engineer for company, explained assessment probably being due to his recommendations for further development work requiring larger sums of money than are available from present ore reserves. He recommended sinking shaft from 1300- to 1900-ft. level and from that depth drive exploration crosscuts into Hesperus and Red Chief ground, adjoining Belmont. Last assessment brings total sum supposed to be paid on new stock up to $9.50, that is, within 50c. of par value. This leaves another 50c. to he called if needed. Creden states that present assessment would carry work recommended for five years if approved by directors.

PARROTT SILVER & COPPER MINING CO. (Butte)—Arguments of attorneys in action brought by W. E. Wall and others against Parrott company were heard Apr. 2 by Judge Bourquin. Action is brought to set aside transfer of Parrot mine to Anaconda Copper Mining Co., to have a receiver appointed to take charge of Parrot affairs and to cause an accounting to he rendered of operations of mine since its transfer to Anaconda company. Plaintiffs claim that offer of one share of Anaconda stock for $2^5/_{28}$ shares of Parrot stock was not an adequate compensation; that in removing Parrot and Gaylord smelting plants all assets and sources of profits were destroyed; that machinery of dismantled plants, valued at $675,000, was sold for only $100,000 and that with loss of smelting plants Parrot property was made a dependency on other company and unable to produce profits which it did before transfer. They also claim that contrary to statement of Anaconda company there still remained in mine ore valued at $2,000,000. To this defendant company replied that at time of transfer Parrot company's property was running hehind each year and that its only hope for future was in consolidation. Since this has been accomplished mine was operated more economically and property has paid larger dividends than before. Parrot now has a large fixed income.

NEVADA

Lander County

AUTO TRUCK ROUTE between Battle Mountain, Willow Creek, Copper Cañon and Hilltop will be established and both freight and passengers hauled.

RICH PLACER GROUND IN COTTONWOOD GULCH, at head of Trout Creek, on west side of Galena Mountain, has been discovered. Six claims have been staked and modern equipment will be installed at once. Nugget worth $127 was found.

GLASGOW & WESTERN (Battle Mountain)—Suit of Glasgow & Western vs. Scott, Davis, Healy and Van Normand, over title to Homestake and Guy Davis placer claims has been decided in favor of defendants. Claims were held for several years by Glasgow & Western, which finally allowed assessment work to lapse. Claims were relocated by defendants who at once let leases. Suit was brought to regain title, and injunction secured to restrain defendants from working until decision was rendered.

Lyon County

RENO-YERINGTON (Yerington)—Contract work is being done on this property, under lease and bond to Mason Valley Mines Co.

MASON VALLEY MINES CO. (Thompson)—Ore receipts for March were as follows: From Mason Valley mine, 8351 tons; from Nevada-Douglas, 3554 tons; from other mines, 2278 tons; total, 14,183 tons. During same month 10 cars of matte were shipped.

SILVER HILL (Silver City)—Lessee on this property, J. Techow, is planning to erect a 50-ton mill and cyanide plant. Large tonnage of milling-grade ore has been developed. Other mines operating in district are: Midas, Oest, French, Silver Central, also McTigue mill and Woodbury & Donovan cyanide plant.

MONTANA-YERINGTON (Yerington)—Raise is being lifted from 160-ft. level to surface. When this is completed it will be used as a working shaft and sinking will be done. If development is satisfactory, work on larger scale will be done and suitable equipment installed. This property is being operated by Mason Valley Mines Co.

NEVADA-DOUGLAS (Ludwig)—Leaching tests are nearly finished and have proved that low-grade oxidized ores can be treated profitably. Experiments are being made on treatment of sulphide ores without roasting, recovery of iron as ferric oxide, and sulphur as sulphuric acid; former being valuable as a pigment and latter in treatment of oxidized ores. A new method of clarifying solutions, it is stated, has also been discovered.

Mineral County

AURORA CONSOLIDATED (Aurora)—In 6000-ft. tunnel a large additional tonnage of ore above average grade ($5) is being developed. When mill construction and tunnel work are finished, it is estimated that total expenditure will be $800,000. New mill should be ready for operation in May.

GRAHAM & DONDERO (Hawthorne)—Development work on this property in Pamlico district has been going on for past year. Incline shaft has heen sunk 150 ft. and drifts driven on vein. Good-grade gold ore assaying 8 to 20% lead and some silver has been developed. Ore is heing treated in Pamlico mill by amalgamation only at present. Concentrating tables will he installed to save lead and silver.

WAGNER AZURITE COPPER CO. (Luning)—New copper-leaching plant was placed in commission recently. Event was celebrated by banquet, this heing first copper-leaching plant in Nevada. Capacity is 200 tons and power is supplied by 100-hp. crude-oil engine. Air compressor has been installed and machine drills will be used. Some ore is being quarried on surface and large tonnage from development is on dumps ready for treatment. At upper workings, hoist has been installed at incline shaft, and development is being done on 50- and 100-ft. levels.

Nye County

MONARCH PITTSBURGH (Tonopah)—New electric hoist is being installed. When this is completed, sinking and unwatering will be resumed.

MANHATTAN-DEXTER (Manhattan)—Lease on waste dump and placer ground on Union No. 9 claim has been granted. Dumps assay $1 to $3 gold and will be treated by placer methods.

JIM BUTLER (Tonopah)—A 150-hp. Nordherg hoist will he installed at Wandering Boy shaft. New engine house and headframe will be huilt. West End company has been notified to cease all work in ground under dispute.

Washoe County

BARGO (Jumbo)—Much development is planned. Electric power is heing furnished hy Truckee River General Electric Co., and force of men has heen employed. Shaft will be deepened and new levels driven. It is reported that Pandora and Golden Gate mines in this district will also start work.

White Pine County

PIERMONT (Spring Valley, via Ely)—Good-grade ore has been opened and large tonnage of ore is ready for shipment. A mill is planned.

JENNIE A (Hamilton)—Lessees have completed erection of hunk and boarding house at mine. Shipping will commence when roads are in condition, several thousand tons of ore being blocked out.

NEVADA CONSOLIDATED (Ely)—Experiments with oil flotation on low-grade ores have heen successful, and it is reported that plant may he erected for their treatment. The question of open-pit mining of Ruth orebody is also being discussed.

LUCKY DEPOSIT (Aurum)—It is reported that this property has been purchased by American Smelting & Refining Co. Examination was made last year and money was advanced for its development. Shoct of good-grade copper ore, 30 ft. wide, has been opened. Shipments have heen made in past, and mining operations are again being carried on.

NEW JERSEY

Morris County

THOMAS IRON CO. (Wharton)—Richmond mines of company were shut down Apr. 6 for an indefinite period following strike vote taken by company's 250 employees. An announcement made by mine officials said that rather than run risk of engaging in a contest with employees it would be better to shut down mine inasmuch as laying off of 85 men on first of month, cause of the strike, resulted from depression of business. Strikers are all members of local union of Western Federation of Miners, and meeting was called by an organizer of Federation. Sentiment among men was almost unanimous for a strike. A year ago there was a long and violent strike at mines,, which was finally won by men when employers recognized their union.

NEW MEXICO

Dona Ana County

MEMPHIS MINING CO. (Oregon)—Property is under lease to Weber Bros. Copper ore has been opened in abandoned 40-ft. shaft.

TORPEDO (Oregon)—Negotiations are under way for resumption of operations. Property has been producer of high-grade copper ore.

Grant County

BURRO MOUNTAIN COPPER CO. (Tyrone)—Concrete foundation of power house near portal of 7000-ft. tunnel is nearing completion. Experimental mill exterior work is completed and plant will be in operation within a short time. Electrical equipment is arriving on property. Passenger depot has been erected by the El Paso & Southwestern R.R. and regular schedule is in effect. Grading for mill is progressing rapidly.

Taos County

GOLDEN TREASURE MINING CO. (Red River)—Incorporation papers have been filed; capitalization, $500,000. G. L. Oldham is agent.

NORTH CAROLINA

Montgomery County

MARTHA WASHINGTON GOLD MINING CO. (Candor)—A Cornish pump has arrived for this company and other machinery has been purchased with which to start exploring large tract of land, adjoining Iola and near Uwarra mines.

UWARRA MINING CO. (Candor)—A new 10x12 duplex hoist has been purchased to replace smaller one now in service and also 1000 ft. of 1-in. steel hoisting cable. A new headframe will also be constructed. In action of Uwarra Mining Co. vs. Candor Mines Co. for underground trespass, referee has made decision establishing boundary line as claimed by plaintiff. This also establishes trespass; $50,000 damages have been asked for and this question will likewise, by consent, be heard by a referee.

