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Zinc and Lead Smelting in Silesia

Notes on Zinc and Lead Smelting; Recovery of Cadmium; Manufacture of Sulphuric Acid. A Remarkably Large Lead Blast-furnace

BY J. S. G. PRIMROSE*

Even the most casual visitor to the remote eastern corner of Silesia would be struck by the enormous industrial activity evinced on all sides. Every few miles there lie groups of smoke-vomiting stacks, indicating a large smeltery, and

new modifications to very old methods makes the varying practice at different works as instructive as interesting.

ORE ROASTING.

Since quite one-half of the ores

the Walter Croneckhütte, near Rosdzin, they have 20 blocks of modern Hasenclever furnaces, with four furnaces in each massive, fired from the ends. These are all three-hearths high, and three men per eight-hour shift can work off about four

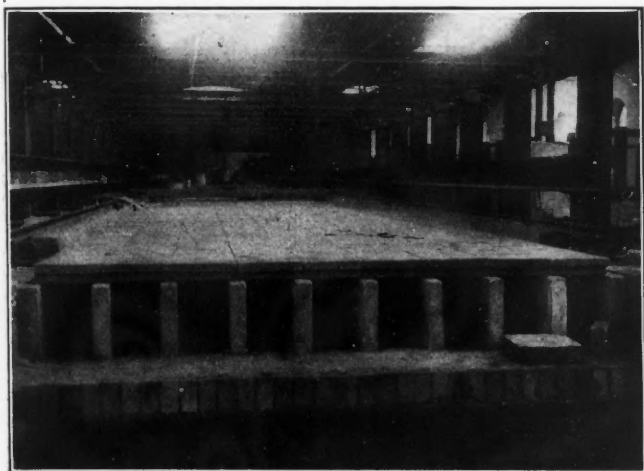


FIG. 1. "BROWN" STRAIGHT FURNACE AT BERNHARDIHUTTE; 250 FT. LONG



FIG. 2. DIRECT-FIRED FURNACE AT WALTER CRONECKHUTTE, SHOWING DAGNER CONDENSERS

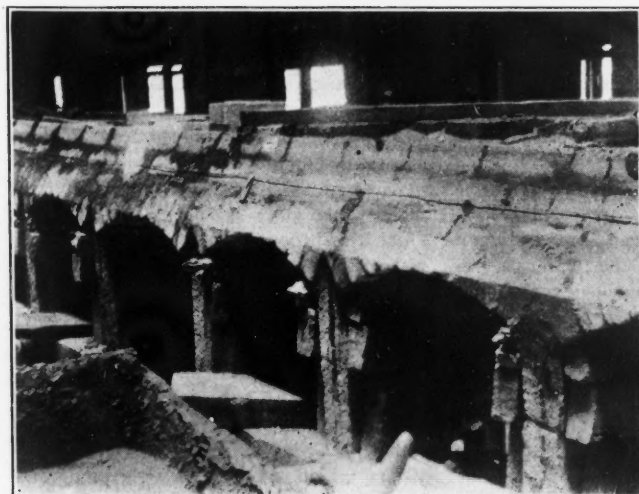


FIG. 3. INTERIOR VIEW OF NEW FURNACES AT BERNHARDIHUTTE (IN COURSE OF ERECTION SHOWING ONLY ROW OF TOP NOTCHES)

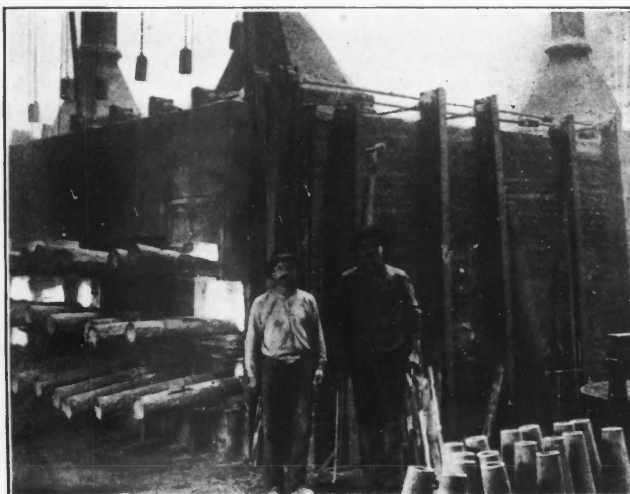


FIG. 4. GAS-FIRED FURNACE OF THE THREE-HIGH, SIEMENS-BELGIAN REVERSING TYPE; HUGO-HUTTE, NEAR ANTONIANHUTTE

each is working at full pressure. To the metallurgist there is here material for many lessons, and the adaptation of

smelted in Upper Silesia is burnt blende, large provision has to be made for roasting furnaces. These are almost always of the multiple-hearth, muffle type where manual labor is used. For example, at

tons of blende to close on 1 per cent. of sulphur, using one-quarter of that weight of the lean brown coal obtainable locally. After drying on top of the furnace the ore is raked down counter to the di-

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rection of the fire gases in the flues. Thick walls and small, tight doors keep down the heat radiation, and regulate the inlet of excess air to the requisite quantity. The greatest care is of course necessary in the top and middle hearths to keep the ore from fritting while the main portion of the sulphur burns out, thus maintaining a roasting temperature with very little extraneous heating. Mechanical furnaces similar to the Brown straight muffle are being largely installed at all the big smelteries, as, for example, at the Bernhardt and Hugo, where several roast houses, each with three 75m. (250 ft.) furnace, are on constant work. Fig. 1 shows a view from the discharge end of one in course of erection, illustrating the steel buckstays, rail for running rabbles, and channel bar for the skewback of the arch. The floor width is 3m. and in the length are four equal-spaced gas ports on each side for firing. Double end flap doors for the entry and exit of the rabbles prevent any

bers filled with brushwood; or sometimes less efficiently by passing the gases over moist slaked lime. The calcium sulphate thus obtained is somewhat of a drug on the market, and is not nearly so paying a by-product as sulphuric acid. The latter is most extensively made in Upper Silesia by the lead-chamber process, but the plant for that, with the necessary concentrators, Glover towers, etc., occupies a very large ground area.

Recently, several of the more up-to-date works, as, for example, the Silesia and Lazy works, have been employing the Winkler contact, or catalytic process, which gives acid of excellent purity and 50 deg. B. without much attention. At first, trouble arose through clogging of the platinum sponge, but the modern mechanical modification obviates this quite successfully. There is also in operation at the Silesiahütte a plant erected nearly 20 years ago, for the Schroeder process for recovery of sulphur-dioxide gas in liquid form, but even the thousand tons

seen from Fig. 2, the old-style knee-condenser has been replaced by sets of Dagner condensers for single-row muffle furnaces, as in this way much better condensation is secured. By simply swinging round the swivel mold into position and gradually knocking in portions of the lower condenser luting, the spelter flows out at each 12-hour tapping, and is thereafter ladled into shallow spelter ingots. Maintaining a good fire and removing the ashes in the narrow space available is rather troublesome. In charging, too, it is difficult, with the constant rubbing of the narrow scoop, to avoid wear on the condenser sole; hence some of the chargers use an iron guide strip.

By far the most prevalent practice now in Upper Silesia is the use of gas-fired furnaces of the three-high, Siemens-Belgian reversing type, as, for example, at Hugohütte. In this case there are checker-works for both air and gas, the currents being alternately deflected by the water-seat valve shown at the side

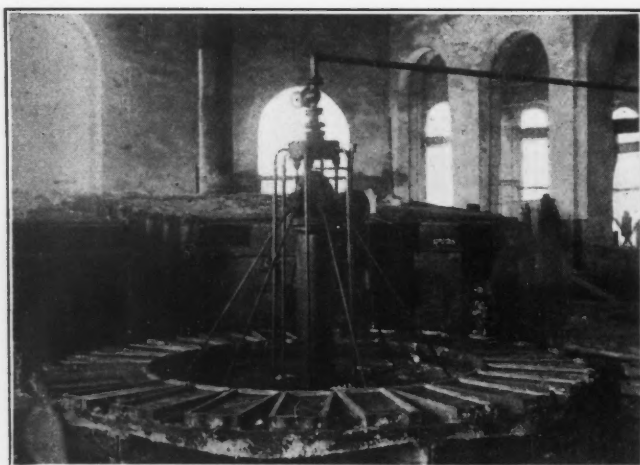


FIG. 5. SPELTER REFINING REVERBERATORIES AND CASTING TABLES

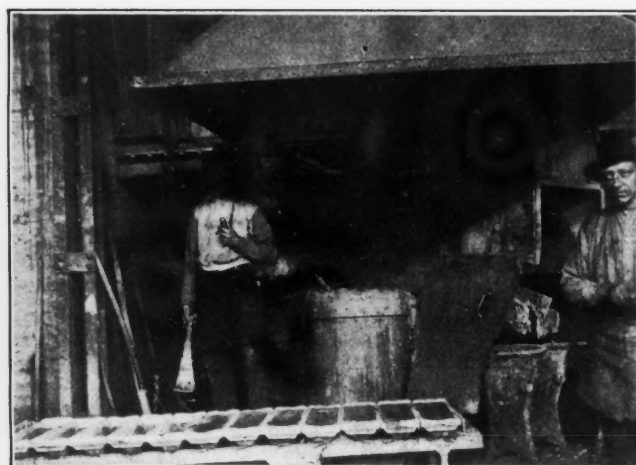


FIG. 6. SIPHON TAP LEAD BLAST-FURNACE AT SILESIAHUTTE

gas escape, and the two-minute return over the furnace affords ample time for the rabbles to cool down. The roasted ore falls into a tube subway, whence a screw conveyer removes it to an automatic elevator outside the house.

The calcination of calamine to drive off its water and carbon dioxide is a comparatively simple affair, usually conducted in hand-rabbled reverberatory furnaces, which seem to be preferable to the old-fashioned shaft calciners.

ACID RECOVERY.

As government regulations prohibit manufactories from passing waste gases into the atmosphere with more than 1 or 2 per cent. of sulphur dioxide, those small works which have not space whereon, or capital wherewith, to erect plant for the chamber process of recovering the sulphur as sulphuric acid, must neutralize their acid fumes. This, as at the Liebehoffnungshütte and elsewhere, is effected by drenching the roasted gases with milk of lime as they ascend scrub-

it makes annually is in excess of the demand. After utilizing some of the heat of the roast gas, the latter is passed up a 100-ft. absorption tower, yielding a 1-per cent. aqueous solution, which on boiling gives up the sulphur dioxide. By cooling the distillate and then compressing it to three atmospheres, the water is removed and the gas is liquefied in the pure state.

DISTILLATION FURNACES.

The distillation of the zinc ore is variously carried out in Upper Silesia, where the tendency of late has been to follow the Rhenish practice in furnace design. Perhaps the oldest type of furnace exists in two of the benches at the Walter Croneckhütte, where direct firing is still used. Almost everywhere else the Siemens open-bottom, or, in rare instances, steam-blown, producers are used, two open-grate fires (gasifying little more than 10 lb. of fuel per square foot of hearth per hour), providing the necessary gas for each 60-muffle block. As

of Fig. 4. This must be done frequently, say, each half hour, to avoid unequal heating of the top and bottom rows of retorts. To the retorts are fitted condensers of the leg-of-mutton shape, from which the zinc is periodically ladled. Once the brown fumes of cadmium are well off and the carbon monoxide coming away freely and ignited, the ballons (prolongs) are set in position to catch the fume. Frequently the furnaces are arranged only two rows of muffles high, with one in the top niche for each two resting in the lower, so as to break-joint and deflect the flame upon the retorts, no matter which way the flow is going. A large pocket, or blind-chamber, is often arranged in the flues to catch metal, slag, and a large amount of dust before passing the products of combustion into the regenerators, thus helping to prevent the clogging up of the checker-work.

A NEW TYPE OF FURNACE

Perhaps the last word in Silesian practice is the substitution of counter-current

recuperation for reversing regeneration in the new bench of furnaces at the Silesiahütte, a side view of which is given in Fig. 10. In this form of furnace two producers are employed to each block, carrying 24 small retorts on top and 12 larger ones below on each side. The heat of the escaping waste gases is recuperated by air alone, and the combustion chamber, 30 in. wide, runs the whole length of the furnace in the center. The flame is reverberated, by the arched roof, over on each side to the retorts, and no reversing of the direction of the gas, brought directly from the producers, or elaborate regenerative chambers, are necessary. The ease of control over the heating up and the steadiness of the temperature maintained give longer life to the muffles, and less distillation losses through cracked muffles.

MUFFLE MAKING

The newest machinery of any in the

D-shape about 14 in. high by 9 in. wide. When the pressure gage shows a sudden rise over 2000 lb. per sq. in., the valves are opened, the plunger drops down and the top block is swung aside, after which the muffle is pushed up carefully by raising the annular ring, great care being taken (by using a guide counter-poised from the roof) to prevent bending of the emerging muffle. Cutting off the muffle with a wire at the required length, about 6 ft., it is removed to the drying room for a period sometimes extending over a year before it is called into use. Only the very largest muffles, approximately 7 ft. long by 2 ft. high, are now made by hand, but in many places the peculiarly shaped condensers are still made by hand.

CHARGING

The depth of the Silesian muffles makes the keeping open of the charge an important point, so the fine roasted blende is mixed with about its own weight of

dues are next raked out, a suitable chute conveying them to wheeled buckets in the tunnel below the platform and level with the regenerators. Carefully luting up again with clay after discarding cracked muffles, the condensers are replaced and charging proceeds. Long, narrow scoop shovels are used. One laborer fills the shovel from the charge on the floor, then the charger lifts it, introduces it through the front, and overturns the scoopful to empty when home in the retort. This very laborious method is almost universal, and only in one smelter have they tried a machine. It was actuated electrically, and had to be fed by an overhead conveyer. Thence the charge passed from the hoppers down six separate tubes, from which the material poured into horizontal pipes 4 in. in diameter, and placed muffle-width apart. These feeders could be elevated or sloped to slip right up the condensers, and in them worked a continuous screw driven from behind, which forced the

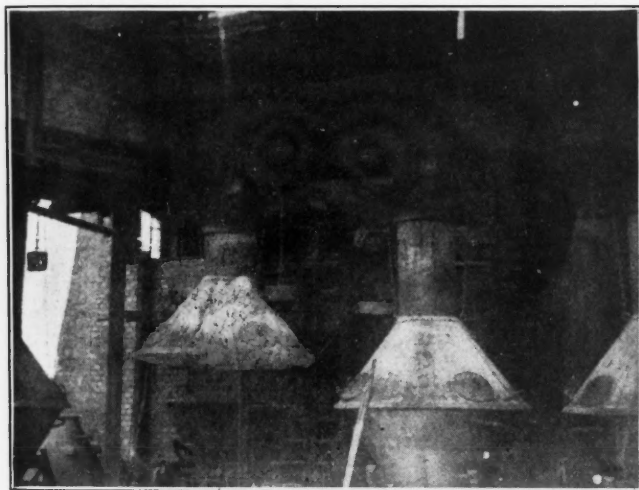


FIG. 7. CONVERTERS FOR HUNTINGTON-HEBERLEIN PROCESS AT FRIEDERICHSHUTTE

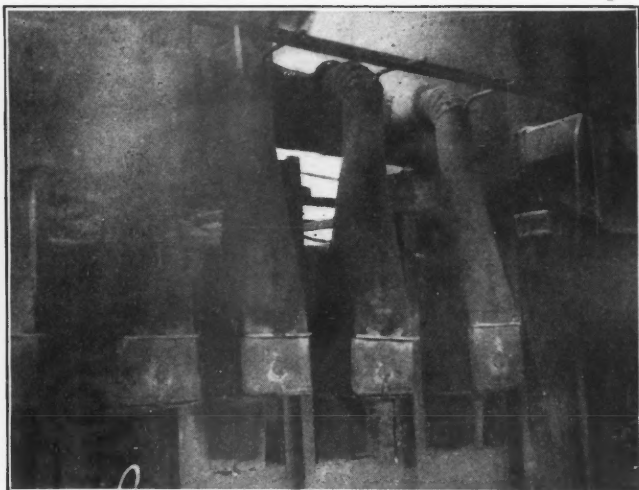


FIG. 8. ZINC DISTILLATION FURNACE FOR CRUSTS AT FRIEDERICHSHUTTE

field is here (Silesiahütte) employed for insuring uniformity in the preparation of the muffle material. Indeed, it is now only in rare cases that the old method of making muffles by hand survives. Nearly everywhere, edge runners do the grinding and pug-mills the first admixture and compression of the requisite proportions of "rotted" fat clay, rough burnt clay and pot chippings. The cakes cut from the roll discharged by the pug-mill are taken to a hammering machine, where a cam-lifted weight drops on the material and gradually thumps it into a 12-in. to 14-in. cylinder as the piston-bottom is lowered. When heavy and solid enough this mass is transferred to the hydraulic press—commonly top fed—and on bolting down the die and cover plates, the central ram makes its way up through the plastic material, forces back the annular ring and shapes the muffle into a

calined calamine, chief of which is smithsonite, broken to the size of small road metal, i.e., lumps of from 3 to 5 cu.in. The reducing material is a partially degasified coal of about walnut size, the gas being taken off in a cinder oven, and burned under boilers for steam raising. First thing each morning the day-shift men, one crew for each side of the bench of furnaces, set about removing the ballons, or prolongs, dumping out the blue powder and sending it off to be ground, sifted and barreled for the trade. A well known peculiarity of this fine zinc dust is its liability to explode, as evinced by one grinder-house completely shattered and burned, too much air having got access to the blue powder. Next the work of tapping or ladling from the condensers proceeds; any spills fall on the charge prepared the day before, so very little loss thereby results. Ashes or resi-

charge forward and into the six muffles simultaneously. The drawback to its use in Silesia was the coarse character of the charge, wherefore it had to be abandoned, but for finer material it seems to be a feasible method.