COGGIN MINE (Eldorado)—A shaft has been sunk to a depth of 250 ft. and development is being done on this level. Mill is treating 32 tons of ore per day. It is operated by electricity. Ore is hoisted in a self-dumping skip and is dumped into a bin. It is then broken, conveyed by an incline belt conveyor to mill where it is stamped to a fineness of 40 mesh, then is passed over and amalgamated-copper plates and from these over two concentrators. It is said that 10 more stamps will be added to mill.

Stanly County

SOUTHERN ALUMINIUM CO. (Whitney)—Work on tunnel on Montgomery side of river at the narrows, where company is constructing large power plant, is nearing completion and foundation is being laid for dam. Purpose of the tunnel is to turn course of river through mountain so that dam can be built on a dry foundation.

TEXAS

Brazoria County

FREEPORT SULPHUR CO. (Freeport)—This company on Apr. 8 made second shipment of sulphur from Bryan Heights property. It is understood that 2000 tons left Freeport on S.S. "Honduras." Cargo is consigned to Baltimore, and New York. New pumping unit is expected to be ready in July.

UTAH

Beaver County

ROB ROY (Beaver City)—Work is to be resumed in near future at this property north of Sheep Rock.

MOSCOW (Milford)—A station has been cut on 600-ft. level of shaft, which is being sunk from surface to 1000-ft. level; and sinking continued 50 ft. below that level. When 800 level is reached new shaft will be connected with older workings higher up by drifting and subsequent raising, as new workings will be considerably deeper than old. Operations then will be carried on chiefly through new shaft.

Juab County

TINTIC SHIPMENTS FOR MARCH amounted to 603 cars; those for week ended Apr. 3 to 143 cars.

CHIEF CONSOLIDATED (Eureka)—A half-mile spur is to be built connecting mine with main line of Denver & Rio Grande R.R.

EAGLE & BLUE BELL (Eureka)—Connections between shaft and winze, which followed oreshoot from 1350- down to 1550-ft. level have been completed. Ore will be hoisted through shaft, and hoisting from winze, by donkey engines done away with. Output from mine for week ended Apr. 3 was 12 cars.

Summit County

PARK CITY SHIPMENTS during March amounted to 5309 tons; those for week ended Apr. 4 to 2,451,500 pounds.

DALY-JUDGE (Park City)—Annual stockholders' meeting will be held May 19 in Jersey City. During March, 1000 ft. of development work was done, and an unusually large tonnage treated by mill. A good share of development work was in ore. Present output is coming from an extensive area, and new ground is being continually opened.

Salt Lake County

UTAH APEX (Bingham)—Dry-crushing section of mill, which has been under reconstruction by General Engineering Co., has been started, and entire mill will be put in commission early in April.

WASATCH MINES (Alta)—Three cars have been shipped by lessees from new orebody in Columbus Consolidated ground. Ore has been opened 50 ft. on strike, averaging about 4 ft. in thickness.

SALT LAKE & ALTA R.R.—Passengers are carried by this railroad between Midvale and Wasatch, according to a schedule recently adopted. There is one train going and returning daily except on Sunday.

WASHINGTON

Okanogan County

OWASCO—United Mines Co. has been incorporated at Spokane with a capital of $1,200,000, to take over and operate these claims near Oroville. Development work will be started at once.

PEACOCK (Okanogan)—Force at this mine has been increased and company contemplates purchase of two 5-ton auto trucks for hauling ore to Okanogan, from where it will be shipped to smelter. Company is also considering building a stamp mill.

CANADA

British Columbia

A RADIUM RESERVATION BILL has been passed by British Columbia legislature authorizing Lieutenant Governor in Council to place a reserve on all radium discovered within public lands in province. Measure provides for a reward of $5000 to first person discovering radium within province. Bill also provides for regulations for exploration, occupation and purchase of radium-bearing ore lands, and for retention by Crown of a 50% interest in all radium produced. Initiative has been taken by Ontario government to stimulate radium exploration in province. A bill introduced into legislature by Minister of Lands, Forests and Mines provides for a reward of $25,000 to first person who discovers radium in province in sufficient quantity for commercial extraction. This bill also authorizes government to reserve all radium in Crown lands, with right to enter upon lands, whether subsequently staked out or not, and to work any deposit of radium found thereon. It may also install necessary works and plant. This legislation further enables government to purchase private lands containing radium, or an interest in them, at prices to be approved by legislature, and to conserve and regulate sale of radium.

BRITISH COLUMBIA COPPER CO. (Princeton)—Sunrise, Tinhorn, Mabel and Milo fractional claims on Copper Mountain have been taken under bond. Company is employing 80 men and using four diamond drills.

POPLAR CREEK (Slocan)—Topsy, Nugget, Tenderfoot and several adjoining claims have been bonded to Victoria and English investors. Rich gold samples were taken from surface of Tenderfoot vein when it was discovered several years ago.

TASSO (Moresby Island)—An aërial tramway 2300 ft. in length has just been completed and 1200-ton bunkers are being built. Shipments by boat will soon be made regularly to smelter. An excellent treatment rate for ore has been secured, owing to its desirable fluxing character. Copper content is 1½ to 3%, with small amount of gold and silver.

Ontario

TOUGH-OAKES (Swastika)—New shaft on No. 3 vein is 90 ft. deep.

JUPITER (South Porcupine)—Mining operations were to be started by McKinley-Darragh, Apr. 13.

KERR LAKE (Cobalt)—Pumps have again been started unwatering lake. Work should be completed in two months.

SWASTIKA (Swastika)—The mining plant and equipment has been seized by the sheriff for debt and will be sold Apr. 18.

BURNSIDE (Kirkland Lake)—Portion of purchase price of this property remaining due was paid over by Kirkland Lake Proprietary, Ltd., on Mar. 31.

KEELEY (South Lorain)—This mine, which is now controlled by Huronian Belt Mining Co., an English concern, is being pumped out preparatory to resumption of operations.

HOMESTAKE MINES & FINANCE CO.—This company has purchased Little Pet and Fogg-Woodbridge claims in Porcupine district lying south of Dome mines, and is bringing in machinery.

HOLLINGER (Timmins)—Main vein has been cut at 550-ft. level where it shows 10 ft. of good ore. Company is installing a new power plant on Gillies Lake. One Nordberg and one Fraser & Chalmers compressor, each having a capacity of 4500 ft. free air per min., have been purchased and will be installed. This plant which has several novel features, is being installed by Canadian Mining & Finance Co. and will be used for Hollinger, Acme and Miller Middleton.

COLOMBIA

EL ENTUSIASMO GOLD MINING CO. (Fresno)—A 45-ton Bucyrus shovel has been purchased for working placer mine. Shovel is mounted ready to go into mine, but is waiting arrival of traction wheels on which it is to operate. This is first steam shovel to enter Colombia.

VENEZUELA

CIA ANONIMA MINERA "LA CUMARAGUA" (Caracas)—In March, 150 tons of ore from mines in Aroa district was shipped to New York. Company is preparing for regular production, after installation of machinery now on ground.

SOUTH AMERICAN COPPER SYNDICATE, LTD. (London)—Quebrada Ry., Land & Copper Co., Ltd., a subsidiary, has completed a smelting plant at Aroa, in State of Bolivar, 55 miles from port of Tucacas. Mines here have been operated for 30 years, ore having been shipped to England for treatment.

The Market Report

METAL MARKETS

NEW YORK—Apr. 15

The metal markets have been again rather quiet. Large sellers have held prices firmly, but there has been pressure to sell from small producers and second hands.

MONTHLY INDEX NUMBERS

Month	1912	1913	1914	Month	1912	1913	1914	Month	1912	1913	1914
Jan.....	111	126	108	May....	118	126	...	Sept.....	127	118	...
Feb.....	109	125	115	June....	117	117	...	Oct.....	133	114	...
March....	111	125	101	July.....	114	110	...	Nov.....	129	110	...
April.....	115	124	...	Aug.....	120	116	...	Dec.....	129	110	...

Average for year 1913, 118; year 1912, 119; year 1911, 112; year 1910, 115.
Numbers for each month and year calculated on approximate sales of pig iron, copper, tin, lead, zinc and aluminum.

Copper, Tin, Lead and Zinc

Copper—The absence, or apparent absence of interest in the market by consumers, together with the three-days' holiday in London and practically one day here, combined to make the market dull and without a special feature. The falling off in prices in London also affected matters here. In the beginning of the week the larger producers were inclined to hold for 14¾c. delivered, 30 days, but during the week that price was reduced by at least ⅛c. Most of the business done was taken by second hands who placed perhaps two or three million pounds at figures said to be around 14½c., delivered 30 days. The business was left almost entirely to those sellers, there being no pressure on the part of producers to get rid of copper. The price reported from Europe was at one time so low that some arbitrage business was possible at a profit. Under these circumstances the market was necessarily sluggish. A considerable part of the sales that were made were for shipment to Europe. Reports from abroad are to the effect that consumption over there continues excellent and that the heavy shipments from this side are going directly into consumers' yards, which is contrary to some of the rumors which have been current here, but which appear to have very little foundation.