When the charges are all in along the block, the first lot will be ready for affixing prolongs and lighting up, the carbon monoxide burning with its characteristic blue flame, which soon becomes tinged with green from burning zinc. Draft excluders are then lowered away, and the charge for the next day made up. Usually from 5½ to 6 tons of ore are drawn from the stock-yard and run into the house, mixed in a pile on the working platform before each furnace with from two to three tons of reduction material, spread out and swept against the length of the furnace front to a depth of about 2 feet.

ECONOMIC CONSIDERATIONS

From 70 to 75 per cent. recovery is considered good practice in Silesia. Means for reducing the losses have been found to work well in Silesia as follows: (1) Letting the temperature of the roasting rise as little over 900 deg. C. as possible, pyrometers being occasionally used to aid this regulation of the temperature, and carefully collecting the flue dust. (2) While by making very dense muffles the absorption may be lessened, such muffles do not usually stand well; so recourse is always had to smashing up the cracked muffles by hand, roughly sorting out the spinel, which assays up to 5 per cent. zinc, for return to the furnace, and sending the best of the clean portion to the muffle

remelting in a reverberatory furnace with sloping hearth is all that is done as a rule. The charge often runs up to 30 or 50 tons, melted slowly in a double-fired hearth, upward of 20 ft. long by 8 to 10 ft. broad, the bath being seldom more than 20 in. deep at the end under the discharge doors, from which the zinc is ladled into flat molds arranged on a swing-table as shown in Fig. 5. This refining process takes out almost all the iron and leaves not more than 1 per cent. of lead in the slabs, which are slowly cooled under a cover and for the manufacture of sheet zinc are rolled out before becoming cold, then reheated and further rolled often enough to give the required thinness. The lead which gravi-

the ore is often sufficiently rich in cadmium to make extraction of that metal worth while. This is done by fractional distillation. When the brown flame due to burning cadmium is very pronounced, the powder from the ballons is removed after distillation has gone on for about two hours; by then all the cadmium has come off. This is sent to a small furnace at the end of the bench, which is heated by the waste gases before escaping to the chimney. Here small retorts are charged with the dust and nearly one-half its weight of small cinder. From the powder, holding very little over 2 per cent. cadmium, this redistillation affords a product with close on 50 per cent. Such an auxiliary furnace is shown in Fig. 9.

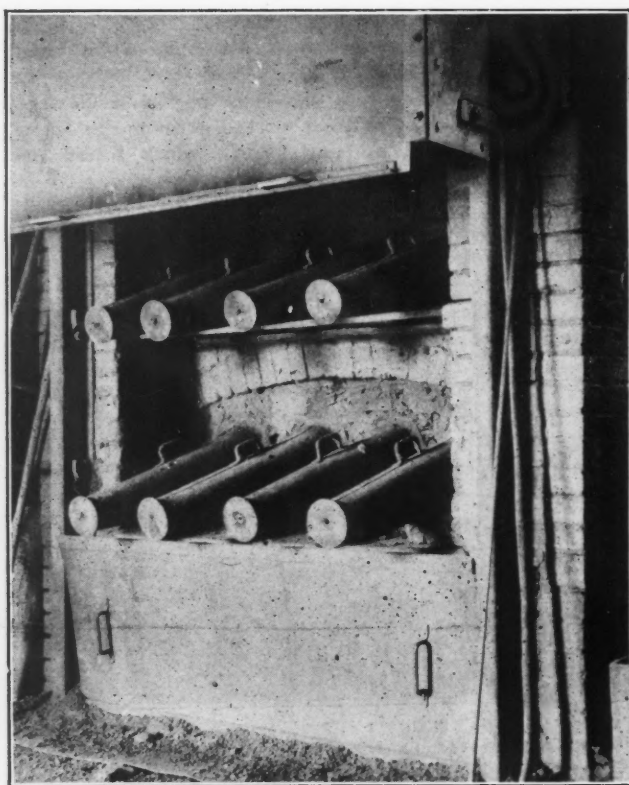


FIG. 9. CADMIUM DISTILLATION FURNACE AT LIEBEHOFFMENGSHUTTE

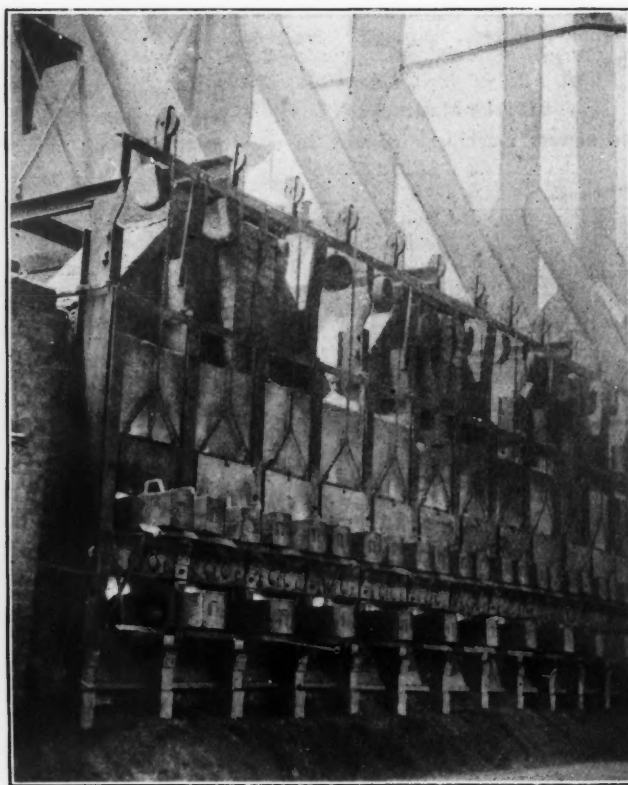


FIG. 10. LATEST FORM OF FURNACE AT SILESIASHUTTE, NEAR LIPINE

maker. (3) Washing the ashes has been tried in some places, but not very successfully. The unconsumed carbon seems to sponge up the zinc slags, and mere washing does not make either serviceable again. Lead concentrates are sometimes got from the ashes where blast-furnace smelting is worked in conjunction with zinc smelting. (4) Even firing keeps breakage of muffles down to about 2 or 3 per cent. at most, and most of the well-made muffles stand usage for five or six weeks before needing replacement.

TREATMENT OF SPELTER

The crude spelter ladled from the condensers in Silesia is too rich in lead for most purposes. Redistillation has not as yet found favor in Silesia, where simple

tates to the bottom of the refining furnace is removed about once a week by a metal screw working in a pipe immersed to the bottom of the bath. A siphon tap has been advantageously employed at several rolling mills for removing this lead-zinc bottom layer.

Only one smelter has tried the electrolytic refining of zinc, but the plant seems to be very costly to work, and has not been augmented despite the very high grade of zinc it produces. A new method of filtering the zinc vapor so that it will be free of lead has just been taken up and promises good results, either for ore smelting or spelter refining.

CADMIUM

In a few of the Silesian zinc smelters

The distillate is now taken to a separate house with a small furnace, often carrying not more than two or four retorts, and coal-fired from the side. Here the material is mixed in 250-lb. lots with 50 lb. of coke, charged into a cylindrical iron retort 6 ft. long and 14 in. in diameter, and distilled at a dull red heat. The metal is condensed in a vertical hoop-shaped condenser, or "snake," as it is called, so arranged as to run the cadmium out at the foot. The cadmium is mostly over 98 per cent. pure and sometimes as high as 99 per cent. Any oxide collected during this distillation is charged back into the retort for the next run.

LEAD

Although there is frequently 4 or 5 per

cent. of lead in the Silesian zinc ores, there are only a few of the smelters which have furnaces for lead recovery. The Silesiahütte keeps three small furnaces going for the production of a very zinkiferous lead, working on the residues from the surrounding smelters. From Fig. 6 it will be seen that the siphon tap is here in use, even although the furnace is comparatively small, being about 20 ft. high and not more than 2 ft. diameter in the hearth. These furnaces yield nearly 25 tons of lead per day. By far the greatest amount of lead produced in this district, however, is made at the Friedrichshütte, near Tarnowitz, where for some time they have been employing the Huntington-Heberlein process on a large scale. The ores sent here are only slightly zinkiferous, and are mainly galena.

on, and for upward of an hour the workmen have to keep the charge tamped down to prevent the air from cutting channels and thus fail to permeate the whole mass. The further details of the Huntington-Heberlein process have been frequently described in the JOURNAL.

In addition to the bench of over 20 five-ton converters, the works at Tarnowitz have recently erected a much larger vessel, as shown in Fig. 12. This is designed to work 15 tons at a time, and is carried on a very strong steel frame 20 ft. above ground level, in order that the large mass of partially-frittered material may be shattered by the fall and thus save hand labor in breaking it up. In this large pot almost $2\frac{1}{2}$ hours are required to complete the blowing of the charge. Even with the best attention

Building Stone, Sand and Clay in California in 1907

The industries of California devoted to the production of mineral structural materials in California, according to figures published by the State mineralogist, produced materials in 1907 to the total value of approximately \$9,225,000 as follows:

Paving blocks, \$200,440; lime, \$743,740; limestone, \$388,014; cement, \$2,291,077; granite, \$451,085; rubble, \$682,996; slate, \$60,000; serpentine, \$3000; glass sand, \$8,178.80; sandstone, \$100,184; marble, \$97,863; clay, (pottery) \$219,179; brick, \$2,965,770; macadam, \$951,198.15. The largest increase, as compared with 1906 is to be credited to the brickmakers, who increased their output from \$2,538,848 to

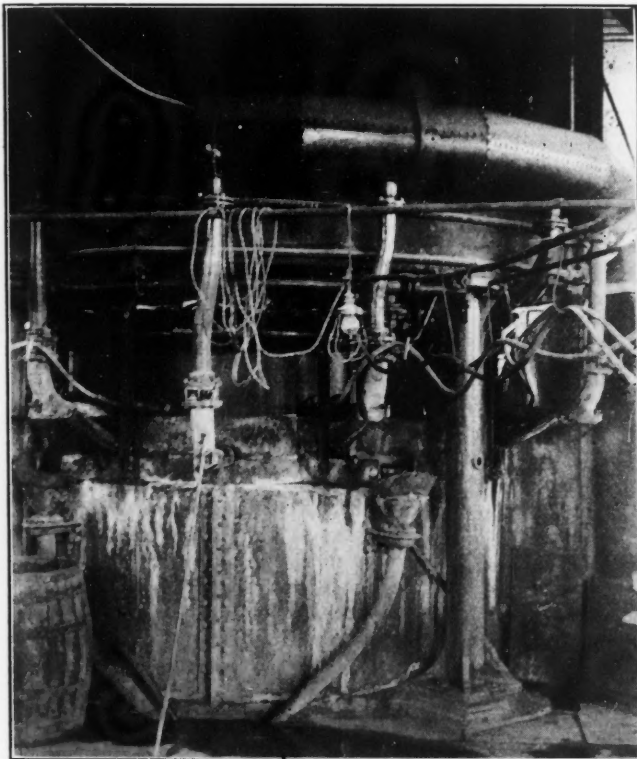


FIG. 11. WATER-COOLED BOSH OF 30-FT LEAD BLAST FURNACE AT FRIEDRICHSHUTTE

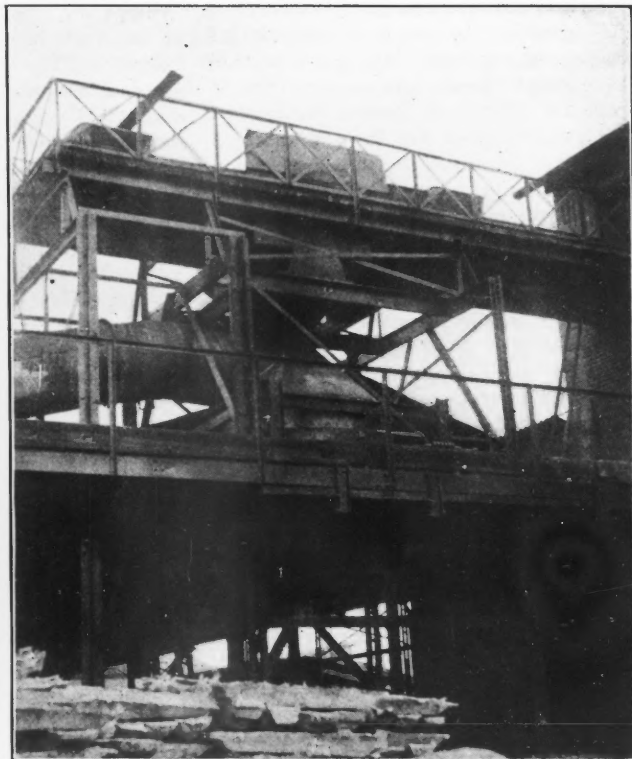


FIG. 12. 15-TON CONVERTER VESSEL AT FRIEDRICHSHUTTE

After crushing and mechanically mixing the ore with about one-tenth its weight of calcined lime, it is elevated to an automatic feed hopper above the center of a Heberlein roasting furnace. When the charge has had free excess of air for 40 to 50 min. at over 600 deg. C., and a good part of the lead has gone to sulphate, the temperature is slackened off a little and a scraper throws about five tons of the charge through an end door into a converter shaped like an inverted cone, perforated at the bottom, and mounted by trunnions on a four wheel carriage. This is next transferred to a position over a blast-pipe, and under a hood with small doors in it, as shown in Fig. 7. Blast from 8 to 10 oz. per sq.in. is turned

there is some lead reduced, and this splashes badly in the fall.

One blast furnace produces all the lead in these works, but it has a capacity of close on 500 tons per day, so rapidly does it run on the ore sintered by the H-H process. From Fig. 11 it will be noted that the bosh is cooled by spraying water upon it. The basin of the siphon tap is almost 5 ft. wide and about 2 ft. across, allowing two men to work at the ladling.