Lake copper continues to be rather nominal, business in that description of metal being largely of a retail order.

The average price of electrolytic which we quote for the week was 14.275 cents.

The London market has been quiet and weakish. On Thursday, Apr. 9, standard copper spot was quoted £65 13s. 9d., and three months £65 18s. 9d. The London exchange was closed until Apr. 14, when spot declined to £64 5s., and three months to £64 11s. 3d. At the close on Wednesday the market was somewhat firmer, spot being quoted £64 15s., and three months £65 per ton.

Base price of copper sheets is now 19¾c. per lb. for hot rolled and 20¾c. for cold rolled. The usual extras are charged and higher prices for small quantities. Copper wire is 15@15½c. per lb., carload lots at mill.

Copper exports from New York for the week were 7012 long tons. Our special correspondent reports exports from Baltimore for the week at 3102 tons.

Tin—The market was interfered with by the holidays in London, where the Metal Exchange was closed from the afternoon of Thursday until Tuesday of this week. In the interim the domestic market remained on the same level as that at which the London market had closed, with, however, little business doing, all interests waiting for the opening in London. The market at the opening showed a decline of over £2, which decline made further progress today—Apr. 15. The cause for this decline is to be sought in the general pessimistic tendency prevailing in all metal markets at this time. The close is weak at £164 15s. for spot and £166 12s. 6d. for three months, and about 36¼c. for April tin here.

Lead—The lead market is quiet and somewhat easier. The A. S. & R. Co. has kept its price unchanged and has continued to take most of the business, outside producers not pressing metal for sale. We quote 3.80c. at New York, and 3.65@3.67½c., St. Louis.

Spanish lead in London is also somewhat lower, being quoted £17 17s. 6d. and English lead 2s. 6d. higher.

Spelter—There has been some pressure to sell and lower prices have been accepted. The demand is slack and the market dull. The close at St. Louis is quoted 4.95@5c.; New York, 5.10@5.15 cents.

The London market for good ordinaries is unchanged at £21 10s.; specials 2s. 6d. higher.

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

Zinc Dust Production in Upper Silesia in the year 1913 was 7190 metric tons, a decrease of 117 from the preceding year. Exports from Germany for the two months ended Feb. 28 were 783 metric tons, an increase of 148 tons over last year.

DAILY PRICES OF METALS

NEW YORK

Apr.	Sterling Exchange	Silver	Copper		Tin	Lead		Zinc	
			Lake, Cts. per lb.	Electrolytic, Cts. per lb.	Cts. per lb.	New York, Cts. per lb	St. Louis, Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.
9	4.8620	58½	*14½	14.25	37	3.80	3.65	5.15	5.00
			@14½	@14.35			@3.67½	@5.20	@5.05
			*14½	14.25			3.65	5.15	5.00
10	.....	58⅜	@14½	@14.35	37	3.80	@3.67½	@5.20	@5.05
			*14½	14.25			3.65	5.15	5.00
11	4.8585	58½	@14½	@14.35	37	3.80	@3.67½	@5.20	@5.05
			*14½	14.20			3.65	5.10	4.95
13	.....	58½	@14½	@14.30	37	3.80	@3.67½	@5.15	@5.00
			*14½	14.20			3.65	5.10	4.95
14	4.8675	58½	@14½	@14.30	36⅜	3.80	@3.67½	@5.15	@5.00
			*14½	14.20			3.65	5.10	4.95
15	4.8665	58½	@14½	@14.30	36½	3.80	@3.67½	@5.15	@5.00

*Nominal.

The quotations herein given are our appraisal of the markets for copper, lead spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.15c. apart. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. below that of electrolytic; of casting copper 0.15 to 0.25c. below. The quotations for lead represent wholesale transactions in the open market for good ordinary brands; the specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb., are: St. Louis-New York, 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,22 c.

LONDON

Apr.	Silver	Copper				Tin		Lead		Zinc	
		Spot		3 Mos.	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
		£ per Ton	Cts. per Lb.								
9	26 11/16	65 11/16	14.17	65 11/16	70½	168½	170½	18	3.91	21½	4.67
10	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	26 11/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	26 11/16	64½	13.96	64 9/16	69½	166	168	18	3.91	21½	4.67
15	26 11/16	64¾	14.06	65	69¾	164¾	166⅝	17⅞	3.88	21½	4.67

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

Other Metals

Aluminum—The market is better and more sales have been made for several weeks past. Prices are rather firmer, and the metal is quoted at 18@18½c. per lb. for No. 1 ingots, New York.

Antimony—The market has been quiet, with hardly more than a retail business doing. Prices remain about the same at 7.25@7.50c. per lb. for Cookson's; 7@7.15c. for Hallett's; 5.90@6.25c. for Chinese, Hungarian and other outside brands.

Quicksilver—Business is fair and prices are unchanged. New York quotations are $38 per flask of 75 lb. for large lots, and 54c. per lb. for jobbing orders. San Francisco, $38 for domestic orders and special terms for export. London price is £7 per flask, with £6 7s. 6d. asked by second hands.

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

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

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

Gold, Silver and Platinum

Gold—The price on the open market in London remained at the usual price, 77s. 9d. per oz. for bars. The demand for France and Russia continues, but was not sufficient to cause any premium to be paid.

Gold production in the Transvaal in March was $14,196,177. For the three months ended Mar. 31 the total was $47,935,053 in 1913, and $40,612,726 in 1914; a decrease of $7,322,327, or 15.3%, this year.

Iridium—There has been no change and the price remains as for some time past, $75@78 per oz., New York.

Platinum—The market is quiet, with little business forward, but there has been no change in prices. Dealers ask $43@44 per oz. for refined platinum, and $46@49 per oz. for nard metal. A sale of a large lot is reported at $42.85 per oz., which is below the European price.

Silver—The market continues quiet and steady with a firm undertone. No special orders are on the market at present, which are calculated to advance the price materially. From the best informed sources we learn that the immediate future of the silver situation, it is thought, will show very little fluctuation.

Shipments of silver from London to the East, Jan. 1, to Apr. 2, as reported by Messrs. Pixley & Abell:

	1913	1914	Changes
India	£2,178,000	£1,841,000	D. £337,000
China	95,000	40,000	D. 55,000
Total	£2,273,000	£1,881,000	D. £392,000

With the marketing of the Syndicate silver, the stocks of metal in London have been considerably decreased. Trade with China continues light, and, in fact, China has been a seller to India.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—Apr. 11

The base price paid this week for 60% zinc ore was $39 per ton. Lead sold at a base price of $45@48 per ton for 80% grade. Shipments this week were light, owing to low prices, bad roads and spring election.

SHIPMENTS WEEK ENDED APR. 11

	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Week	2,469,240	60,000	394,900
Year to date	41,968,240	1,305,190	13,606,630

Shipped during week to separating plants, 2,263,060 lb. zinc ore.

JOPLIN, MO.—Apr. 11

Blende sold as high as $43, the assay base ranging from $38 to $40 and the metal base from $37 to $38 per ton of 60% zinc. Calamine sold at $19@23.50 per ton of 40% zinc. The average price of all grades of zinc is $37.12 per ton. Lead sold as high as $50, on settlements for ore purchased before the decline, the base offerings of the week being $45 per ton of 80% metal content. The average of all grades is $45.80 per ton.

Two of the purchasing agencies increased their demand this week and the shipment was 300 tons larger. The drop in lead prices is felt seriously, on account of the low level of zinc prices and it may force some mines to stop operations. As an offset, however, miners out of employment are securing leases in partnership and cleaning up a quantity of ore by hand.

SHIPMENTS WEEK ENDED APR. 11

	Blende	Calamine	Lead	Value
Total this week	11,446,780	415,650	1,720,820	$259,535
Totals 15 weeks	155,292,740	9,213,440	26,760,450	$3,860,355

Blende value, the week, $215,900; 15 weeks, $3,091,830.
Calamine value, the week, $4220; 15 weeks, $104,565.
Lead value, the week, $39,415; 15 weeks, $663,960.

MONTANA ZINC ORES

The Butte & Superior Co. reports for March, 10,561 tons concentrates made having an estimated content by assay of 10,878,500 lb. zinc.

IRON TRADE REVIEW

NEW YORK—Apr. 15

Nothing new has developed in the iron and steel trades. New orders continue slow, and it is evident that buyers do not care to commit themselves largely until they are more sure of prices and sales than they are at present.

In view of the falling scale of prices there has been some talk of wage reductions. A conference of independent manufacturers was held last week, at which the wage question is said to have been considered. No action was taken.