The lead is desilverized by means of the Parkes process, but the zinc scum, instead of being treated in the old way by distillation in the tilting Faber du Four furnace, is retorted in a small muffle furnace (see Fig. 8) with vertical prolongs attached to the condensers.

\$2,965,770, or practically \$425,000. The cement industry shows a gain of about \$325,000, as compared with the previous year.

The ores of Tombstone, Arizona, occur in fissure veins intersecting a series of sedimentary rocks, and also in irregular bodies of limestone. The ores are of two kinds, viz., (1) quartz ores containing silver and gold with some lead, which were treated by amalgamation with quicksilver, and (2) basic ores, the characteristic of which is manganese. Tombstone was formerly a producer of lead, the ore being smelted locally, but the output was never of much consequence in the lead industry of the United States. Now it promises to become a producer of copper.

Alumina in Copper Blast-furnace Slags

A Study of a Variety of Slags with Evidence to Show That Alumina Invariably Acts as an Acid Combining with More Basic Oxides

BY CHARLES F. SHELBY*

Is alumina an acid or a base; is it both or is it neither and simply a foreign substance carried in a slag menstruum? These questions have been, and are still, repeatedly asked and discussed, with men of recognized prestige and valuable opinions ready to take the defensive for each side.

The stand which I have taken is that the oxide, Al_2O_3 , is an active acid and enters into definite chemical union with the bases present, and that the prevalent slag produced by the great majority of copper-matting blast furnaces is a true bi-silicate-aluminate with oxygen ratios of both the silica and alumina to that of the metallic or earthy bases of 2 to 1. While my impression is that my opinion coincides with what I consider to be that of the majority of operating metallurgists, who have had constant experience with it in appreciable quantities in copper-matting blast-furnace slags (say 8 per cent. or more) in the western part of the United States and Mexico, and whose opinions are fixed, still a few notes gathered in connection with a study of this subject may be interesting.

A MUCH DISCUSSED BUT STILL UNSETTLED QUESTION

Dr. Edward Dyer Peters has long been recognized as an authoritative writer on matters pertaining to copper smelting, and his various works will probably form our most complete compendium of available data on this subject. It is not at all improbable that every English-speaking copper metallurgist in the world has gleaned at least a part of his knowledge from the writings of Dr. Peters. Still it remains a fact that even the latest work of this eminent authority, his 1907 edition of "The Principles of Copper Smelting," leaves the subject of alumina in copper-matting blast-furnace slags dubious and unsettled.

I quote from the opening paragraph of his discussion of this subject, as follows: "Alumina (Al_2O_3)—I have left to the last the discussion of this very dangerous and uncertain substance as a constituent of copper slags."

In the closing paragraph, I find the following: "I am aware that, in spite of the amount of space devoted to aluminous slags, I am leaving the subject in as doubtful and unsatisfactory a condition as at the beginning of the section. This is unavoidable until the matter has

been thoroughly and scientifically investigated. All that the metallurgical writer can do to assist the student is to lay before him the results of experience, as typified by analyses and criticisms of alumina slags from various smelting plants, and to warn him of the necessity of extreme caution when he is obliged to smelt ores containing any considerable proportion of this substance."

A quotation from Prof. L. S. Austin's writings on this subject, which appears in the same work on page 398, is as follows: "The behavior of zinc and alumina in a slag is such as to obscure the mutual action of its acidic and basic elements, and we are finding today a portion of our metallurgists adopting a very different way of looking at these relations, which has resulted in their using a working hypothesis, capable at least of satisfying the varying conditions of their practice. This consists in looking upon both zinc and alumina, not as bases, but as elements singly dissolved in the molten magma; that is, they are non-effective bases, which, as their relative proportion increases, singly stiffen the slag, much as sand stiffens mortar."

These quoted statements, and verbal discussions with others, have inspired me with sufficient confidence that some of the results of my studies of this subject will be interesting and instructive to a large number of readers, even though they may contain nothing new to the majority of those who at the present moment are most actively interested.

THE OXYGEN RATIO

It is generally conceded that the copper-matting furnace is selective in its action, delivering two molten products, the matte and slag, the first of which is subject to wide variations of copper and iron contents; a correct balance is then presumably always available to make its standard chemical union for the slag. If this is not available, the furnace commences to accumulate the excess, build accretions and slow up. Should the excess happen to be silica, the charge remains in the furnace longer and is subject to the oxidizing action of more air per unit of time, and the oxidation of the iron that previously went to the matte will go after this accumulation and take it away while more is being formed. The process will continue, and the grade of the matte will be raised, but at the expense of hearth activity; and to get the furnace to

its normal running capacity, the charge will have to be corrected.

In this manner the furnace may be continually taking care of charge variations, accumulating one part or another, slowing down or speeding up to accommodate itself to changing conditions, but all the time delivering its regular type of slag, so far as the ratio that exists between the acids and bases is concerned. Of course there are exceptions when the ratio I have given may be altered, but it brings in policies that are not common with the standard practice under consideration, the quantity of fuel used and the temperature in our furnaces.

The accompanying Table I, of different slags selected at random and from all sections of the country, shows that the proportion of the oxygen of the acids to that of the bases is rather commonly 2 to 1. That they are not exactly so in every instance can probably be explained by those who made them, or may be attributed to one or more of the following reasons: (1) errors in analyses; (2) incomplete analyses; (3) unfluxed material in the slag.

We may deal with reason (1) in a general manner and then refer to each slag by itself. The majority of these slag analyses are either arithmetical averages of a number of daily results or simply a single analysis. They were all made in a rapid manner to check furnace work and, while sufficiently accurate for the purpose for which they were intended, the results cannot be considered scientifically correct. It is a common error in the smelter laboratory to report low silica results on a well chilled slag if the silica is below 38 per cent. and to report high results if above 40 to 42 per cent. Alumina may be high or low, depending on the method used, and the personal factor and other considerations may slightly affect all the results.

Slag No. 1, the analysis of which is given in the first column, is the average slag made at Cananea during the first three months of 1907. The oxygen ratio of the acid to bases is almost exactly as 2 to 1. The furnaces ran well, and conditions were normal. The results are the averages of about 200 analyses representing about 200,000 tons of smelted material.

No. 2 is the average slag at Cananea for the month of October, 1907. The oxygen ratio is a very little greater than 2 to 1; the sum of the analyses is 2.5 per cent. higher than those of No. 1. The

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furnaces ran well and conditions were normal. The results are the average of about 60 analyses representing about 70,000 tons of material.

No. 3 is the average slag made at Aguascalientes for the 12 months ending April 30, 1903. The oxygen ratio of acids to bases is almost exactly 2 to 1, and still the slag is quite different from those previously mentioned. The silica and lime are much higher, but the alumina and ferrous oxide are correspondingly lower. The furnaces ran well and conditions were normal, and the figures given represent the average of approximately 1000 analyses and the smelting of probably 300,000 tons of material. (I was connected with the operating department of the plant while these slags were made.)

No. 4 is a slag which was reported to me as having been made at Aguascalientes March 20, 1906. The oxygen ratio is almost exactly 2 to 1, but a part of both the ferrous oxide and the lime of the previous slag is replaced by mag-

nesia and baryta. The slag is reported to have been very satisfactory, and the furnaces ran well. The oxygen ratio is less than 2 to 1, and to a peculiar circumstance can be attributed, in part, the cause. The furnaces ran exceptionally well, and the supply of ore demanded that they be pushed to their maximum capacity all the time. A part of the charge was a hematite ore that was used as a flux, but which contained sufficient copper to leave a margin of profit. This ore also contained quite an appreciable amount of fines, and owing to the rapid running of the furnaces, a part of these fines, especially the purer and harder granules, would sift down through the interstices of the charge, either by gravity or a jigg-ing action of the blast, and be caught up by the slag before reduction could take place and washed out of the furnace by the slag. That some of this iron was not chemically combined was made evident by its segregation in ladle samples of the slag, by the rusty color on the tops of the pots of slag and on the outside of each layer on the dump, and the presence

reasonably rich, neither an analytical nor a microscopical examination could show that a trace of the valuable metals had been left; in this manner the furnace made as clean a gossan in a few minutes as nature might produce in centuries.

No. 8 is the average of the daily slags at the Copper Queen for the month of October, 1907, and represents the smelting of probably 100,000 tons of material. The oxygen ratio is almost exactly 2 to 1. It is the highest in alumina we have dealt with, and the lowest in silica; and the lime and ferrous oxide contents are at variance with any examples so far considered; still, the ratio remains constant. The furnaces ran well, and conditions were normal.

Slag No. 9 is a specimen analysis from Teziutlan, having higher baryta contents than any other shown. It is low in acids to correspond with the formula, but not knowing the conditions we can offer no explanation. Possibly the discrepancy may be traceable to analytical errors or unfluxed material in the slag.

No. 10 is a slag analysis given me as representing that produced by the furnaces of the Tennessee Copper Company some time during the year 1906, the furnaces operating on the raw-ore charge (the matte-concentration charge is quite different). It is the lowest in lime thus far examined. It closely approximates the formula of 2 to 1 with slightly high acid results.

No. 11, is an often quoted Deadwood-Delaware slag made in 1899. It is the highest slag in silica we have examined, and still the oxygen ratio of the acids to bases is almost exactly 2 to 1.

This table shows results from a number of the important copper producers, and many more could be tabulated with similar results. They illustrate slags of widely varying composition, but all closely adhering to the type specified. We find the silica ranging from 34.3 to 48 per cent., the alumina from 2.05 to 12.6 per cent., the ferrous and manganous oxides from 19.9 to 37.6 per cent., the lime from 8.21 to 25.83 per cent., the magnesia from none to 12.9 per cent. and the baryta from none to 6.2 per cent.

High silica slags, in districts where lime and iron fluxes are scarce or costly, have always been the aim of the smelter metallurgist, and the inability to produce them has often embarrassed the unfortunate superintendent, while their production has been a source of pride to the more fortunate. Still I can see no more cause for glory in the 48-per cent. Deadwood slag (No. 10 of the table) than in the 34.3-per cent. Copper Queen slag. I consider them both as adhering to nature's rules, and in accordance with these laws subservient to laws we cannot change.

AS REGARDS THE ZINC OXIDE

In these tabulations the zinc reported in some of the slags has not been con-

TABLE I. ANALYSES OF TYPICAL COPPER BLAST FURNACE SLAGS.

Constituents.	Per Cent. Oxygen.	No.										
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
SiO ₂	52.9801	35.8	37.1	42.58	42.40	45.60	37.24	35.6	34.3	35.5	41.36	48.0
Al ₂ O ₃	46.9667	10.1	11.4	4.00	2.05	6.80	12.60	9.3	12.9	6.2	6.16	5.4
FeO	22.2531	37.6	36.0	20.74	19.20	16.20	27.93	37.1	30.9	27.9	36.91	13.0
MnO	22.5352		0.5	0.85	0.70	0.45		1.3				
CaO	28.5205	12.5	12.9	25.83	21.90	24.80	18.19	12.3	16.9	17.5	8.21	20.0
MgO	39.7022		0.6		2.20	1.20	3.16	2.5	1.8		2.94	12.9
BaO	10.4302				3.10	0.96				4.2		
ZnO	19.6560			2.40	7.40	2.50				6.2	2.43	
Total		96.0	98.5	96.40	98.95	98.51	99.12	98.1	96.8	97.5	98.03	99.3
		Per Cent. Oxygen.										
SiO ₂		18.97	19.66	22.56	22.46	24.16	19.73	18.86	18.17	18.81	21.91	25.43
Al ₂ O ₃		4.74	5.35	1.88	0.96	3.19	5.92	4.37	6.06	2.91	2.89	2.54
Total in Acids		23.71	25.01	24.44	23.42	27.35	25.65	23.23	24.23	21.72	24.80	27.97
FeO		8.37	8.01	4.61	4.27	3.60	6.21	8.25	6.88	6.21	8.21	2.89
MnO			0.11	0.19	0.16	0.10		0.29				
CaO		3.56	3.68	7.37	6.25	7.07	5.19	3.51	4.82	4.99	2.34	5.70
MgO			0.24		0.87	0.48	1.25	0.99	0.71		1.17	5.12
BaO					0.32	0.10				0.44		
Total in Bases		11.93	12.04	12.17	11.87	11.35	12.65	13.04	12.41	11.64	11.72	13.71
One-half oxygen in acids. Oxygen in zinc oxide		11.85	12.50	12.22	11.71	13.67	12.82	11.61	12.11	10.86	12.40	13.98
				0.47	1.45	0.49				1.22	0.48	1.37

No. 1, Cananea, first quarter, 1907; No. 2, Cananea, October, 1907; No. 3, Aguascalientes, year ending April 30, 1903; No. 4, Aguascalientes, March 26, 1906; No. 5, Aguascalientes, March 27, 1906; No. 6, Morenci, year 1903; No. 7, Old Dominion, two years, 1905-1906; No. 8, Copper Queen, October, 1907; No. 9, Teziutlan; No. 10, Tennessee ore charge; No. 11, Deadwood & Delaware, S. D., July 14, 1899.

nesia and baryta. The slag is reported to have been very satisfactory, and the furnaces ran well.

Slag No. 5 is reported to have been made at the same place the following day; the oxygen ratio of acids to bases is very much greater than 2 to 1. The slag is also reported to have been "slow and thick like molasses" and had to be abandoned, implying that the charge was too acid for the proportion of fuel and for other conditions.

No. 6 is the average of the daily slags at Morenci, Arizona, for the year 1903. The oxygen ratio is almost exactly 2 to 1, and the type of slag is again different from those previously cited. The furnaces ran well and conditions were normal.

No. 7 is the average slag for the two years ending December 31, 1906, at the Old Dominion, representing nearly 2000 analyses and the smelting of about 800,-

of ferric oxide in the chilled sample of the slag dissolved in hydrochloric acid (the iron contents of which are included in the analysis as tabulated). A further examination of the dump would reveal that this rusty discoloration would only be present on the outside of the layers or scales as an excrescence, and that if they were peeled off and broken the fracture would be as black as desired.

This will serve as only one instance to prove that unless all the conditions under which a furnace plant is operating are known or stated, a few figures such as a slag analysis shows may sometimes be more misleading than instructive. I have also witnessed a fast-running furnace carrying out unaltered silica in pieces from 1/8 to 1/4 in. in diameter, in such quantities that if the silica had been combined chemically with the slag, it would not have run. While the ore from which it came was

silica, and that it can replace silica in direct oxygen equivalents without altering fuel and other conditions, is not intended to be inferred. That bi-silicates of ferrous oxide and lime are to a certain degree interchangeable, and that either can be replaced in part by magnesia, no one will dispute; but what happens if we try to replace the ferrous oxide entirely with lime, or, worse yet, with magnesia? If we leave the fuel alone the furnace will stop; and the same would happen if we were to try to replace all the silica with alumina; the nearer we approach the change the greater the difficulties. The causes will not be discussed here, as they would more properly come under another heading; but a study of the heats of formation will reveal the cause, and the reader is referred to Prof. Joseph W. Richards' works on "Metallurgical Calculations" for detailed information on this subject.

Referring again to Dr. Peters' discussion of this subject we note on pages 394 to 397 of his work, a record of some of Prof. H. O. Hofman's scientific researches into the possible action of alumina in slags. After having selected an artificial laboratory slag of the following composition, as his standard:

	Per Cent.	Per Cent. Oxygen.
Silica.....	32.10	17.01
Ferrous oxide.....	35.90	7.98
Lime.....	32.00	9.12

which we note is almost a perfect mono-silicate, he replaces, according to their oxygen equivalents, each of the elementary constituent parts in turn with the oxide, alumina, and in advancing steps of 1/8 by proportion, studying their physical characteristics and noting their melting temperatures.

I have made an examination into the results of this experiment to note any observations that could be gathered from the changing oxygen ratios that might occur resulting from the alumina substitutions, and in Table II is shown Prof. Hofman's slag compositions with the melting temperatures, and I have appended the oxygen contents of the various constituents, and my calculations of the ratios between the acids and bases.

MEANING OF TABLE II

My deductions from these results are as follows: That in the substitution of the bases for alumina the melting temperature is either lowered or not appreciably affected, as the slag is changing from the mono-silicate formula through either a mixture of mono- and bi-silicates or intermediate types to the bi-silicate, except when brought under the influence of other well known and recognized conditions, which will be given consideration.

In the replacement of the SiO₂ with Al₂O₃ is noted an immediate stiffening of the slag and a raising of the melting temperature until 75 per cent. of the SiO₂

has been replaced with Al₂O₃, when the temperature could no longer be measured. With the Al₂O₃ as an acid the slag continuously remains a mono-silicate; but considering the Al₂O₃ as a base we note that when 50 per cent. of the SiO₂ has been replaced with Al₂O₃ we still have a mixture fusible at 1220 deg., and with the oxygen contents of the acids at 8.50 and the bases 25.62, indicating a tri-basic slag. What would happen were we to try and make a SiO₂, FeO, CaO combination according to that ratio, and analyzing somewhat as follows: SiO₂, 13.77; FeO, 43.11; CaO, 43.12 per cent.? We would certainly have to accept inevitable defeat from the furnaces. I would deduce from this experiment that the substitution of SiO₂ with Al₂O₃ in mono-silicate slags is accompanied by a rise in the formation temperature.

In the replacement of FeO with Al₂O₃ we notice at first a falling off in the melting point and then a rise until 75 per cent. had been replaced, after which the combination was still fusible but the temperature was above the capacity of the recording instruments. We note at this point that the slag is slightly acid in accordance with the bi-silicate-aluminate formula, whereas it remains a mono-silicate, should we consider Al₂O₃ as a base.

I would deduce from this experiment that considering Al₂O₃ as an acid, the slag indicates an improvement, as it goes through the change from a mono-silicate to a bi-silicate formula, which improvement is in turn counterbalanced by the decreasing ratio of the FeO to the CaO, causing an offsetting increased viscosity and higher melting point.

In the replacement of the CaO with Al₂O₃ we immediately note a lowering of the melting temperature which remains constant until about the point where the slag would be a true bi-silicate-aluminate, and substantially the same observations will be gathered from the experiments on the replacement of both the FeO and CaO with Al₂O₃. We also note in both instances that he found it possible to fuse together slags in this manner that would have a tri-silicate aluminate formula, and in this connection I cannot help but feel as a reasonable deduction that we have arrived at still further proof as to the acid action of alumina in our blast-furnace slags.

A FIELD FOR FURTHER STUDY

It would certainly be most interesting in connection with a further study of this subject, if some of our college laboratories would duplicate Prof. Hofman's experiments, varying his procedure by starting out with a slag of the bi-silicate formula, in which case I would look for very different results. Whereas in Prof. Hofman's mono-silicate experiments the replacement of the SiO₂ with Al₂O₃ was accompanied by marked difficulties and the replacement of the bases

with Al₂O₃ indicated an improvement, I would expect to deduce from the proposed experiment the indications of troubles in replacing the bases with Al₂O₃ and not such marked difficulties in the replacement of the SiO₂. Were the experiment to be tried with a tri-silicate as the standard, I would expect results similar to those from the bi-silicate, but with immediate and more pronounced troubles in the replacement of the bases with Al₂O₃.

A discussion of the rôle of alumina in lead and copper slags, written by Carl Heinrich and published in the JOURNAL as long ago as July 17, 1886, covers the ground very thoroughly, and the author gives to his satisfaction conclusive evidence as to the existence of alumina in the slags he had to deal with as an active acid. His experience at the works of the Champion Copper Mining Company, of New Zealand, is most interesting, and will in part be noted herein again, in view of the very high proportion of alumina in his slags.

The accompanying table is from his paper:

ANALYSES OF FOUR SLAGS, CHAMPION COPPER MINING COMPANY.

	No. 1 from First Run.	No. 2.	No. 3.	No. 4.
SiO ₂	36.4	34.6	39.1	21.8
Al ₂ O ₃	27.8	26.4	22.9	31.2
FeO.....	14.2	32.2	29.6	31.5
MgO.....	18.4	6.8	8.4	15.5
CaO.....	1.5	tr.	tr.	tr.
	98.3	100.00	100.00	100.00

PER CENT. OXYGEN.

	No. 1.	No. 2.	No. 3.	No. 4.
SiO ₂	19.4	18.4	21.3	11.6
Al ₂ O ₃	13.1	12.4	10.8	14.7
FeO.....	3.2	7.2	6.6	7.0
MgO.....	7.3	2.7	3.3	6.2
CaO.....	0.4			

"Counting alumina as a base, the oxygen ratio of acids and bases in these four slags were as follows:

	1	2	3	4
Acids.....	19.4	18.4	21.3	11.6
Bases.....	24.0	22.3	20.7	27.9

ALUMINA AS AN ACID.

	1	2	3	4
Acids.....	32.5	30.6	32.1	26.3
Bases.....	10.9	9.9	9.9	13.2

"The first way of looking at the composition of these slags threw no light whatever on their behavior in the furnace. It made the worst of all, the scaffold slag No. 3, a correct mono-silicate, while the crucible slag No. 4, which had separated from the other slag, would have a composition more basic even than a sub-silicate, and the two better slags, Nos. 1 and 2, were slightly basic mono-silicates. This way of looking at their compositions surely did not seem rational.

"But looking at their composition the other way, it was found that the two better slags, Nos. 1 and 2, were very nearly correct tri-silicate-aluminates, while the infusible scaffold slag, No. 3, was more acid still than a tri-silicate-alumin-

ate, and the crucible slag, No. 4, which had been separated and settled in the crucible, being too thick to run out of the slag hole, although melted, was a correct bi-silicate-aluminate."

THE FURNACE MAKES ITS OWN SLAG

The writer of the article claims to have secured the best results in his small circular furnace and heavy fuel charge, from the tri-silicate-aluminate slags, and his bi-silicate, No. 4, which was an accidental slag formed by the furnace itself, although abnormally high in magnesia, showed characteristics of a possibility that might have determined a slag policy; but in view of his lack of bases he preferred to make, and succeeded in making a slag with oxygen ratios of acids to bases of 3 to 1, counting alumina as an acid.

As an appendix to his article, he publishes a few more notes in the JOURNAL of August 21, 1886, proving the correctness of his views, in which he mentions having tried his best to make alumina act as a base, but could not get the furnace to help him out, which calls to my mind a humorous incident that it will do no harm to introduce.

On making a morning round in connection with my duties, I was informed by the skimmer in charge of a reverberatory furnace, that it was "strictly on the bum," and he attributed the cause to a bad lot of coal. Mentally, I was forced to coincide with his views, but verbally persuaded him into believing that the coal was all right, and a good grating and careful attention during the day would materially help to straighten it out.

Next day it was, "Good morning, Joe, how is the furnace to-day?"

"Vell, I tells you, Mr. Shelby, dat coal's no good, I don't care wat you says; you can fool me, but you can't fool dat furnace."

And it is the same thing with the alumina; when it goes up the silica must go down, and there is no getting around it without more fuel and another type of slag.

THE MANSFELD SLAG

Let us give a short consideration to the famous Mansfeld slag, the high silica-alumina content of which would call for an explanation by the believers in alumina's rôle as a base. Following is a recognized analysis:

	Per Cent.	Per Cent. Oxygen.
SiO ₂	47.66	25.25
Al ₂ O ₃	16.45	7.73
FeO.....	5.04	1.12
MnO.....	0.35	0.08
CaO.....	18.89	5.39
MgO.....	4.55	1.81
K ₂ O.....	4.89	0.83
Na ₂ O.....	0.39	0.10
ZnO.....	1.92	0.38
	100.14	42.69

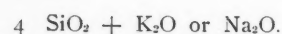
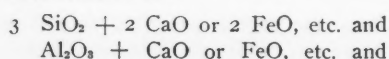
Considering alumina as a base, we have

acids 25.25 and bases 17.16 per cent., approaching very closely a sesqui-silicate slag, or with an oxygen ratio of acids to bases of 1.5 to 1; which would indicate some unexplainable reasons for their very high fuel percentage, whereas we can easily make bi-silicates with much less fuel. On the other hand, considering alumina as an acid, we find the oxygen of the acids to be 32.98 and of the bases 9.33 per cent., indicating nothing except remote possibilities of a ratio of 3.5 to 1. This does not seem reasonable either, and we must look further.

With plenty of heat and local intensity, conditions will change and slags can be made, which, with our common temperatures, would be impossible. I have melted into a viscid molten mass in what was previously the fire-box of an ordinary reverberatory furnace, and which at the time mentioned was fired with pulverized fuel and an air blast through the back wall, tons of ash from the coal, the ash giving the following analysis: 54.8 per cent. SiO₂, 23.1 per cent. Al₂O₃, 10.4 per cent. Fe and 4 per cent. CaO. It formed principally near the bridge-wall (in the fire-box), and, as the heat was very intense and constant, conditions were good for extraordinary results.

This product was certainly fused, and generally chemically combined. Of course it would not flow; but on being stirred up with an iron bar it would string out more than any silicious-slag I have ever seen. I did not have an analysis made of this fused product, but granting that the composition was the same as that of the ash, and that the iron was present as ferrous oxide, we have 29.03 per cent. oxygen in the SiO₂; 10.85 per cent. in the Al₂O₃; 2.98 per cent. in the FeO; and 1.14 per cent., in the CaO. If the alumina were an acid, there would be 10 oxygen in the acid to 1 in the bases, or, were alumina a base, there would have been 2 of oxygen in the acid to 1 in the bases, which should have been easily melted, whereas it only fuses into a pasty viscid mass, although the temperature was high enough to soften the exposed surface of the silica brick.

In the Mansfeld slag we find an appreciable amount of the strong alkalis which might easily be in chemical union, and as a mobile slag under high temperature conditions, with an oxygen ratio of acids to bases of 8 to 1, and in case of such event the 0.93 per cent. oxygen in these alkalis would accommodate 7.44 per cent. in the acids, leaving net for the other bases 25.54 per cent. oxygen in the acids as against 8.40 per cent. in the other bases, or in the ratio of 3 to 1, indicating a tri-silicate slag, quite possible under their conditions, and giving a slag formula of:



Does this not appear more reasonable?

GLASSES AND IRON BLAST FURNACE SLAGS

Two specimen glass analyses are given as follows:

COMPOSITION OF TWO SAMPLES OF GLASS.

	Per Cent.	
	1	2
SiO ₂	74.09	66.75
Al ₂ O ₃	0.40	1.31
CaO.....	5.85	13.37
K ₂ O.....	7.32	15.50
Na ₂ O.....	12.34	3.07
	Per Cent. Oxygen.	
	1	2
SiO ₂	39.25	35.36
Al ₂ O ₃	0.19	0.61
CaO.....	1.67	3.81
K ₂ O.....	1.24	2.63
Na ₂ O.....	3.18	0.79

These are two quite different analyses as regards the proportion of alkalis and alkaline earths. Applying our Mansfeld formula, we find in the first 39.44 per cent. acid oxygen with 1.67 per cent. CaO oxygen to satisfy at 3 to 1, 5.01 of the acids, leaving 34.43 per cent. net, with 4.42 in the strong alkalis, or practically at the ratio of 8 to 1. In No. 2 we have 35.97 per cent. acid oxygen with 3.81 per cent. in the CaO to satisfy 11.43 per cent. of the acids, leaving 24.54 per cent. net with 3.42 in the strong alkalis, or a little less than enough to satisfy the ratio of 8 to 1. These glass analyses are not introduced as slag types, but their oxygen ratios have been examined into simply as a comparison with the Mansfeld type from the strong alkali point.

Table III presents a study of a wide variety of blast-furnace slags.

DISCUSSION OF TABLE III

Nos. 1, 2 and 3 are types specified by Thomas D. West in his "Metallurgy of Cast Iron." Nos. 4, 5, 6 and 7 are types specified by Dr. Thomas B. Stillman in his 1900 edition of "Engineering Chemistry," and No. 8 is a slag made by the Cleveland Furnace Company, December, 1907, and analyzed by F. G. Hawley, of the Cananea Consolidated Copper Company. No. 4, as reported by Dr. Stillman, did not specify either Na₂O nor K₂O, but simply 3.98 per cent. alkalis. As a consequence the analysis is repeated in No. 4½, showing the results in No. 4, considering all the alkalis as Na₂O and in No. 4¾ as K₂O.

Should we consider Al₂O₃ as an acid these slags range generally between a bi- and a tri-silicate formula; whereas giving Al₂O₃ the rôle of a base, their formulas seem to vary more in accordance with the Al₂O₃ contents than in any other manner. This point is especially noticeable in No. 3, in which the Al₂O₃ contents have dropped off sharply and the slag gets back toward the higher silicate degree.

I do not feel at liberty to criticize these

analyses any further and to attempt to show reasons why none of them agree with an exact formula, or to try and make them do so. I have had absolutely no experience in the metallurgy of iron and am unfamiliar with any invisible conditions that might affect these analyses except in the case of No. 8, the sample of which slag was taken by myself personally and analyzed under my supervision. The sample was originally small and practically consumed in endeavoring to locate the remaining 6.5 per cent. before the presence of fluorine in very appreciable quantities was discovered. It is then quite possible that should we accord this element sufficient of the Ca reported as CaO to form CaF₂, that the oxygen contents of the remaining bases would be such as to give the slag an exact bi-silicate-aluminate formula.

A few years ago Thorn Smith brought a Ducktown slag into prominence by having comparative analyses made at 20 different smelter laboratories with No. 1

ulative, for all were made under strongly oxidizing conditions, the converter slag being the most basic of the three. No explanation of these slags will be attempted further than to say they are most likely a physical mixture of mono- and bi-silicates or intermediate types. They are here given merely as presenting a possible reason why some of our pyritic furnaces may depart from the bi-silicate formulas, and under strongly oxidizing influences, a preponderating amount of iron, and in the absence of fuel tend to produce slags of a more basic nature.

THE BI-SILICATE, THE COPPER-MATTING SLAG

In my studies of slag analyses, I have certain standard types, as everyone has, of mono-silicates and others; but in studying the types of those produced at our larger copper-matting plants when exceptional conditions do not exist, I have arrived at the firm conclusion that in our

initely settled, offered in the hope that it will save someone who may wish to carry the subject farther the necessity of going over the same ground. I do not wish to be interpreted as endeavoring to lay down the law as to the behavior of alumina in all cases and to call it unequivocally an acid; its combination with silica in nature in many different proportions and its chemical affinity for the mineral acids, would not permit of such a statement; Cr₂O₃ is to a certain extent analogous to Al₂O₃, but it has long been recognized as an active acid in its place. We are able to form chemically calcic-ferrites and acknowledge the weak acidity of Fe₂O₃, but both CaO and FeO are bases in our slags. Lime is a stronger base than ferrous oxide, and silica is a stronger acid than alumina, and as one electro-positive element becomes negative to one more positive than itself, alumina may be chemically negative to silica and silica in turn negative to fluorine, whereas all three are positive to lime or ferrous oxide.

I maintain, and make my metallurgical calculations with the belief that the silica in our blast-furnace slags combines with the metallic, earthy and alkaline bases in the most natural manner that existing conditions control, and I have never observed an instance in which I could bring myself to believe that it was in direct chemical union with the alumina, playing the rôle of a base. Nor do I believe that it can be forced to do so, at least not until after the silica has satisfied itself with the common bases in its highest natural oxygen ratio. Even a study of our iron blast-furnace slags with high silica-alumina contents has given me the impression that they respond better to inquisitive formulas with alumina considered acid rather than basic.

And as a general resumé of these notes, and my study of this subject, I have arrived at the conclusion that in our prevalent copper-matting blast-furnace slags the oxide, alumina, is neither a base nor a foreign substance carried in the slag menstuum, but is always present as an active acid; and that when one may seemingly be replacing an undisputed base with this oxide and thereby causing it to assume the rôle of a base he is simply altering the silicate degree of the slag.