Notwithstanding the supposed depression of trade pig-iron make continues to increase, the greater part of the gain coming from the steel-works furnaces. The crop prospects reported so far are very good, so that a revival of trade at an early date is possible.

The pig-iron market is still quiet. Little new buying is reported, and that only in small orders.

The United States Steel Corporation reports the total unfinished orders on its books on Mar. 31 at 4,663,825 tons of material. This is a decrease of 372,615 tons as compared with Feb. 28, but an increase of 40,145 tons over the Jan. 1 report.

United States Foreign Trade in Iron and Steel, two months ended Feb. 28, is valued by the Bureau of Commerce as follows:

	1913	1914	Changes
Exports	$49,230,280	$32,513,096	D. $16,717,184
Imports	5,447,668	4,510,741	D. 936,927
Excess, exports	$43,782,612	$28,002,355	D. $15,780,257

The total quantity of exports for which tonnages are given was 491,532 long tons in 1913, and 239,966 in 1914; imports, 43,861 tons in 1913, and 32,145 in 1914. Many important articles are not given by weight, but only in values.

Pig-Iron Production in March again showed an increase. The reports of the furnaces, as collected and published by the "Iron Age," show that on Apr. 1 there were 227 coke and anthracite furnaces in blast having a total daily capacity of 75,900 tons, an increase of 4500 tons over Mar. 1. Making allowance for the charcoal furnaces the total make of pig iron in the United States in March was 2,376,000 long tons; for the three months ended Mar. 31 it was 6,210,000 tons. Of this total 4,296,660 tons, or 69.2%, of the total was made by the furnaces owned or operated by the steel works.

PITTSBURGH—Apr. 14

Reports from the various branches of the finished steel trade indicate that there has been no diminution in the flow of orders in the past week or two, but since the bookings have for many weeks been at a smaller rate than the shipments it is necessary to curtail production further, and so while steel was being produced and shipped at the rate of between 70 and 75% of capacity late in February and early in March the rate has since dropped to 60% or less and a continuance of present market conditions will probably bring about a rate of not over 50% within a few weeks.

In Pittsburgh steel circles there is an increasing belief that the market will turn in the near future to the extent of buyers supplying their more pressing wants, the continued wait for lower prices having brought results. Plates and bars are now 1.15c. on desirable orders and shapes are 1.20c. on ordinary business, while sheets are 1.90c. on ordinary business and this basis is sometimes shaded.

Pig Iron—While the fairly good buying movement in pig iron some three months ago did not result in any material increase in production by merchant furnaces, the trend is now clearly toward decreased production, and within 30 days the merchant furnaces will probably be making less iron than at any time for years. One Toledo stack went out

last week and one Shenango and Fannie furnace, in the Shenango valley, have gone out this week. It is reported that two or three other stacks in the valleys will be banked or blown out shortly. There is no market activity and prices are purely nominal: Bessemer, $14; basic, $13; malleable, $13@13.25; No. 2 foundry, $13.25; forge, $12.75, at Valley furnaces, 90c. higher delivered Pittsburgh.

Ferromanganese—The market is very quiet, consumers not being interested, except as to occasional small tonnages, and prompt and contract English and German material continues quotable at $38@39, Baltimore, with $2.16 freight to Pittsburgh.

Steel—The reduced quotations named last week, $21 for billets and $22 for sheet bars, are practically nominal since the market has not been seriously tested. It is considered not improbable that on desirable business these figures could be shaded 50c. or $1 a ton. Rods are quiet at $26.

FOREIGN NOTES

Pig-Iron Production in Germany in February is reported by the German Iron & Steel Union at 1,445,511 tons, or 120,994 tons less than in January. For the two months ended Feb. 28 the total was, in metric tons:

	1913	1914	Changes
Foundry iron	582,326	533,680	D. 48,646
Forge iron	88,193	74,417	D. 13,776
Steel pig	421,850	428,014	I. 6,164
Bessemer pig	61,776	35,670	D. 26,106
Thomas (basic) pig	1,951,077	1,940,235	D. 10,842
Total	3,105,222	3,012,016	D. 93,206

The total decrease was 3%. Steel pig includes spiegeleisen, ferromanganese, ferrosilicon and all similar alloys.

IRON ORE

Imports and Exports of Iron Ore in the United States, two months ended Feb. 28, in long tons:

	1913	1914	Changes
Imports	364,197	214,378	D. 149,819
Exports	20,247	8,974	D. 11,273

Imports of manganese ore were 97,096 tons in 1913, and 39,655 in 1914; decrease, 57,441 tons.

Imports of Iron Ore in Germany, two months ended Feb. 28, were 1,953,810 metric tons; exports, 327,059; excess of imports, 1,626,751 tons. Imports of manganese ore were 107,927 tons; exports, 1233 tons.

COKE

Coke production in the Connellsville Region for the week is reported by the "Courier" at 356,320 short tons; shipments, 348,959 tons. The production in the Greensburg and Upper Connellsville districts was 45,231 tons.

Anthracite Shipments in March were 5,164,703 long tons, which is an increase of 255,415 tons over March, 1913. For the three months ended Mar. 31 the shipments were 16,919,876 tons in 1913, and 14,461,886 in 1914; a decrease of 2,457,990 tons, or 14.5%, this year.

Exports and Imports of Fuel in the United States, two months ended Feb. 28, in long tons:

	Exports		Imports	
	1913	1914	1913	1914
Anthracite	667,053	404,228	5	107
Bituminous	1,872,753	1,690,069	260,564	229,476
Coke	155,651	128,912	10,701	13,131
Bunker coal	1,176,941	1,150,561	.....	.....
Total	3,872,398	3,373,770	271,270	242,714

The bunker coal, or coal furnished to steamships in foreign trade, is practically all bituminous. The greater part of the trade, both imports and exports, is with Canada. There is a decrease of 498,628 tons, or 12.9%, in the total exports; and a decrease of 28,556 tons, or 10.5%, in the imports.

CHEMICALS

NEW YORK—April 15

The general market has been steady, but rather quiet, with a fair business in most lines.

Arsenic—Business is moderate and supplies are good. The price still seems fixed at $3 per 100 lb. for white arsenic.

Nitrate of Soda—Business has quieted down and futures are a shade off. Spot is quoted 2.25c. per lb., while 2.22½c. is asked for May, 2.20c. for June and 2.17½c. for July delivery.

Copper Sulphate—Business is fair, and prices are unchanged. The quotations are $4.80 per 100 lb. for carload lots and $5.05 per 100 lb. for smaller parcels.

PETROLEUM

Production of oil in Oklahoma in March is reported at 6,618,608 bbl.; shipments, 5,835,651 bbl.; stocks, March 31 were 52,898,843 bbl. The buying price for Oklahoma oil has been decreased 5c. per bbl., and is now 95c. per bbl. at well, the drop being reported due to overproduction.

NEW CALEDONIA

Exports from New Caledonia in January are reported by the "Bulletin du Commerce" of Noumea at 6824 metric tons chrome ore and 1108 tons of nickel ore. Exports of metals were 1098 tons nickel matte and 24 tons cobalt matte.

Exports for the year 1913 were 93,190 metric tons nickel ore carrying 6.25 to 6.30% metal, and 5893 tons matte carrying 46 to 50% nickel. This would give a total of approximately 10,933 tons of metallic nickel.

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.

	November	December	January	February	March
Alaska shipments	3,391,300	3,104,155	2,701,258	1,803,579	2,069,960
Anaconda	25,250,000	25,100,000	24,400,000	21,300,000	.....
Arizona, Ltd.	2,800,000	2,920,000	3,474,000	3,062,000	3,286,000
Copper Queen	7,115,991	9,033,459	8,796,358	6,987,366	7,637,042
Calumet & Ariz.	4,600,000	5,230,000	5,975,000	5,596,850	5,875,000
Chino	4,270,821	4,390,018	6,488,220	5,642,426	.....
Detroit	1,922,352	2,021,034	1,590,681	1,814,214	1,973,725
East Butte	1,002,190	1,324,560	1,256,000	1,193,960	1,546,180
Giroux	250,000	197,649	148,411	90,017	287,980
Mason Valley	1,174,000	1,372 000	944,000	1,254,000	.....
Mammoth	1,700,000	1,400,000	1,625,000	1,400,000	1,800,000
Nevada Con.	5,443,647	5,343,862	5,791,122	4,588,243	.....
Ohio	772,120	722,940	700,728	582,000	.....
Old Dominion	2,450,000	2,613,039	2,797,000	3,066,000	2,997,000
Ray	4,753,964	5,075,202	5,705,000	5,432,000	.....
Shannon	1,110,000	1,078,000	937,432	903.761	1,082,000
South Utah	225,072	242,362	275,569	333.874	406,381
Tennessee	1,666,753	1,700,000	1,474,890	1,232,812	.....
United Verde*	3,000,000	3,000,000	3,000,000	2,700,000	.....
Utah Copper Co.	10,787,426	10,306,646	10,329,564	.....	.....
Lake Superior*	6,600,000	5,600,000	7,400,000	8.500,000	11,000,000
Non-rep. mines*	6,000,000	6,250,000	6,200,000	5 600,000	.....
Total prod.	96,285,636	98,024,926	102,100,233	.....	.....
Imp., bars, etc.	21,796,866	23,578,938	24,504,249	19,918,448	.....
Total blister	118,082,502	121,603,864	126,604,482	.....	.....
Imp. ore & matte	8,080,186	12,205,187	10,893,969	9,713,164	.....
Total Amer.	127,062,688	133,809,053	137,498,451	.....	.....
Miami†	3,230,000	3,210.000	3,258,950	3,316,482	3,361,100
Shattuck-Arizona	995,429	1,050,781	1,276,636	1,134,480	.....
Brit. Col. Cos.:					
British Col. Cop.	655,637	795,004	607,930	.....	.....
Granby	1,944,145	1,605,382	1,793,840	1,661,212	.....
Mexican Cos.:					
Boleo†	2,315,040	2,315,040	2,369,920	1,984,080	.....
Cananea	3,800,000	3,646,000	3,460,000	2,688,000	4,260,000
Moctezuma	3,517,800	3,139,613	3,024,556	2,642,543	2,882,884
Other Foreign:					
Braden, Chile	1,592,000	2,122,000	2,430,000	2,362,000	1,810,000
Cape Cop., S. Af.	649,600	683,200	519,680	459,200	.....
Kyshtim, Russia.	1,624,000	1.742,720	1,559,040	1,534,400	.....
Spassky, Russia.	904,960	900,480	902,720	902,720	.....
Exports from					
Chile	7,616,000	10,640,000	5,488.000	6,720,000	6,944,000
Australia	11,200,000	6,720,000	,712,000	7,952,000	8,176,000
Arrivals-Europe‡	9,107,840	13,787,200	8,599,360	18,354,560	17,572,800

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

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

STATISTICS OF COPPER

	United States			Visible Stocks.		
Month	U.S.Refin'y Production	Deliveries, Domestic	Deliveries, for Export	United States	Europe	Total
Year, 1912	1,581,920,287	819,665,948	746,396,452	.....	.....	.....
IV,'13.	135,353,402	78,158,837	85,894,727	104,269,270	87,180,800	191,450,070
V.	141,319,416	81,108,321	68,285,978	75,549,108	85,948,800	161,497,908
VI.	121,860,853	68,362,571	68,067,901	67,474,225	77,235,200	144,709,425
VII.	138,074,602	58,904,192	78,480,071	52,814,606	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.	.....	.....	.....	64,609,319	46,435,200	111,044,519

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

Mining Companies—United States

Name of Company and Situation		Shares Issued	Par	Dividends Total	Latest	Amt.
Acacia, g	Colo.	1,438,989	$ 1	$ 122,004	Jan '11	$0.01
Adams, s.l.c.	Colo.	80,000	10	778,000	Dec. '09	0.04
Ahmeek, c.	Mich.	50,000	25	2,200,000	Jan. '14	2.00
Alaska Mexican, g.	Alas.	180,000	5	3,309,381	Feb. '14	0.20
Alaska Treadwell, g.	Alas.	200,000	25	13,985,000	Feb. '14	1.00
Alaska United, g.	Alas.	180,200	5	1,630,800	Feb. '14	0.30
Am. Zinc, Lead & Sm.	U. S.	165,360	25	985,820	Apr. '13	0.50
Anaconda, c.	Mont.	4,332,500	25	84,667,500	Jan. '14	0.75
Argonaut, g.	Calif.	200,000	5	1,200,000	June '10	0.05
Arizona Copper, pf.	Ariz.	1,426,120	1.20	1,890,621	Oct. '13	.....
Arizona Copper, com.	Ariz.	1,519,896	1.20	16,446,145	Feb. '14	0.30
Bagdad-Chase, g., pf.	Calif.	84,819	5	202,394	Jan. '09	0.10
Baltic, c.	Mich.	100,000	25	7,950,000	Dec. '13	2.00
Bingham N. H., c.	Utah.	228,690	5	339,957	Nov. '13	0.10
Bonanza Dev., g.	Colo.	300,000	1	1,425,000	Oct. '11	0.20
Bunker Hill Con., g.	Calif.	200,000	1	821,000	Apr. '14	0.05
Bunker Hill & Sul., l.s.	Ida.	327,000	10	15,056,000	Apr. '14	0.25
Butte-Alex Scott, c.	Mont.	74,000	10	148,000	Oct. '13	0.50
Butte & Ballaklava, c.	Mont.	250,000	10	125,000	Aug. '10	0.50
Caledonia, l.s.c.	Ida.	1,300,000	1	52,000	June '10	0.01
Calumet & Arizona, c.	Ariz.	596,353	10	19,775,546	Mar. '14	1.25
Calumet & Hecla, c.	Mich.	100,000	25	123,750,000	Mar. '14	5.00
Camp Bird, g.s.	Colo.	1,100,051	5	9,761,377	Jan. '14	0.24
Centen'l-Eur., l.s.g.c.	Utah.	100,000	5	3,900,000	Oct. '13	1.50
Center Creek, l.z.	Mo.	100,000	10	500,000	Feb. '14	0.05
Champion, c.	Mich.	100,000	25	8,500,000	Oct. '13	1.00
Chief Consolidated, s.g.l.	Utah.	876,453	1	218,138	Feb. '14	0.10
Cliff, g	Utah.	300,000	1	90,000	Jan. '13	0.10
Cliff, g	Alas.	100,000	1	210,000	Oct. '13	0.01
Colo. Gold Dredging	Colo.	100,000	10	550,000	Jan. '14	2.50
Colorado, l.s.g.	Utah.	1,000,000	0.20	2,570,000	Dec. '12	0.03
Columbus Con., g.s.	Utah.	285,540	5	226,832	Oct. '07	0.20
Commercial Gold	Ore.	1,750,000	1	43,750	Dec. '10	0.00½
Con. Mercur, g.	Utah.	1,000,000	1	3,445,313	July '13	0.03
Continental, z.l.	Mo.	22,000	25	308,000	Jan. '14	0.50
Copper Range Con., c.	Mich.	393,445	100	13,985,021	Oct. '13	0.75
Daly Judge, s.l.	Utah.	300,000	1	720,000	Jan. '14	0.15
Daly West, s.l.	Utah.	180,000	20	6,606,000	Jan. '13	0.15
Doctor Jackpot, g.	Colo.	3,000,000	0.10	45,000	Mar. '11	0.00½
Doe Run, l.	Mo.	65,782	100	3,550,969	Dec. '13	0.76
Eagle & Blue Bell, g.s.l.	Utah.	893,146	1	178,629	Nov. '13	0.05
Elkton Con., g.	Colo.	2,500,000	1	3,329,460	Feb. '14	0.02
El Paso, g.	Colo.	490,000	5	1,707,545	Feb. '14	0.10
Ernestine, g.s.	N.M.	300,000	5	165,000	Mar. '13	0.05
Fed. M. & S., com.	Idaho.	60,000	100	2,708,750	Jan. '09	1.50
Fed. M. & S., pf.	Idaho.	120,000	100	8,567,434	Mar. '14	1.50
Florence, g.	Nev.	1,050,000	1	840,000	Apr. '11	0.10
Frances-Mohawk, g.	Nev.	912,000	1	546,000	Jan. '08	0.05
Free Coinage, g.	Colo.	10,000	100	180,000	Dec. '09	1.00
Fremont Con., g.	Calif.	200,000	2.50	228,000	Apr. '14	0.02
Frontier, z.	Wis.	1,250	100	146,202	Nov. '13	2.00
Gemini-Key'ne, l.g.s.	Utah.	5,000	100	2,230,000	Dec. '13	10.00
Gold Chain, g.	Utah.	1,000,000	1	130,000	May '13	0.03
Gold Coin of Victor.	Colo.	1,000,000	1	1,350,000	Feb. '09	0.02
Gold Dollar Con.	Colo.	2,500,000	0.10	100,000	Dec. '12	0.00½
Gold King Con., g.	Colo.	5,750,370	1	1,407,319	Dec. '11	0.03
Golden Cycle, g.	Colo.	1,500,000	5	2,775,000	Apr. '14	0.03
Golden Star, g.	Ariz.	400,000	5	140,000	Mar. '10	0.05
Goldfield Con., g.	Nev.	3,558,367	10	26,330,470	Oct. '13	0.40
Grand Central, g.	Utah.	500,000	1	1,570,750	Jan. '14	0.05
Granite, g.	Colo.	1,650,000	1	269,500	Nov. '12	0.01
Hazel, g.	Cal.	900,000	1	971,000	Dec. '13	0.01
Hecla, l.s.	Idaho.	1,000,000	0.25	3,010,000	Mar. '14	0.02
Hercules, l.s.	Idaho.	1,000,000	1	3,650,000	July '11	0.06
Homestake, g	S. D.	218,400	100	34,924,978	Apr. '14	0.65
Horn Silver, l.s.z.	Utah.	400,000	25	5,662,000	Sept. '07	0.05
Iowa, g.s.l.	Colo.	1,666,667	1	216,832	July '13	0.00½
Iowa-Tiger Leasing g.s.	Colo.	12,655	1	13,921	Jan. '12	0.10
Iron Blossom, s.l.g.	Utah.	1,000,000	0.10	1,870,000	Jan. '14	0.10
Iron Silver, s.l.g.	Colo.	500,000	20	4,850,000	Oct. '13	0.10
Jamison, g.	Cal.	390,000	10	378,300	Jan. '11	0.02
Jerry Johnson, g.	Colo.	2,500,000	0.10	175,000	Aug. '12	0.01
Kendall, g.	Mont.	500,000	5	1,475,000	Nov. '12	0.02
Kennedy, g.	Cal.	100,000	100	1,831,001	Apr. '10	0.03
King of Arizona, g.	Ariz.	200,000	1	396,000	Aug. '09	0.12
Klar Piquette, z.l.	Wis.	20,000	1	187,500	Apr. '13	0.50
Knob Hill, g.	Wash.	1,000,000	1	45,000	May '12	0.00½
Liberty Bell, g.	Colo.	130,551	5	1,452,338	Sept. '12	....
Little Bell, l.s.	Utah.	300,000	1	75,000	Mar. '11	0.05
Little Florence, g.	Nev.	1,000,000	1	430,000	Jan. '08	0.03
Mammoth, g.s.c.	Utah.	400,000	25	2,300,000	July '13	0.05
Mary McKinney, g.	Colo.	1,309,252	1	1,116,938	Jan. '14	0.02
May Day, g.s.l.	Utah.	800,000	0.25	132,000	Feb. '13	0.03
Mexican, g.s.	Nev.	201,600	2.50	20,160	Aug. '11	0.10
Miami, c.	Ariz.	664,993	5	2,961,102	Feb. '14	0.50
Modoc, g.s.	Colo.	500,000	1	275,000	Dec. '11	0.01
Mohawk, c.	Mich.	100,000	25	3,175,000	Aug. '13	2.00
Monarch-Mad'a, g.s.l.	Colo.	1,000,000	1	40,000	May '11	0.01
Montana-Tonop., s.g.	Nev.	921,865	1	530,000	Dec. '12	0.10
Mountain, c.	Cal.	250,000	25	4,216,250	May '08	0.44
National, g.	Nev.	750,000	1	570,000	May '11	0.10
Nevada Con., c.	Nev.	1,999,524	5	15,477,067	Mar. '14	0.37½
New Century, z.l.	Mo.	330,000	1	237,600	Oct. '09	0.01
New Idria, q.	Cal.	100,000	5	1,730,000	Dec. '13	0.10
North Butte, c.	Mont.	410,000	15	11,480,000	Jan. '14	0.50
North Star, g.	Cal.	250,000	10	4,161,986	Mar. '14	0.20
Old Domin'n, M. & Sm.	Ariz.	162,000	25	3,563,000	Jan. '14	1.25
Ophir, s.g.	Nev.	201,600	3	2,068,360	Jan. '12	0.10
Opohongo, g.s.l.	Utah.	898,978	0.25	80,907	Jan. '13	0.02
Oroville Dredging	Cal.	700,000	5	1,468,086	Mar. '14	0.12
Osceola, c.	Mich.	96,150	25	11,987,375	Jan. '14	2.00
Parrot, c.	Mont.	229,850	10	7,324,608	Feb. '14	0.15
Pearl Con., g.	Wash.	1,909,711	0.05	181,422	Dec. '10	0.02
Pharmacist, g.	Colo.	1,500,000	1	87,500	Feb. '10	0.00½
Pioneer, g.	Alas.	5,000,000	1	2,041,526	Oct. '11	0.03
Pittsburgh-Idaho, l.	Iad.	803,000	1	216,810	Oct. '12	0.04
Pittsburgh Silver Peak, g	Nev.	2,790,000	1	715,400	Mar. '14	0.02
Portland, g.	Colo.	3,000,000	1	9,517,080	Jan. '14	0.02
Quilp	Wash.	1,500,000	1	67,500	Feb. '13	0.01
Quincy, c.	Mich.	110,000	25	20,952,500	Dec. '13	1.25
Republic, g.	Wash.	1,000,000	1	85,000	Dec. '10	0.01½
Rochester, l.z.	Mo.	4,900	100	188,396	Dec. '10	0.50