The ore deposits of the Ten Mile district, of Colorado, are of enormous size, but are chiefly pyrites, or pyrites and blende, of low grade of silver. Streaks and pockets of galena occur in the great mass of mixed ore, and there are some strong shoots of lead ore, which have been worked successfully, as in the White Quail mine. The ore-bearing formation of the Ten Mile outcropped at the surface and was easily opened, dipping at a gentle angle, but the oxidized ores, which were richer than the sulphides, extended only to a small depth.

TABLE III. PERCENTAGE COMPOSITION AND OXYGEN RATIOS OF A NUMBER OF IRON BLAST FURNACE SLAGS

	1	2	3	4	4½	5	6	7	8
SiO ₂	27.68	42.17	61.06	44.27	44.27	43.25	45.46	35.00	34.5
Al ₂ O ₃	22.28	13.59	5.38	12.91	12.91	15.94	16.59	14.36	13.4
CaO.....	40.12	33.02	19.81	19.81	19.81	36.46	32.81	45.37	40.0
FeO.....	0.80	1.28	3.29	16.50	16.50	0.31	0.27	0.44	0.4
MnO.....	0.26	0.35	3.39	3.19	3.19	0.10	0.08	.....	.....
MgO.....	7.27	8.31	7.12	.....	.....	2.12	1.08	1.40	5.2
Na ₂ O.....	.....	.....	.....	3.98	.....	.....	.....	.....	.....
K ₂ O.....	.....	.....	.....	.....	3.98	.....	.....	.....	.....
	98.35	98.64	99.29	99.94	99.94	98.18	96.29	96.57	93.5
Per Cent. Oxygen.									
SiO ₂	14.66	22.34	32.35	23.45	23.45	22.91	24.08	18.54	18.28
Al ₂ O ₃	10.46	6.38	2.53	6.06	6.06	7.49	7.79	6.74	6.29
Acids.....	25.12	28.72	34.88	29.51	29.51	30.40	31.87	25.28	24.57
CaO.....	11.44	9.42	5.65	5.65	5.65	10.40	9.36	12.94	11.41
FeO.....	0.18	0.28	0.73	3.67	3.67	0.07	0.06	0.10	0.09
MnO.....	0.06	0.08	0.76	0.72	0.72	0.02	0.18	.....	.....
MgO.....	2.89	3.30	2.83	.....	.....	0.84	0.43	0.56	2.06
Na ₂ O.....	.....	.....	.....	1.02	.....	.....	.....	.....	.....
K ₂ O.....	.....	.....	.....	.....	0.67	.....	.....	.....	.....
Bases.....	14.57	13.08	9.97	11.06	10.71	11.33	10.03	13.60	13.56
Oxygen ratios acids always 1.000.									
Bases:—Al ₂ O ₃ as Acid.....	0.580	0.456	0.286	0.375	0.363	0.373	0.315	0.538	0.552
Bases:—Al ₂ O ₃ as Base.....	1.707	0.871	0.386	0.730	0.713	0.821	0.740	1.097	1.085

in the following table accepted as the standard:

ANALYSES OF DUCKTOWN SLAG.

	1	2	3
SiO ₂	33.78	35.92	29.97
Al ₂ O ₃	4.07	3.46	3.55
FeO.....	40.86	52.73	58.40
MnO.....	0.53	.....	.....
CaO.....	12.48	2.43	2.12
MgO.....	2.87	1.22	.....
ZnO.....	3.55	2.04	2.36

No. 2 is a 1906 specimen analysis from the Tennessee Copper Company's furnaces on the matte concentration charge, and No. 3 is a specimen converter slag. The percentages of oxygen in these slags are as follows:

	1	2	3
SiO ₂	17.90	19.03	15.88
Al ₂ O ₃	1.91	1.63	1.67
Total acids.....	19.81	20.66	17.55
FeO.....	9.09	11.73	12.99
MnO.....	0.12	.....	.....
CaO.....	3.56	0.69	0.60
MgO.....	1.14	0.48	.....
Total bases.....	13.91	12.90	13.59
ZnO.....	0.70	0.40	0.46

The study of these slags is purely spec-

standard copper-matting furnace practice the furnace itself will generally deliver a slag closely approximating a true bi-silicate with alumina in combination with the bases as an active acid. In fast-running furnaces it is a frequent occurrence to find uncombined minerals or elementary compounds washed out with the slag almost in the same form as when introduced into the furnace, causing misleading analytical interpretations. I am also convinced that the oxidation of the sulphides of iron on the charge is one of the most important factors that the copper pyro-metallurgist has to deal with, greatly affecting the quantity of fluxes used and hearth activity.

There are exceptions to all rules, and no one of us is infallible, and I present these notes simply as notes. I have given the subject a large share of thought and study, during a long period of time and coincidental with the smelting of a large tonnage of aluminous material. This is my opinion of a subject that has not been def-

The Silicious Silver Mines of Parral, Mexico

Although Long One of the Large Producing Camps, Parral Now Depends on Deeper Mining and Cyanidation of Its Low-grade Ore

BY CLAUDE T. RICE

Parral is situated in a dry region, bare of timber, about 56 miles west of Jimenez on the branch road of the Mexican Central (completed about 1900), which leaves the main line at that point and extends 41 miles beyond Parral to Rosario. Parral is a town of approximately 15,000 inhabitants, situated among the rolling eastern foothills of the Sierra Madre range and along a stream almost dry in summer. Overlooking the town are the Tajo and the Prieta, two of the mines that in the

rich ore above water level has been mined, has caused the production of the Parral district proper to become small.

While the Parral district is often considered as including both Santa Barbara and Minas Nuevas, in this article the remarks will only apply to the mines in the immediate vicinity of Parral and those near Minas Nuevas.

HISTORY OF THE DISTRICT

The mines at Santa Barbara were dis-

covered on the Veta Colorada by Diego Rodrigo, and subsequently that vein aided greatly in maintaining the output from Parral. Before the completion of the railroad (about 1900) the ore was hauled to Jimenez and shipped thence to Mapimí, or El Paso for treatment, but this was expensive. Consequently, after English-speaking people began to obtain a foothold in the district, the milling of the ore was begun. The hyposulphite process was introduced about 1884 and since that time until within the last year consider-



PALMILLA MINE, PARRAL

past have helped to make Parral famous.

Parral is an attractive town with several plazas, but, of course, it does not rival Chihuahua in size or beauty. It is a supply point for the camps to the west and south, such as Santa Barbara, Guanaceví, Indé, and other camps.

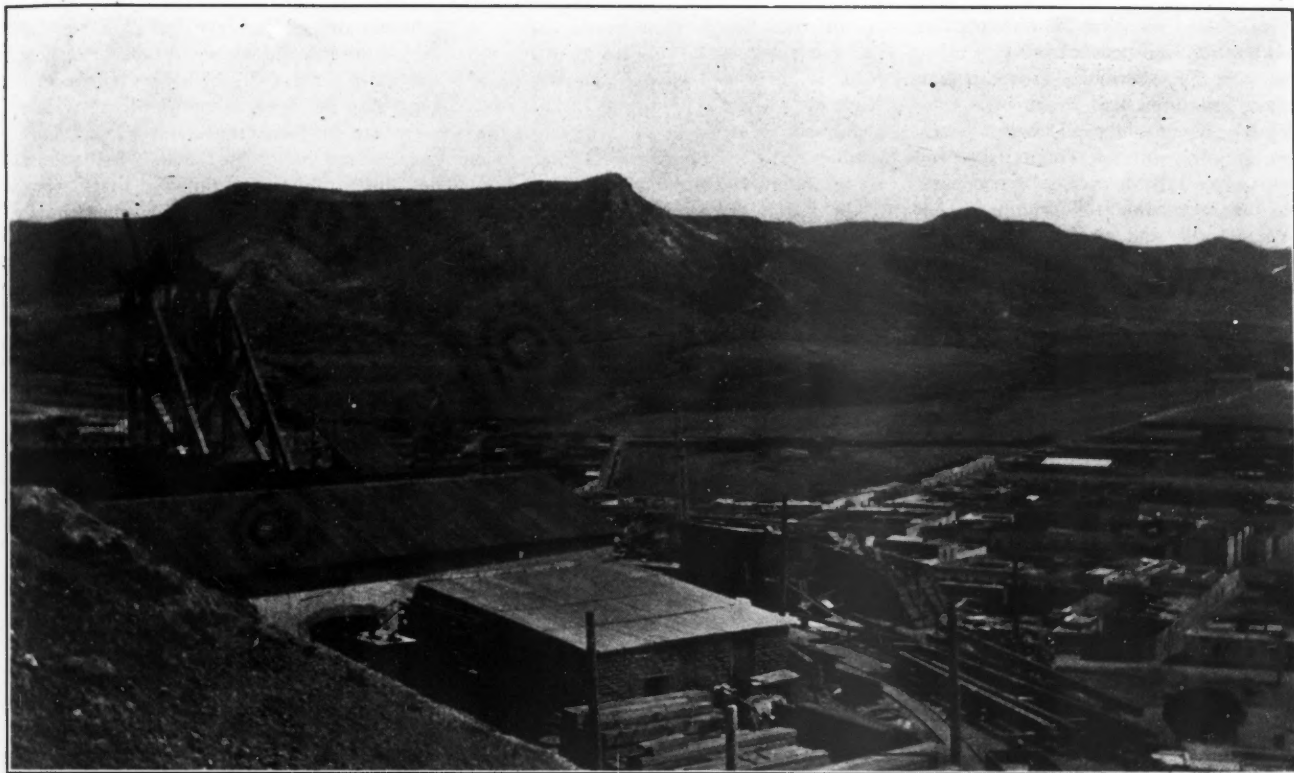
The low metal prices have been especially hard on Parral miners, as the mines were in that critical stage when the smelting ores were being rapidly diminished, and yet the milling of the ores on the spot had not been solved in practice. This, together with the fact that most of the

covered many years before there is any record of mining near Parral, but in time here also the Spaniards found ore, for the veins generally have strong outcrops. As at Santa Barbara, so also at Parral, the veins were first worked for gold, although the gold in most of the sulphide ore, as well as in the oxidized ore, amounted to only a few grams per ton.

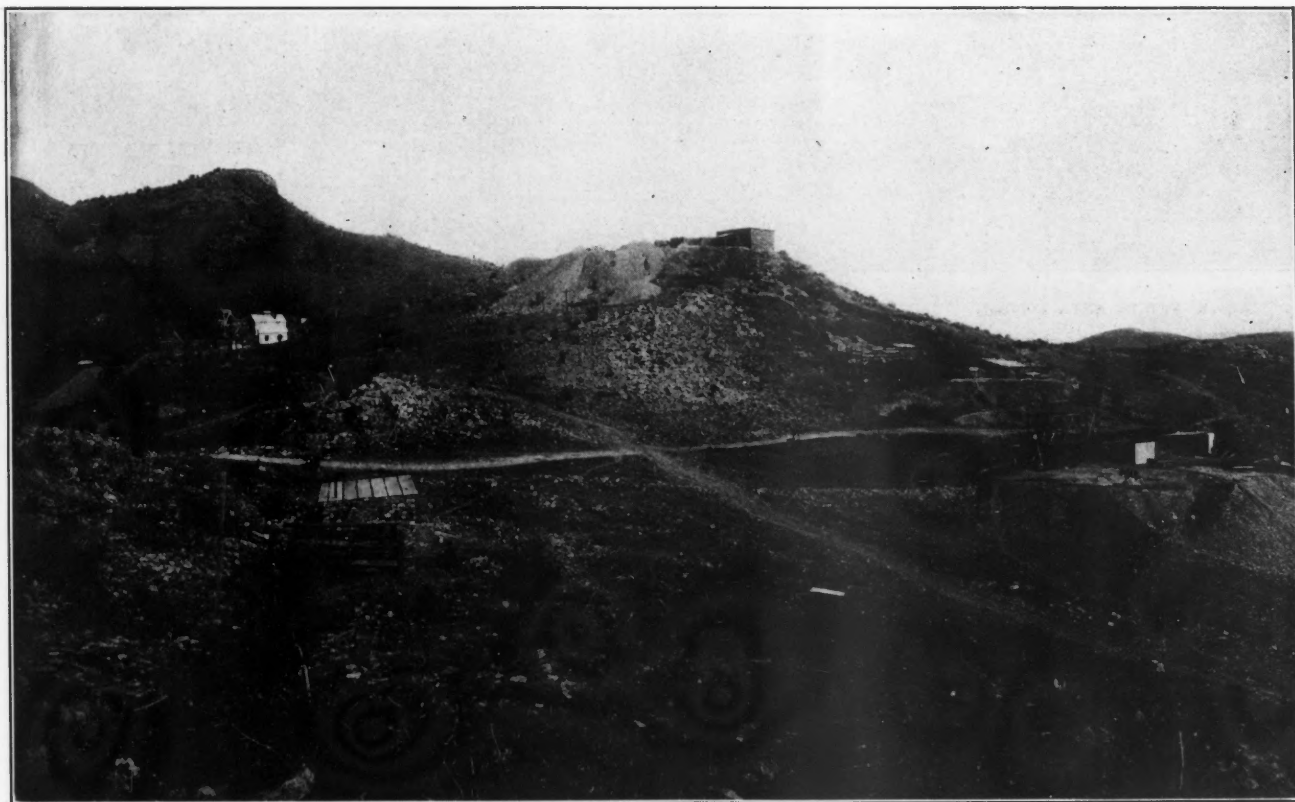
The date of the discovery of the ore is uncertain, but the town was founded about 1600, and the first records in the town hall bear the date of 1612. Probably the discovery of ore was the cause of the

discovered on the Veta Colorada by Diego Rodrigo, and subsequently that vein aided greatly in maintaining the output from Parral.

Before the completion of the railroad (about 1900) the ore was hauled to Jimenez and shipped thence to Mapimí, or El Paso for treatment, but this was expensive. Consequently, after English-speaking people began to obtain a foothold in the district, the milling of the ore was begun. The hyposulphite process was introduced about 1884 and since that time until within the last year consider-



PRIETA MINE, PARRAL



SAN CRISTOBAL, PORVENIR, AND CAYMAN MINES NEAR PARRAL

able ore has been milled in the district. Although on some favorable ores of the district an extraction of 85 per cent. has been made by the hyposulphite process, the extraction in most cases was below 75 per cent.; furthermore, as roasting is required, this process is expensive. Consequently, owing to the successful cyanidation of silver ores at Guanajuato and elsewhere, recently there has been considerable talk regarding the cyanidation of the Parral ores, and already one cyanide plant of 500-ton capacity is being erected to treat ore from the Veta Colorada mines.

In recent years there have been two notable ore discoveries in the district. About 12 years ago Angel Garcia, or rather leasers working on his property, discovered rich ore at the Refugio mine

of Pedro Alvarado, how he was a *peon* when he found the ore, and countless other stories equally false. Indeed the visitor from the United States, after all the wild and weird stories that he has read, is surprised when he meets Pedro Alvarado to see a quiet, small, dark-complexioned, bearded man, who little resembles the vain-glorious individual whom he had expected to meet.

The Palmilla mine had belonged to the Alvarado family for years and had long been worked by them. Pedro Alvarado never was a miner; he simply directed the work done by *gambucinos* on the property, and it was the *gambucinos* who discovered the real orebody. After that Pedro Alvarado worked the mine extensively on his own account by Mexican methods, long refusing to permit an

ported regarding him, for when asked by a friend about the story he replied that he did not now nor never had cared whether or not the debt was paid. Pedro Alvarado has shown many eccentricities, the most remarkable being his unconcern regarding the large amounts of ore which were stolen from the mine by his employees and his trusted men. Sometimes he discharged the thieves that were caught, other times he only warned them. His attitude seems to have been shown by a remark he is said to have made, during the time that the Palmilla mine was "in bonanza," when informed that certain men were stealing ore: "What does it matter, I have much silver, and the Palmilla mine will be furnishing much rich silver ore when I am gone."