Mining Companies—United States—(*Continued*)

Name of Company and Situation		Shares Issued	Par	Dividends Total	Latest	Amt
Round Mountain, g.	Nev.	866,426	$ 1	$ 363,365	Aug. '13	$0.04
Seven Troughs Coal., g.	Nev.	1,500,000	1	37,500	July '12	0.02½
St. Joseph, l.	Mo.	1,000,000	10	9,205,548	Mar. '14	0.10
Shannon, c.	Ariz.	300,000	10	750,000	Jan. '13	0.50
Shattuck-Arizona, c.	Ariz.	350,000	10	1,750,000	Jan. '14	0.50
Silver King Coal., l.s.	Utah.	1,250,000	5	2,346,585	Dec. '13	0.15
Sioux Con., s.l.g.	Utah.	745,389	1	872,097	July '11	0.04
Skidoo, g.	Cal.	1,000,000	5	275,000	May '12	0.02½
Snowstorm, c.g.	Ida.	1,500,000	1	1,192,103	Oct. '13	0.02
South Eureka, g.	Calif.	299,981	1	366,881	Apr. '12	0.07
Standard Con., g.s.	Cal.	178,394	10	5,274,407	Nov. '13	0.25
Stratton's Ind., g.	Colo.	1,000,000	0.60	425,250	May '13	0.06
Success, z.	Ida.	1,500,000	1	925,000	May '13	0.02
Superior & Pitts., c.	Ariz.	1,499,793	10	6,509,106	Mar. '14	0.38
Tamarack, c.	Mich.	60,000	25	9,420,000	July '07	4.00
Tennessee, c.	Tenn.	200,000	25	4,006,250	Mar. '14	0.75
Tomboy, g.s.	Colo.	300,000	4.85	3,332,245	Dec. '13	0.48
Tom Reed, g.	Ariz.	909,555	1	1,828,300	Apr. '14	0.06
Tonopah Belm't, s.g.	Nev.	1,500,000	1	5,618,000	Feb. '14	0.25
Tonopah Ext., g.s.	Nev.	943,433	1	473,709	Jan. '14	0.05
Tonopah of Nev., s.g.	Nev.	1,000,000	1	11,350,000	Jan. '14	0.25
Tri-Mountain, c.	Mich.	100,000	25	1,450,000	Dec. '13	2.00
Tuolumne, c.	Mont.	800,000	1	520,000	May '13	0.10
Uncle Sam, g.s.l.	Utah.	500,000	1	495,000	Sept. '11	0.05
United Cop. Min., c.	Wash.	1,000,000	1	40,000	Nov. '12	0.01
United (Crip. Ck.) g.	Colo.	4,000,100	1	440,435	Jan. '10	0.04
United Globe, c.	Ariz.	23,000	10	1,703,000	Jan. '14	7.50
United Verde, c.	Ariz.	300,000	10	33,922,000	Apr. '14	0.75
Utah, s.l.	Utah.	100,000	10	281,860	Dec. '10	0.02
Utah, c.	Utah.	2,797,182	10	20,978,865	Sept. '13	0.75
Utah Con., c.	Utah.	300,000	5	8,250,000	Mar. '14	1.00
Valley View, g.	Colo.	1,000,000	1	240,000	Dec. '10	0.04
Victoria, g.s.l.	Utah.	250,000	1	207,500	Mar. '10	0.04
Vindicator Con., g.	Colo.	1,500,000	1	2,767,000	Oct. '13	0.03
Wasp No. 2, g.	S. D.	500,000	1	436,965	Oct. '13	0.01
Wellington Mines, g.	Colo.	10,000,000	1	300,000	July '13	0.00½
Wolverine, c.	Mich.	60,000	25	7,740,000	Apr. '13	5.00
Work, g.	Colo.	1,500,000	1	172,500	July '08	0.00½
Yak, s.l.	Colo.	1,000,000	1	1,927,655	July '13	0.02
Yankee Con., g.s.	Utah.	1,000,000	1	143,500	Jan. '13	0.01
Yellow Aster, g.	Cal.	100,000	10	1,201,789	Mar. '14	0.05
Yellow Pine, l.z.s.	Nev.	1,000,000	1	393,008	Mar. '14	0.02
Yukon Gold, g.	Alas.	3,500,000	5	2,735,500	Mar. '14	0.07½