But the Palmilla did not continue in



SOUTH END OF VETA COLORADA, REFUGIO LIXIVIATION PLANT IN FOREGROUND; ESCARPMENTS MARK COURSE OF VEIN

in a vein parallel to the Veta Colorada and only a few hundred feet west of it. Years before some shallow shafts had been sunk on the property, but no ore was found; it was this work that discouraged further prospecting and delayed the discovery of the large orebodies in that vein.

PEDRO ALVARADO AND THE PALMILLA MINE

About 1900, rich ore was discovered in the Palmilla mine, although the mine had been worked for years without striking any considerable bodies of good ore. This mine has produced several millions of dollars and has made famous its owner, Pedro Alvarado. Wild stories regarding Señor Alvarado have been circulated by men who desired to advertise the district and float nearby properties. All sorts of stories have been told regarding the life

American even to enter the property. The main fault of Pedro Alvarado has been that he was too credulous; consequently he made many queer purchases, including, among other things, a blast furnace to smelt an ore carrying little lead, no copper and over 60 per cent. silica; and a quantity of 6x14-in. steel I-beams, 32 ft. long, with which to roof over a wide stope in the mine. These I-beams were taken down to the 500-ft. level (quite an engineering feat), but were never put in place, although small drifts mark the site of the "hitches" where they were to have been put.

Much ore was produced from the Palmilla by Pedro Alvarado, and it was even said that he had asked to be allowed to pay the national debt of Mexico, but this is only another of the many untruths re-

ported regarding him, for when asked by a friend about the story he replied that he did not now nor never had cared whether or not the debt was paid. Pedro Alvarado has shown many eccentricities, the most remarkable being his unconcern regarding the large amounts of ore which were stolen from the mine by his employees and his trusted men. Sometimes he discharged the thieves that were caught, other times he only warned them. His attitude seems to have been shown by a remark he is said to have made, during the time that the Palmilla mine was "in bonanza," when informed that certain men were stealing ore: "What does it matter, I have much silver, and the Palmilla mine will be furnishing much rich silver ore when I am gone."

GEOLOGY OF THE DISTRICT

The Parral district is characterized by large areas of igneous extrusions which form the capping to the deeper-lying Cretaceous shales, laid bare by erosion in

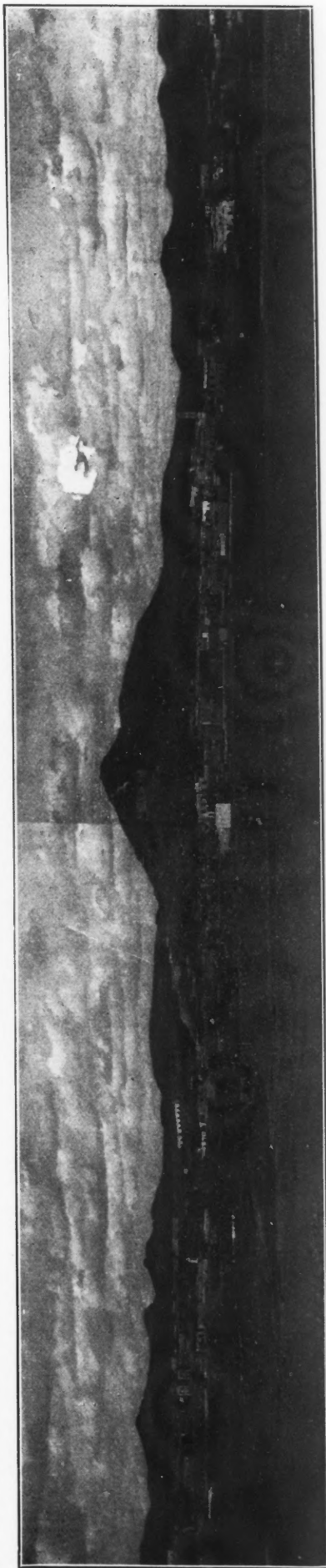
many parts of the district. Near the Veta Colorada, this eruptive rock, or porphyry as the miners call it, appears to be an andesite, but near the Palmilla the rock appears to be more rhyolitic in character. Through these igneous extrusions cut several prominent dikes, and along and near some of these the veins are formed. As yet, none of the prominent veins, either laterally or in depth, have passed out of the igneous rock into the sedimentaries which outcrop here and there throughout the district.

There are several vein systems in the district, each of which is characterized by a different variety of ore. Near Parral there are two veins, on one of which are the Prieta and the Tajo, and on the other the Aguilereña and the Jesus Maris, two *antiguas* which have not been worked for years. These ores are mixed argentiferous sulphides carrying pyrite, galena, and sphalerite, as well as small amounts of chalcopyrite, in a silicious gangue. In fact, near the permanent water level in the Tajo mine small bodies of oxidized copper ore are being worked. The following is a typical assay of the ore that is generally shipped from this part of the district: Zinc, 17 to 20 per cent.; lead, 12 to 17; iron, 8; silica, 30 to 35; and 30 to 40 oz. of silver per ton.

Near Minas Nuevas, about seven miles northwest of Parral, is the Veta Colorada vein and to the west of it about 600 ft. is the approximately parallel vein on which is situated the Refugio mine. By some this vein is thought to pass into the Veta Colorada, but underground, it is said by the former manager of the property, there is no indication of such a joining (or crossing) of the Veta Colorada and the Refugio vein.

THE VETA COLORADA

The Veta Colorada is one of the famous veins of Mexico, for much ore has been mined from this vein, which has been productive along a distance of $2\frac{1}{2}$ miles; but as the fault scarp which marks the vein is quite strong and can be traced for a considerable distance on each side of the ore-producing area, frequently the statement is made that the vein is ten miles long. This vein is simply a fault or shear zone in the country rock along which the ore has been formed, partly by deposition in open spaces along the fault, but mainly by silicification and impregnation of the country rock. This impregnation occurs generally on the hanging-wall side, but sometimes the ore also is found extending into the country rock on the foot-wall side. Consequently the vein is characterized by a well marked foot-wall and has generally only a commercial boundary for a hanging wall. Throughout the vein many false walls are found on the other side of which the good ore extends. These false walls are often so smooth and well defined that the former miners did not prospect to the other side



PANORAMIC VIEW OF PARRAL, MEXICO; TAJO AND PRIETA MINES ON HILL IN CENTER

of them; consequently, much ore has been left in the old stopes of the upper part of the vein. Indeed, almost invariably when the main fault plane was a false footwall, the old miners failed to find the ore. It is from these bodies of good ore and the richer filling that the mines working on the Veta Colorada are at present producing.

The ore from the Veta Colorada is highly silicious and is characterized by a high percentage of calcium fluoride; in fact, much of the ore is silicified country rock. In the upper part of the vein the ore contains much iron oxide, and it is from this fact that the vein takes its name, the "Red vein." Peculiarly, the ore does not carry much iron below water level, indicating that the iron oxide is probably the result of the accumulation from the erosion of vein matter, or possibly has been transported thither by circulating surface water.

In the past the ore milled and shipped from the Veta Colorada has averaged, per metric ton, about 850 grams silver, 0.2 grams gold, $\frac{1}{2}$ per cent. lead, 8 to 10 per cent. iron (above water level), 12 to 15 per cent. calcium fluoride (locally designated as "unavailable lime" and calculated in assays as CaO, instead of CaF₂, as it really occurs), and 60 per cent. silica, the silver in the ore being present above water level as chloride, bromide, or iodide and below mainly as argentite.

The vein strikes N. 15 deg. E. and dips in the upper levels about 50 deg. to the southeast, but flattens somewhat in depth. The vein is often said to be 100 ft. in width, but as the hanging wall is merely a commercial boundary, the width of the vein depends on the speaker's conception of what is ore. As yet the vein has rarely been mined over a greater width than 40 ft., and most of the stopes are nearer 10 ft. in width. This represents the width of the ore available at present, but the successful adaptation of the cyanide process to the treatment of this ore will extend the width of the commercial ore somewhat.

PALMILLA-SAN JUANICO VEIN SYSTEM

The other belt of mineralization in the Parral district is that extending north and south through the vicinity of the Palmilla mine. In this belt are the San Juanico, Palmilla, San Cristóbal, Porvenir, Cayman, and other properties. Near this belt there occurs a large north and south dike which is very noticeable on the north side of Palmilla hill. This belt is the scene of much of the recent development in the district which has been encouraged by the history of the Palmilla mine. The ores of this belt are quite silicious as are the other ores in the Parral district, but they are notable as carrying gold along with the silver. Generally this gold amounts to only 5 or 6 grams per ton, but some of the ore from the Palmilla and especially from the San Juanico mine has

carried several ounces of gold per ton. For several years the Palmilla mine shipped a high-grade ore averaging 2500 grams silver and 25 to 30 grams gold per ton, but much of the ore shipped was of lower grade, carrying 1500 grams silver and 5 to 8 grams of gold per ton. All the ore in this belt is silicious, carrying over 50 per cent. silica, considerable fluor-spar, very little lead, and a trace of copper, the silver being present mainly as a chloride or a sulphide.

THE PALMILLA MINE

This mine is at present the most famous in the district. The ore occurs in a fairly vertical chimney, several hundred feet long and one to two hundred feet wide, forming the core of Palmilla hill, which rises 400 ft. above the gulches at its base. The walls of the chimney are commercial, for much of the ore is simply silicified country rock. Small veins join this chimney both from the west, south and southwest, but are cut off on the north side by a dike. The ore is mostly of milling grade but in it occur narrow shoots of rich ore. As has been said, several small veins have been traced out of the Palmilla, but in none of these has rich ore been found to extend beyond the Palmilla claim, although considerable money has been spent in prospecting the vicinity.

One of the best signs of the greatness of the Palmilla mine is the peculiar methods of working that it has been able to survive; for instance, Pedro Alvarado sunk nine shafts from the top of the hill, all of which extend to the 300-ft. level and several to the deepest, the 600-ft. level. The vein makes about 800 gal. of water per minute; at present the American company is keeping the water down with the old electric pumps, but new electric pumps are to be installed so as to attain greater depth. Apparently most of the shipping ore in the upper workings has already been mined, for, during the time that Alvarado was trying to lower the water in the mine so as to get deeper on the vein, he sought diligently for shipping ore; but there remains much milling ore above the present water level. The mine is equipped with a tramway $4\frac{1}{2}$ to 5 km. long, this being the only tramway in the district.

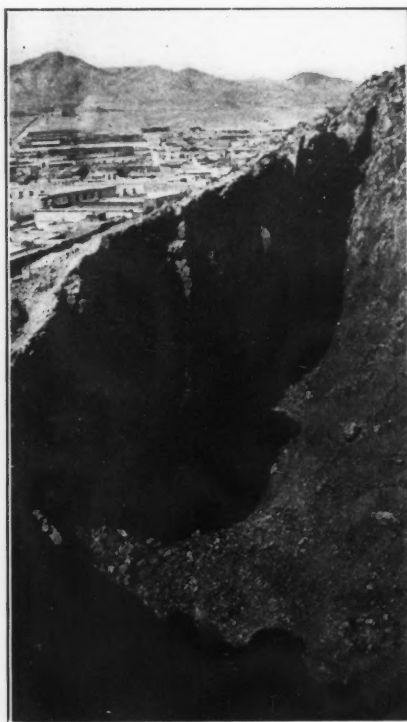
MINES AT PRESENT WORKING

As has been said the slump in metal prices, especially of silver, has been hard on the Parral mining companies, consequently few mines are working. The Palmilla mine is shipping considerable ore; the Tajo mine near Parral is at present shipping mainly copper ore; the Veta Grande, the Verde and Los Muertos mines on the Veta Colorado are mining old filling and ore overlooked in the old stopes, all this coming from above water level; the Porvenir is doing some development work and the Prieta mine is being

unwatered, 500-gal. electric sinking pumps being used. The other properties are shut down.

The most important work in the district is the building of the Veta Colorado cyanide mill, designed by Robert Allen, of Kalgoorlie, Australia, in which complete sliming in Wheeler pans and tube mills, air agitation in Brown vats and filtering on Ridgway filters will be used.¹

The future of the district depends on the successful milling of the ores on the spot. Formerly the companies, on account of the high freight and smelter charges, tried hyposulphite lixiviation, but this also was expensive and many of them returned to smelting when the smelters began to encourage the mining of silicious ores by reducing the charges on that class of ore.



OLD OPEN CUT AT TAJO MINE FROM WHICH THE MINE GETS ITS NAME

Recently the district has been greatly encouraged by the success attending the cyanidation of silver ores in other parts of Mexico, so that all the companies are anxiously awaiting the completion of the Veta Colorado mill. The company holding the Palmilla lease is also talking of building a cyanide mill for the treatment of its ores; in order to profitably mine much of the ore on the upper levels, such a mill will be necessary.

The quantity of water found at depth in the Parral mines is ample for all milling purposes. Although it has caused considerable trouble in some cases, the flow of water is not excessive and can easily be handled provided that suitable pumps of ample capacity are installed. On

¹Described in THE ENGINEERING AND MINING JOURNAL, July 18, 1908.

the Veta Colorado vein, where the water trouble is most serious, the main trouble has been due to the fact that, although all the mines drain into one another, no mutual agreement can be made between the companies regarding pumping.

At present the mines of the district obtain wood and timber at fair prices from large tracts of timber land to the west along the Parral and Durango railroad, while a local electric-power company furnishes fuel-generated electricity.

While the chief causes of the quiescence at Parral are low-metal prices and absence of means for cheaply milling the low-grade ore developed while mining the shipping ore, there is another factor which will tend to extend the period of quiet beyond its normal length. This is the fact that in the past many of the mines have been sold at highly exorbitant prices, and consequently, even when good men have been in charge of the properties, the shareholders have received poor returns for the money invested. Unfortunately in many cases men, but little experienced in mining, have been sent down to take charge of the mines and in such cases still smaller returns were received. Besides, several wild-cat companies have been promoted to work mines at Parral. Even when the companies, which have been fooled, own good mines, they are reluctant to advance more money to experiment on the treatment of the ore, but prefer that others should do the experimenting; thus, there is little prospect of much mill building at Parral in the immediate future.

CONCLUSIONS

The district has produced much silver in the past, and it will continue to do so in the future, but this production will come mostly from low-grade ore treated locally in cyanide mills and not from ore shipped to the smelters. Therefore, it is to be hoped that the Veta Colorado company will emerge from its difficulties, and that the cyanide plant, which it is building, will soon be in successful operation, for there is no one thing that will have so great an effect upon the future of the Parral district as the successful cyanidation of the low-grade silver ore from the Veta Colorado.

Experiments have been made to reduce the wear on the lining of a cupola above the melting zone by introducing several rows of hollow cast-iron blocks. These blocks resist erosion better than firebrick, and easily withstand the temperature around the charging doors.

According to a writer on copper and brass, in selecting coal for muffles it is advisable to have present as little sulphur as possible; but for furnaces where the products of combustion come in contact with the molten metal, the necessity for sulphur-free coal is increased.

Short Talks on Mining Law—VII

By A. H. RICKETTS*

It has been said by the courts that miners used the terms "vein, lode and ledge" found in the United States mining act before geologists attempted to give them a definition, and that a "vein, lode or ledge" within the meaning of those terms, as used in the act, is that which is so called by miners. Among practical miners, generally narrow veins are designated simply as "veins," while veins of great thickness are called "lodes," and when a lode contains more than one vein or is of great width it is popularly called a "broad lode," but the existence of veins within a lode formation does not necessarily make it a broad lode in the eyes of the courts. The courts generally seem to make no distinction between the terms "vein" or "lode," but in several cases it has been held that the definition of a lode or vein must always have special reference to the formation and particular characteristics of the particular district in which the lode or vein is found.

The question of what constitutes a vein or lode within the intent of different sections of the mining act is said to arise (1) between miners who have located claims on the same vein or lode, (2) between placer and lode claimants, (3) between mineral claimants and townsite patentees, (4) between mineral and agricultural claimants, and what is said in one character of cases may or may not be applicable in the other. Loosely speaking, a vein or lode is any seam or fissure in the earth's crust filled with any valuable mineral deposit in place, but it does not follow, as shown in a previous article, that mineral in vein or lode formation is necessarily subject to lode location under the mining act.

ELEMENTS OF VEINS AND LODS

The essential elements of a vein or lode are mineral or mineral-bearing rock and boundaries. A vein need not be of uniform dip, thickness or richness, nor have well defined walls. It may be very thin and it may be many feet thick, or thin in places—almost "pinched out" in miners' phrase—in some places, leaving only a narrow seam of clay to lead the way for the miner to follow his vein until the country rock disappears, and in some places widening out into extensive ore-bodies. An intrusion of the country rock into a lode or vein is called a "horse." The vein may vary in direction, width and dip. It may split into branches both in length and in depth which may or may not again unite. It should be continuous only in the sense that it may be traced through the surrounding rocks and not consist of detached pieces or bunches

of quartz. It must be "in place," that is, inclosed by the fixed and immovable rock forming the general mass of the mountain. If the rock above the vein is in its original position, although somewhat broken and shattered by the movement of the country, or other cause, it is "in place." A fissure in the earth's crust, an opening in its rocks and strata made by some force of nature, in which the mineral is deposited would seem to be essential to a lode in the judgment of geologists. But it has been judicially said that to the practical miner the fissure and its walls are only of importance as indicating the boundaries within which he may look for and reasonably expect to find the ore he seeks. So that a lode within the meaning of the mining act is whatever the miner could follow and find ore.

It is said that the best judicial definition of a lode is "a zone or belt of mineralized rock lying within boundaries clearly separating it from the neighboring rock. It includes all deposits of mineral matter found through a mineralized zone or belt, coming from the same sources, impressed with the same forms and appearing to have been created by the same processes."

So a tilted bed of limestone, broken up, crushed, disintegrated and fissured in all directions so as to destroy to a great extent all traces of stratification and containing mineral sufficiently diffused to justify giving the limestone the general designation of mineralized matter, metal-bearing rock and bounded on one side by a wall of quartzite and on the other side by a belt of clay or shale, was held to be a broad lode or zone. So "yellow porphyry" containing numerous seams, crevices, fissures and deposits where the quartz rock and decomposed earth and rock with mineral sufficiently diffused to give such porphyry the general designation of mineralized matter within a foot-wall and hangingwall of "purple porphyry" was declared to be a broad lode or zone. In another case it was held that strata lying along the plane of contact between blue and brown limestone, if mineralized to the extent of showing valuable minerals and distinguishable from other parts of the country rock by carrying ore and by association with the plane of contact, constituted a mineralized zone.

A broad lode or zone may contain more than one vein. But if there are within the limits of such lode or zone true fissure veins plainly bounded it cannot be deemed a single vein or lode although such zone may have boundaries of its own which may be traced. For example, it has been held that "where mineral deposits are separated into three well defined parts traceable for a great distance in their length and depth and having distinct foot-and hanging-walls, each part is a separate vein within the meaning of the mining laws giving the right to follow the dip of

a vein beyond the side lines, although there are many ore-bearing cracks and seams running out from each vein and sometimes extending over to the other."

The ownership of the apex of a broad lode confers the right to all minerals within its walls, although one of the walls is within the surface boundaries of adjoining territory claimed adversely, provided the formation is such as to present a unity of the whole mass.

The end lines determine the right to the vein or lode upon its strike and the vein or lode may be pursued underneath the surface beyond either side line and between the end lines upon its dip. The practical idea of the miner when he speaks of following the dip, is when he works downward, leaving the apex farther from and above him at each advance. A location made wholly upon the dip is illegal.

The apex is the top or summit of the vein or lode. It may be a point or a line of great length and may be on or at any distance below the surface. It has been held that unless there is some edge or end as a beginning point in a vein or lode from which it can be followed down at some angle below the horizon, there is no apex from which the vein or lode can be followed beyond the side lines. An outcropping is not necessarily the apex of a vein or lode, nor is a swell in the mineral matter a true apex. The existence of the apex is a question of fact, but what constitutes the apex is a question of law. It is possible that there be an actual and also a legal apex of the same vein or lode.

RIGHTS OF OWNERS

The owner of the apex may invade other territory in the pursuit of the vein or have his own territory invaded, whether the claim is patented or unpatented, and the relative dates of the location or patent are immaterial, except when the dip carries the vein or lode into land previously patented as agricultural land. In the latter case the vein or lode cannot be followed therein. In no event has the owner of the apex the right for any purpose to invade the surface, nor to subterraneously explore ground adversely held to determine the continuance of his vein or lode therein. The vein or lode must be followed from his own claim and even then he is regarded as a trespasser until he proves his right of entry.

Veins or lodes may intersect upon their strike or dip, or below the point of union become one vein or lode, in which case the prior location takes the vein or lode below the point of union, including all the space of intersection. Where two or more veins or lodes cross each other, priority of title governs and the senior location is entitled to all ore or mineral contained within the space of intersection, but the junior location has the right of way through the space of intersection for the convenient working of the mine. Where

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two or more veins unite the prior location takes the vein below the point of union including the space of intersection. The courts are not in accord as to what is precisely meant as to the extent of such right of way, that is, whether it is limited to the space of intersection of the veins or lode, or extends to the space of intersection of the claims. The current of authority is in favor of the more limited view of the law.

The right to follow the dip does not attach to a vein or lode within a placer claim held or patented merely as such. The right to follow the dip of a vein or lode within a mining claim carved out of "agricultural" lands held in private ownership, will depend upon the terms of the grant of the claim by the owner of such lands, as there is no "location." The fact that land patented as "agricultural" is subsequently discovered to be valuable for its minerals does not affect the title of the patentee thereto. No adverse entry can be made upon such land for the purpose of prospecting, working or locating the same.

Alaska Mexican Gold Mining Company

The report of the Alaska-Mexican Gold Mining Company for the year ending Dec. 31, 1907 enters into the operation of the mine and of the mill and the costs connected with these operations, in the most minute detail. The following is necessarily greatly condensed:

FINANCIAL STATEMENT.

	Total.	Per Ton Milled.
Receipts:		
From bullion.....	\$347,212	\$1.6205
From base bars.....	4,601	0.0215
From sulphurets.....	296,165	1.3822
From interest.....	2,086	0.0097
Total.....	\$650,063	\$3.0330
Disbursements:		
Mining and development.....	\$254,829	\$1.1893
Milling.....	56,808	0.2651
Sulphuret expense.....	25,823	0.1206
General expense.....	7,269	0.0339
Construction and repair.....	1,317	0.0061
All other expenses.....	15,106	0.0705
Total.....	\$361,152	\$1.6855
Net operating, profit.....	\$288,911	\$1.3484

THE MINE

During the year the development fell short of that done in previous years. The development in 1906 is here shown in parenthesis: Drifts and crosscuts, 1487 ft. (4857 ft.); raises, 493 (1760); stations and skip chutes, 101 (441); shaft sinking, 21 (182); totals, 2102 (7240). The total development in 1905 was 8006 ft.

The total amount of ore mined and sent to the mill in 1907 was 156,987 short tons of which 84.36 per cent. came from the 660-, 770- and 880-ft. levels; a small amount of stoping was also done at the 550- and 990-ft. levels.

It is estimated that the ore reserves above the 1100-ft. level amount to 794,924 tons including ore in pillars. There were 158,568 ft. of holes drilled during the year by which were broken 157,263 tons of ore

and waste making an average of 0.99 tons broken for every foot drilled.

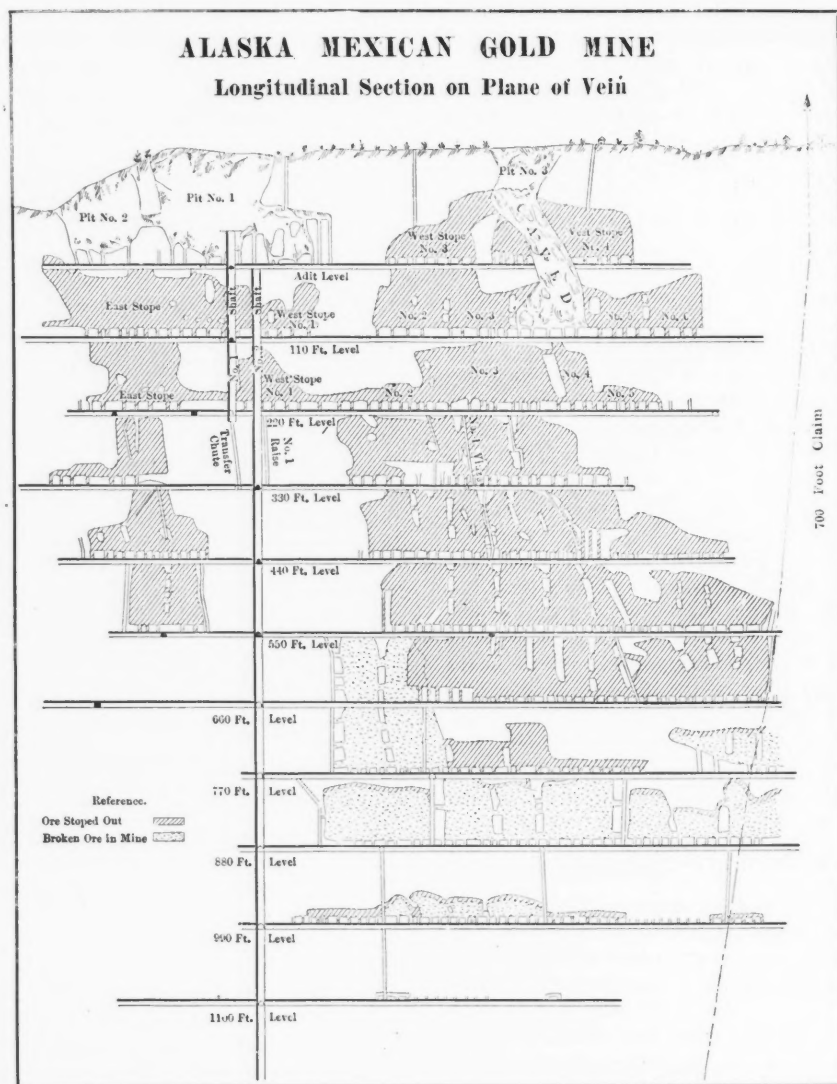
The average assay of 1024 samples show that the ore is gaining in value with depth: From the 550-ft. level, 5 samples showed \$1.94 per ton; from 660-ft. level, 215 samples showed \$2.45; 770-ft. level, 260 samples, \$2.79; 880-ft. level, 194 samples, \$2.85; 990-ft. level, 268 samples, \$3.52; 1100-ft. level, 82 samples, \$4.22; average, 1024 samples, \$2.80 per ton.

THE MILL

The 120 stamps in the mill crushed

oz. The amount of mercury fed per ton of ore crushed was: 0.2633 oz. to the batteries; 0.0102 oz. to the plates; 0.0106 for cleaning amalgam; total 0.2841 oz. per ton of ore crushed. The consumption of quicksilver by the batteries was lowest in the month ended May 15 (0.1771 oz.) and highest in the month ended Dec. 15 (0.3125 oz.). On the plates the lowest consumption was in the month ended Aug. 15 (0.0051 oz.) and the highest in the month ended Feb. 15 (0.0323 oz.).

The average gross value per ton of ore crushed was \$3.0913 and the value of the



DEVELOPMENT OF THE ALASKA, MEXICAN MINE.

214,263 tons of ore at a cost of \$0.2651 per ton milled. The ore yielded \$351,813 in free gold, including copper and base bars, and \$296,165 from sulphurets treated. The total yield was, therefore, \$647,978 or \$3.0242 per ton. The mill ran 172½ days on steam power and 134½ days on water power, the lost time being 54 days. The average duty per stamp was 5.81 tons per 24 hours. The consumption of quicksilver was 60,874 oz., of which the batteries used 56,419 oz.; the plates, 2182 oz.; and miscellaneous places, 2273

tailings was \$0.1941. The extraction, therefore, was 93.72 per cent.

In 1907 the average number of men employed per day was 143 and the average wage paid each was \$3.26 per day.

It is stated by a writer on copper and brass that it is usually safest to use the purest copper for all brass alloys for rolling and drawing into tubes. Arsenic must not be present in a greater amount than 0.05 per cent., antimony, 0.01 per cent., or bismuth more than 0.005 per cent.

The Flushing System at the Gute Hoffnung Mine, Germany

By LUCIUS W. MAYER*

The Gute Hoffnung mine, one of the Mechernich Lead Company's properties, is situated in a town called Beschier, near Mechernich, Germany. The ore is found in flat seams averaging about 6 m. in thickness, and inclined about 5 deg. from the horizontal; the roof is in many places a soft clay formation. Chiefly for this reason a flushing system has been introduced, tailings from the mill being brought into the mines to replace the pillars.

In general, the method of mining employed is to run 2x2-m. drifts in the bottom of the seam, and extending these drifts so as to block out the ground to the limits of the orebody. From these laterals, cross-drifts are driven and pillars 10x10 m. square blocked out. Having blocked out a sufficient area the next operation is to bring down the roofs over the drifts to the height of the seam. This operation is carried on in the drifts around the pillars, so that before robbing is begun, the pillar has been blocked out to the full thickness of the seam. The pillars are then attacked, leaving shells standing temporarily. Dams of timber are arranged in the usual way in the adjoining drift openings, and securely wedged in walls, roof and floor of the opening. Very often, it is necessary to leave a shell of ore 3 or 4 ft. thick for a roof under the clay. In the work of robbing the pillar, very little timber is used, the pillar being undercut, and everything above brought down as the work advances. A pillar area having been prepared to receive its filling of tailings, a pipe line is introduced into the room. As the sand and water are flushed into the workings a sort of silt lake is formed, the sand gradually settling to the bottom. In the center of the area to be filled is placed a vertical piece of tin pipe perforated with small holes. The water passing through these holes into the pipe flows through a horizontal connecting pipe to the drifts and the pumping station. As the material enters this pond, a man provided with a hoe gradually builds up a surrounding wall or dam which holds the water in place until it drains off. As the filling material accumulates in height, the center pipe is lengthened by means of additional sections.

More or less difficulty has been caused by clogging of the pipe systems, due to the presence of more or less heavy mineral in the tailings. This material accumulates in the pipes, and is difficult to dislodge. By placing cocks at intervals in the pipe line it has been found possible to locate the blockade more readily. A

similar difficulty in France was overcome by reducing the discharge of the pipe.

The pipe through which the sand passes into the mine is connected with a hopper in the concentrating mill. Tailings are dumped into the hopper soon after they leave the tables in the mill. In the hopper sprays of water, discharging about 50 gal. per minute, flush the material away; where the hopper meets the pipe line, a further supply of water, amounting to about 40 gal. per minute, is introduced.

The specific gravity of the material flushed is said to be about 2.8, and the average amount of water used 4000 liters per cu.m. of sand, barely one and one-half times as much water as sand. The figure given for cost per cu.m. of sand filled in is 0.43 marks, or 10.7c., or 3c. less than the cost of dry back filling by hand, as formerly practiced. Using 2.8 as the specific gravity of this material, the cost per ton flushed is 5.01 cents.

The Huelva Pyrite Deposits, Spain *

By BRUNO WETZIG

The masses of pyrite in the Huelva district occur on a plateau, rising to an elevation of about 1300 ft. above sea level, and consisting chiefly of shales and apparently stratified eruptive diabasic rocks, with occasionally a little greywacke and limestone. This plateau is a plain of erosion, for the rocks, which have an east and west strike, and northward dip, are folded and disturbed considerably. Into this mass certain eruptives rich in quartz have been intruded that affect the orebody.