Iron, Industrial and Holding Companies

Amalgamated, c.	Mont.	1,538,879	$100	$83,584,748	Feb. '14	$1.50
Am. Sm. & Ref., com.	U. S.	500,000	100	25,833,333	Mar. '14	1.00
Am. Sm. & Ref., pf.	U. S.	500,000	100	47,333,333	Mar. '14	1.75
Am. Smelters, pf. A.	U. S.	170,000	100	8,385,000	Jan. '14	1.50
Am. Smelters, pf. B.	U. S.	300,000	100	12,732,000	Jan. '14	1.25
Cambria Steel	Penn.	900,000	50	19,472,500	Feb. '14	0.62½
Greene Cananea	U. S.	486,302	100	3,877,437	Mar. '14	0.50
Guggenheim Expl.	U. S.	831,732	25	18,937,165	Jan. '14	1.25
Inter'l Nickel, com.	U. S.	115,826	100	11,037,449	Dec. '13	3.00
Inter'l Nickel, pfd.	U. S.	89,126	100	7,823,735	Feb. '14	1.50
Inter'l Sm. & Ref.	U. S.	100,000	100	3,700,000	Mar. '14	2.00
National Lead, com.	N. Y.	206,554	100	7,951,139	Mar. '14	0.75
National Lead, pf.	N. Y.	243,676	100	28,517,373	Mar. '14	1.75
Old Dominion, c.	Ariz.	293,245	25	5,046,991	Jan. '14	1.25
Phelps, Dodge & Co.	U. S.	450,000	100	32,171,527	Mar. '14	4.00
U. S. Steel Corp., com.	U. S.	5,083,025	100	206,915,963	Mar. '14	1.25
U. S. Steel Corp., pf.	U. S.	3,602,811	100	370,574,026	Feb. '14	1.75
U. S. S., R. & M., com.	U.S.-Mex.	486,320	50	5,835,512	Jan. '14	0.75
U. S. S., R. & M., pf.	U.S.-Mex.	351,105	50	13,390,755	Jan. '14	0.87½

Canadian, Mexican and Central American Companies

Ajuchitlan, g.s.	Mex.	50,000	$ 5	$ 212,500	Oct. '12	$0.25
Amparo, g.s.	Mex.	2,000,000	1	1,340,884	Feb. '14	0.05
B. C. Copper	B. C.	591,709	5	615,198	Jan. '13	0.15
Beaver Con., s.	Ont.	1,996,490	1	409,879	Dec. '13	0.03
Buffalo, s.	Ont.	1,000,000	1	2,657,000	Feb. '14	0.03
Canadian Goldfields, g.	B. C.	600,000	0.10	187,099	Jan. '14	0.001½
Chontalpan, g.s.l.z.	Mex.	7,000	25	52,500	Mar. '14	0.75
Cobalt Townsite, s.	Ont.	1,000,000	1	940,000	Feb. '14	0.48
Coniagas, s.	Ont.	800,000	5	6,040,000	Nov. '13	0.70
Con. M. & S. Co. of Can	B. C.	58,052	100	1,364,325	Feb. '14	2.00
Crown Reserve, s.	Ont.	1,768,814	1	5,554,076	Apr. '14	0.02
Crow's Nest Pass C. Co.	B. C.	248,506	25	2,182,864	Mar. '11	0.25
Dos Estrellas, g.s.	Mex.	300,000	0.50	9,885,000	Sept. '13	1.25
El Oro, g.s.	Mex.	1,147,500	4.85	8,947,261	July '13	0.24
Esperanza, s.g.	Mex.	455,000	4.85	11,996,303	Jan. '14	0.24
Granby, s.l.c.	B.C.	148,496	100	5,310,636	Mar. '14	1.50
Greene Con., c.	Mex.	1,000,000	10	8,544,400	Nov. '13	0.50
Guanajuato D., pf., s.	Mex.	10,000	1000	274,356	Jan. '11	3.00
Hedley Gold	B. C.	120,000	10	1,293,520	Mar. '14	1.50
Hollinger, g.	Ont.	600,000	5	1,800,000	Apr. '14	0.15
Kerr Lake s.	Ont.	600,000	5	5,070,000	Mar. '14	0.25
La Rose Con., s.	Ont.	1,498,407	5	5,312,185	Jan. '14	0.45
Le Roi No. 2, g.	B. C.	120,000	24.30	1,472,580	Jan. '13	0.36
Lucky Tiger Com., g.	Mex.	715,337	10	2,240,460	Apr. '14	0.07
McK.-Dar. Sav. s.	Ont.	2,247,692	1	3,990,887	Jan. '14	0.06
Mines Co. of Am. (new)	Mex.	1,700,000	10	*1,215,000	July '13	0.12½
N. Y. & Hond. Ros., g.	C. A.	150,000	10	3,290,000	Jan. '14	0.20
Nipissing, s.	Ont.	1,200,000	5	11,340,000	Jan. '14	0.37½
Peñoles, s.l.g.	Mex.	80,000	25	6,361,688	June '13	1.25
Peregrina M. & M., pf.	Mex.	10,000	100	328,656	Sept. '10	3.50
Pinguico, pf., s.	Mex.	20,000	100	660,000	Apr. '12	3.00
Right of Way Mns†s.	Ont.	1,685,500	1	202,260	Dec. '11	0.02
Rio Plata, s.	Mex.	373,437	5	345,714	Feb. '13	0.05
San Rafael, g.s.	Mex.	2,400	25	1,441,180	Oct. '13	0.50
San Toy, g.s.	Mex.	5,750,000	1	530,000	July '13	0.01
Sorpresa, g.s.	Mex.	19,200	20	3,979,240	Jan. '11	34.00
Stand'd Silver-Lead.	B. C.	2,000,000	1	1,275,000	Apr. '14	0.05
Timiskaming, s.	Ont.	2,500,000	1	1,534,155	Apr. '13	0.06
Tem. & Hud. Bay, s.	Ont.	7,761	1	1,893,684	Mar. '14	3.00
Trethewey, s.	Ont.	1,000,000	1	1,001,998	Dec. '13	0.10
Wettlaufer-Lorrain, s.	Ont.	1,416,590	1	637,465	Oct. '13	0.05

*Previous to reorganization, $5,258,881.
†Previous to January, 1910, $324,644.

Assessments

Company	Delinq.	Sale	Amt.
Advance, Ida.	Apr. 15	May 15	$0.003
Bullion, Ida.	Apr. 11	May 11	0.005
Caledonia, Nev.	Apr. 7	Apr. 29	0.10
C & R., Ida., post'd	.....	Apr. 24	0.005
Confidence, Nev.	Apr. 21	May 1	0.10
Consolidated Virginia, Nev.	Apr. 10	May 1	0.10
Demijohn	Apr. 1	Apr. 20	0.0025
Diamond Black Butte, Mont.	Apr. 10	May 14	0.005
Eagles Nest, Nev.	Mar. 20	Apr. 23	0.005
Emerald Tintic, Utah	Apr. 15	May 9	0.0033
Empire, Ida., postponed	.....	May 1	0.005
Florence, Ida.	Apr. 19	May 11	0.001
Great Western, Nev.	Apr. 6	Apr. 28	0.01
Hypotheek, Ida.	Apr. 9	May 11	0.01
Mass Cons., Mich.	Apr. 7	.....	1.00
Nevada Silver Reed, Utah	Apr. 6	Apr. 27	0.001
New York, Nev.	Apr. 6	Apr. 27	0.05
Ophir, Nev.	Apr. 7	Apr. 29	0.10
Samson, Ida.	Mar. 28	Apr. 28	0.002
Savage, Nev.	Apr. 16	May 7	0.10
Southern Swansea, Utah	Apr. 18	May 6	0.0003
Tintic-Central, Utah	Apr. 11	Apr. 29	0.005
Tonopah-Gypsy Queen, Nev.	Mar. 25	Apr. 29	0.01
Utah-Arizona, Utah	Apr. 4	Apr. 22	0.0025
Verda, Utah	Apr. 15	May 5	0.001
Victoria, Mich.	Apr. 15	May 24	1.00
Wasatch-Utah, Utah	Apr. 6	May 11	0.01
Western Union, Utah	Mar. 31	Apr. 20	0.0025
Wisconsin, Utah	Apr. 3	May 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	.....	28.284	27.416	.....
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

Month	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	14.946	65.519	65.259
March	14.713	14.131	14.930	14.625	65.329	64.276
April	15.291	.....	15.565	.....	68.111	.....
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	.....	224.159	.....
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	.....	4.242	.....	17.597	.....
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
January	6.931	5.262	6.854	5.112	26.114	21.583
February	6.239	5.377	6.089	5.227	25.338	21.413
March	6.078	5.250	5.926	5 100	24.605	21.460
April	5.641	.....	5.491	.....	25.313	.....
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	.....	16.71	.....	16.40	.....
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 Apr. 14		SALT LAKE Apr. 14	
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.02¾	Beck Tunnel	.04
Cripple Cr'k Con.	.007½	Black Jack	.07
C. K. & N.	.07¼	Cedar Talisman	.01
Doctor Jack Pot.	.05½	Colorado Mining	.10
Elkton Con.	.45¾	Crown Point	.02¼
El Paso	2.09	Daly-Judge	5.20
Findlay	.01½	Gold Chain	.12
Gold Dollar	.04	Grand Central	.58
Gold Sovereign	.02¼	Iron Blossom	1.27½
Golden Cycle	‡1.50	Little Bell	.15
Isabella	.11¾	Lower Mammoth	.01¾
Jack Pot	.05¾	Mason Valley	2.00
Jennie Sample	.05	May Day	.06½
Jerry Johnson	.03½	Nevada Hills	.28
Lexington	.003	Prince Con.	.21
Old Gold	.01	Silver King Coal'n.	3.05
Mary McKinney	.55¾	Silver King Cons.	2.17½
Pharmacist	.01	Sioux Con.	.03
Portland	1.07	Uncle Sam	.03½
Vindicator	.91	Yankee	.04½

TORONTO Apr. 14			
Name of Comp.	Bid.	Name of Comp.	Bid.
Bailey	.03	Foley O'Brien	.23
Conlagas	7.85	Hollinger	16.00
Peterson Lake	.38¾	Imperial	.01½
Right of Way	.04¾	Jupiter	.12½
T. & Hudson Bay	73.00	Pearl Lake	.07
Timiskaming	.15	Porcu. Gold	.11
Wettlaufer-Lor.	.04¾	Preston E. D.	.02¼
Big Dome	8.75	Rea	.20
Crown Chartered	.00¾	Swastika	.01¾
Dome Exten.	.06½	West Dome	.11½

SAN FRANCISCO Apr. 14			
Name of Comp.	Bid.	Name of Comp.	Bid.
Comstock Stocks		Misc. Nev. & Cal.	
Alta	.00½	Belmont	7.75
Belcher	.32	Jim Butler	.94
Best & Belcher	.04	MacNamara	.06
Caledonia	.79	Midway	.32
Challenge Con.	.05	Mont.-Tonopah	.91
Chollar	‡.01	North Star	.32
Confidence	.22	West End Con.	.84
Con. Virginia	.22	Atlanta	.28
Crown Point	.27	Booth	.04
Gould & Curry	.03	C.O.D. Con.	.05
Hale & Norcross	.04	Comb. Frac.	.07
Mexican	1.10	Jumbo Extension	.27
Occidental	.70	Pitts.-Silver Peak	.34
Ophir	.39	Round Mountain	.29
Overman	.13	Sandstorm Kendall	.11
Potosi	.01	Silver Pick	.07
Savage	.12	Argonaut	2.50
Sierra Nevada	.14	Bunker Hill	‡1.90
Union Con.	.11	Central Eureka	.60
Yellow Jacket	.30	So. Eureka	‡1.50

N. Y. EXCH. Apr. 14		BOSTON EXCH Apr. 14	
Name of Comp.	Clg.	Name of Comp.	Clg.
Amalgamated	73¾	Adventure	1
Am.Sm.&Ref.,com	67¼	Alumeek	290
Am. Sm. & Ref., pf.	101¼	Alaska Gold M.	24½
Am. Sm. Sec., pf. B.	83½	Algomah	1¼
Anaconda	33¾	Allouez	41
Batopilas Min.	¼	Am. Zinc	16¼
Bethlehem Steel, pf.	82½	Ariz. Com., ctfs.	4¼
Chino	40¼	Bonanza	.51
Colo. Fuel & Iron	29	Butte & Balak	2¼
Federal M. & S., pf.	33	Calumet & Ariz.	66½
Great Nor., ore., ctf	30¾	Calumet & Hecla	416
Guggen. Exp.	52¾	Centennial	16
Homestake	114½	Cliff	1
Inspiration Con.	17¼	Copper Range	37½
Miami Copper	25½	Daly West	2
Nat'l Lead, com.	46¼	East Butte	10¾
National Lead, pf.	107	Franklin	5½
Nev. Consol.	14¼	Granby	84
Phelps Dodge	179	Hancock	16½
Pittsburg Coal, pf.	90	Hedley Gold	30
Quicksilver, pf.	2	Helvetia	.35
Ray Con.	20½	Indiana	3¾
Republic I&S, com.	22½	Island Cr'k, com.	47½
Republic I&S, pf.	83¼	Island Cr'k, pfd.	85¾
SlossSheffi'd, com.	26¼	Isle Royale	18½
Sloss Sheffield, pf.	86	Keweenaw	3¾
Tennessee Copper	33½	Lake	7½
Utah Copper	54¼	La Salle	4¾
U. S. Steel, con.	57¼	Mass	3¾
U. S. Steel, pf.	109¼	Michigan	.75
		Mohawk	43¾

N. Y. CURB Apr. 14			
Name of Comp.	Clg.	New Arcadian	4
		New Idria Quick	3½
Ariz. Belmont	‡.03½	North Butte	26½
Barnes King	‡1¾	North Lake	1¾
Beaver Con.	.30	Ojibway	1
Big Four	.08	Old Dominion	50
Boston Montana	8¼	Osceola	77
Braden Copper	8¼	Quincy	60
B. C. Copper	1¾	Shannon	5¼
Buffalo Mines	1¼	Shattuck-Ariz.	24½
Can. Cop. Corpn.	2¼	Superior	29
Can. G. & S.	.07	Superior & Bost.	1 1/16
Caribou	.68	Tamarack	34
Con. Ariz. Sm.	1/16	Trinity	3½
Coppermines Cons.	2¼	Tuolumne	.55
Davis-Daly	1/16	U. S. Smelting	37½
Diam'field-Daisy.	.05½	U. S. Smelt'g, pf.	47½
Ely Con.	.04	Utah Apex	1½
Florence	.56	Utah Con	10½
Gold Hill Con.	¾	Victoria	1¼
Goldfield Con.	1½	Winona	3¾
Greene Cananea	37	Wolverine	43
Greenwater	.06¾	Wyandot	.60
Internat. S. & R.	‡106		
Kerr Lake	4 7/16		
La Rose	1 5/16		
McKinley-Dar-Sa.	.76		
Mines of Am.	2¼		
New Utah Bingham	.69		
Nipissing Mines	6½		
Ohio Copper	¾		
Oro	.12		
Puebla S. & R.	2¾		
South Utah M&S.	‡.25		
Stand'd Oil of N.J.	405		
Stand'd Silver Lead	1 1/16		
Stewart	1¾		
Tonopah	6½		
Tonopah Ex.	2		
Tonopah Merger	.59		
Tri-Buillion	¾		
Tularosa	1/16		
Yukon Gold	2¾		

LONDON Apr. 4	
Name of Comp.	Clg.
Camp Bird	£0 13s 0d
El Oro	0 14 3
Esperanza	0 17 10½
Mexico Mines	5 2 6
Oroville	0 12 9
Santa Gert'dis.	0 15 0
Stratton's	0 0 6
Tomboy	1 2 6

BOSTON CURB Apr. 14	
Name of Comp.	Bid.
Bingham Mines	.05
Boston & Corbin	.28
Boston Ely	.35
Butte & Lon'n Dev.	.44
Cactus	.01
Calaveras	1¼
Chief Cons.	.80
Contact Copper	.07
Corbin	.75
Cortez	.25
Crown Reserve	1 1/16
Eagle & Blue Bell	1
First Nat. Cop.	2
Houghton Copper	2½
Majestic	.22
Mexican Metals	.10
Moneta Pore	‡.02
Nevada-Douglas	.86
New Baltic	1 7/16
Oneco	1¼
Raven Copper	.16
Smokey Dev.	‡.25
So. Lake	4
S. W. Miami	1¼
Tonopah Victor	.34
Trethewey	.23
United Verde Ext.	.78

‡Last Quotation.