The great masses of ore in the Rio Tinto and Tharsis mines, which are hundreds of feet thick, lead the casual observer to believe that the character and structure of the deposits are uniform, but closer study reveals the existence of separate beds of ore alternating with wedges, or lenticles of barren shale, called *cuña de esteril*. The orebodies, which are purely of sedimentary origin and of pre-Tertiary age, coincide in strike and dip with the shales, and are folded and disturbed in the same manner. Some of the orebodies are characterized by a higher percentage of lead and zinc, others by a high percentage of copper, while in still others, the ore is compact and rich in sulphur, carrying little copper. Occasionally the pyrite is so minutely interbanded with fine laminae of shale that it assumes the appearance of shale, but the weight of this "shale" indicates to the miner the presence of pyrite.

The orebodies worked in the Carpio, Cruzadillo, Poytos and Lomero mines outcrop for a distance of more than 3 miles.

*Abstract from paper in *Zeits. für Prak. Geologie*, Vol. XIV; pp. 173-186. See also, *Trans. A. I. M. E.*, Vol. XXXIII; pp. 704-707.

The outcrop matter, or gossan, which is formed chiefly from the decomposition of pyrite, is an index of the character of the underlying ore, for wherever the gossan is a compact red hematite, the underlying pyrite is compact and poor in copper, but where the gossan is yellow and porous, pyrite rich in copper is generally found at greater depth.

Associated with the gossan, and closely resembling it, is a peculiar deposit, locally called *toba*. This *toba* was formed by the deposition, around pebbles of quartz and shale, of iron oxides formed by the oxidation of iron sulphate, leached from overlying masses of pyrite. In this way a conglomerate with a ferruginous cement was formed, while the gossan appears to be a breccia of iron oxides cemented by infiltrated silica. At the Rio Tinto mines the *toba* forms a large plateau called the Mesa de los Pinos, in which remains of Tertiary plants are found. In the Caridad mine it stands up as isolated veins among Eocene limestones.

Manganese deposits occur in the same formations as the pyrite, and like them, are interbedded with the shales. The manganese ore, however, rarely continues to a greater depth than 70 ft., and only at one mine, the Santa Catalina, have the manganese oxides been worked to a depth of 330 ft. Below the zone of oxidation the manganese occurs as silicates and carbonates in beds and lenticles quite similar in character to the pyrite deposits. These carbonates and silicates of manganese are, undoubtedly, primary deposits of sedimentary origin.

Red Cross Dynamite

The E. I. du Pont de Nemours Powder Company is marketing a new explosive called Red Cross dynamite, in which the ingredients are so chosen that the freezing point of the nitroglycerin is lowered to 35 deg. F. When the temperature drops below this point, the dynamite freezes very slowly. On the other hand, when frozen it can be thawed easily and quickly. In most sections of the United States this new dynamite will be frozen only at times when the temperature is unusually low. At such times it can be thawed with only a fraction of the trouble and expense necessary when ordinary dynamites are used. Red Cross dynamite is made in strengths from 25 to 60 per cent., according to both the straight and ammonia dynamite formulas, to suit the requirements of the consumer.

The London *Mining Journal* (May 16, 1908) states that two dredges will be installed at the platinum mines belonging to the Nijne-Taghilski works on the Martian river, Russia. A third dredge will work on Visimo-Shaitan pond and a fourth will work the auriferous sands of the Taghil river.

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Losses of Coal in Mining a Flat Seam

Economy of Operation Cannot Be Obtained Where There Are Losses of Rail, Poor Ventilation and Indifferent Haulage. Air vs. Electricity

A U D L E Y H. S T O W *

Pillar work is not by any means the only class of mining that admits of closer analysis; the arrangement and placing of partings, the grades on the various hauls, the question of interest charges on track, and whether or not the old track is kept in repair and new track properly laid, are points to be carefully considered. It is also well to observe whether mine cars are kept in repair, the number of wrecks and cause of same, the system of timbering, and whether the system of drainage, pumping, ditching and baling will stand close scrutiny.

Considerable progress is being made in the analysis of the cost sheets, although often without as close a correlation as there should be between the apparent costs, and the conditions existing underground. The statement that track has cost less this month than the month before, means little unless it is known that it is as well laid; that haulage costs are less also means little unless the conditions are known; the actual performance of the drivers may have been poor, but the hauls less scattered and shorter. While supplies may have cost less, reserve stock on hand may have been recklessly used up. The cost of timbering may appear less at the time that whole panels or rooms are filling up with slate for the lack of a little timely timbering; the total costs per ton may be less while thousands of dollars worth of coal may have been left in the gob in order to save a fraction of a cent per ton on only a part of the output, and so on through the list. The most thorough comprehensive analysis of costs may be misleading, unless the general conditions in the mines are known and the relation established; not that it is thought practicable to express conditions of track, for instance, in arbitrary degrees of excellence or deterioration. Any apparent reduction in the cost of track should call for the closest scrutiny in the mines by someone independent of the mine organization, in order to determine whether the apparent reduction was at the cost of general efficiency or maintenance. If the inspections merely result in controlling the grade of execution of the underground work, they are not useless additions to cost; made in a fair spirit by competent men, they should save their cost many times over in the run of a year.

It is thought that the mine foremen's best interests are identical with those of the company; if the mine foreman is getting a high recovery of pillar coal at a

slight increase in cost, which increase may be only a small fraction of the worth of the coal, if he is holding straight break lines when considerable temporary spurts in output might be made at the cost of lost coal later, if his track, bratticing, etc., is well kept up, necessarily at a slight increase in cost to what it might be, fair inspections should be only too welcome; that they are not desired, may be usually considered as good evidence that they are needed. No matter how good the mine foreman's intentions may be, as long as he knows he is valued in the market solely by the bookkeeper's annual report of the cost of coal per ton, just so long may he be expected to keep down apparent costs, no matter what are the real expenses.

While there are all possible variations in the management of mines, in high coal as well as in medium and low coal, still in a general way, inspection may be said to be needed in low coal more than in a high seam, for low-coal mining is the more difficult proposition.

ONE FORM OF EXTRAVAGANCE

One of the most common and expensive forms of extravagance in mine management, is the reckless waste and loss of rail. Much might be done in the way of impressing the mine foreman's assistants with the value of rail in dollars and cents, not per ton, which for some reason or other seems to make little impression, but per single rail; at \$36 per ton delivered, a single 16-lb. rail 30 ft. long will cost at the freight depot \$2.87, or, say, \$3.25 to \$3.50 at the working face; 25-lb. rail at \$34 will cost from, say, \$4.50 to \$4.75 per single rail. In reporting six 16-lb. rail left in a certain air course, the rail should be described as \$21 worth of rail; in some instances at least, six rail has seemed to make less impression than six spikes—the spikes could be picked up, while a driver would have to be sent after the rail.

The fan may be of a modern type, with large capacity for the requirements; the State mine inspectors may report the ventilation as good, and there may be no complaint on this score from the men. Inspection by the operator would seem useless. If the fan has a capacity of 200,000 cu.ft. of air per min., quite possibly 100,000 cu.ft. will be ample for present needs, although the excess should be utilized in assisting to clear the mines of dust. It is not that the loss is a serious one at present, but that in, say, five years, with another mile of leaky brattices added to the circuit, the situation may be serious,

in spite of the ample ventilation capacity. The capacity of the fan should be the standard of comparison, instead of the minimum requirements of the men, in order to prevent accumulated back costs in the way of brattice repairs. Where practicable, the double air course is advisable, as it almost eliminates the brattice as well as the resulting leakage.

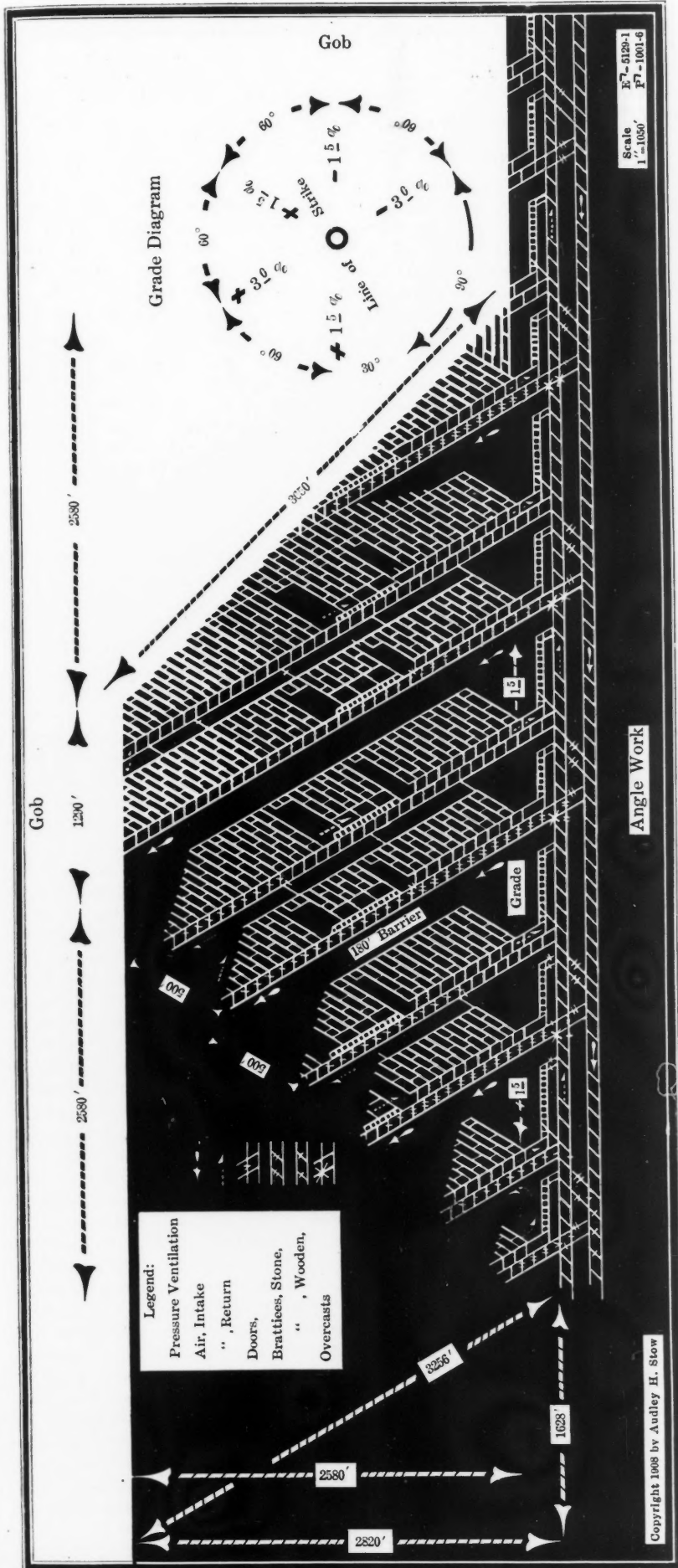
Doubling the ventilating cross-section reduces the friction and loss of pressure materially; doubling the air course leaves the main entry and what would otherwise be its air course, as double intakes—in the case of exhaust fans—reducing the friction on this part of the circuit as well, but more particularly in the case of moving trips.

VENTILATION

Interesting as is the subject of ventilation, only a few points can be considered at present.

Driving every other room only, as in panel 12-4, Fig. 4, shown on page 894 of THE ENGINEERING AND MINING JOURNAL for May 2, 1908, will doubtless be seriously criticized by many on the score of ventilation, and thought impracticable for that reason; while it is not contended that every other room only can be readily driven under all conditions, yet it is a fact that instances have been seen in high non-gaseous seams, where work was driven in this way, and the air in the faces of the rooms was quite as good, if not better than in low coal with every room driven. The question of driving every other room only, in high coal, is much the same as whether it is necessary to drive breakthroughs as close together in high coal as in low coal; judging solely from practical experience, without any consideration of theoretical reasons, it seems only too clear where there is no gas that breakthroughs can be driven further apart in high coal than in low coal, other conditions being the same. Again, in a heading with 5000 cu.ft. of air passing through the last crosscut or breakthrough per minute, if say 80 ft. is a suitable distance between breakthroughs, a somewhat greater distance should be allowable with 50,000 cu.ft. of air passing. Were there no objections to breakthroughs, this point would not be worth the space it has already taken; it is hardly possible, however, to get as good a recovery from pillars where the work is badly cut up with breakthroughs. Useless waste of coal is now becoming a matter of national concern; the manager or superintendent should not be forced to

*Consulting mining engineer. Maybeury, West Virginia.



METHOD OF DEVELOPING A FLAT COAL SEAM BY DRIVING THE ENTRIES AT AN ANGLE

cut up work further than actually necessary in any given case; not that healthful conditions should be sacrificed to the recovery of coal, any more than the recovery of coal should be handicapped unnecessarily.

In gaseous workings, the life of every man working in that section may be said to be dependent upon the integrity of the entry brattices, although doors, overcasts, etc., are necessary. The closer the breakthroughs are driven, the larger is the number and the greater the danger to every man working in the mines. It may be claimed that no large number of explosions can be traced to this cause; it is true, however, that brattices absolutely without leakage are rather scarce. The smaller the number of brattices the less should be the leakage, and in instances where the ventilation is barely up to the requirements, even the loss of a small amount of air may be of importance; the larger the number of brattices, the greater the chance of some brattice being wrecked by a fall of slate, at a critical time.

Theoretically, there is ample grounds for making the spacing of breakthroughs bear some relation to the thickness of seam and quantity of air passing, although material quantities of gas, when it occurs, will necessarily keep the spacing within close limits. If these points are considered, it would seem that it should be a matter of State regulation to see that room-work is not unnecessarily cut up with breakthroughs, on the score of recovery, and that breakthroughs on entries are not unnecessarily close together, on the score of safety.

In mines where the roof will not stand any length of time after the rooms are driven out, without filling up with slate, the system of driving every other room only, as in panel 12-4, Fig. 4 (before referred to), represents a material improvement in not merely reducing slate and track costs, but in making possible a materially better recovery of coal on the pillars. It is not contended that it would be practicable to drive every other room only, where the volume of air is only sufficient for driving every room; but that in the absence of gas, with, say, three or four times the amount of air that would be a liberal allowance for driving every room, it is practicable to drive every other room only, without the necessity for using brattice cloth.

EXHAUST vs. FORCE FAN

Whether it is best to have a fan exhaust, and thus distribute the dust through the workings, or have the ventilator act as a force fan, in which case the men and mules must travel through the dust and gas-laden air, has been so long discussed that there is doubtless little more to be said. The question has suggested itself, whether increasing the

volume of air would not act more favorably in the case of a force fan than in the case of the same fan exhausting; doubling the air would certainly assist to retard the deposition of dust and make the mines safer. The excess of air could be admitted at advantageous points along the traveling ways. Where a fan is run as a force fan during the day while exhausting at night in winter time, the dangerous accumulations of ice in the air course, should be partly overcome.

In Figs. 3 and 4, on pp. 893 and 894 of the *ENGINEERING AND MINING JOURNAL* for May 2, 1908, the ventilation is supposed to be straight overcast, without doors. Double cross-entries and double cross-entry air courses, as shown in Fig. 4, should be sufficient. Where the roof is bad and the places must be driven narrow, the additional yardage for triple cross-entries and triple cross-entry air courses would hardly be justifiable. Where the roof would admit of these being driven room width, the resulting ventilating cross-section should be sufficient for a considerable excess over actual requirements. The 11th cross at 1755-ft. centers, would be nearly four miles from daylight; for this distance a triple, if not quadruple, main entry and main-entry air course would certainly be preferable; the additional cost of entry yardage per ton of coal recovered should not be more than half that for the cross-entries.

In the case of panel workings, as illustrated in Figs. 3 and 4, the idea has also suggested itself as to whether some such arrangement as outlined in Fig. 1, which is along the line of the proposed haulage for panel 8-1, Fig. 3, would not be preferable on the score of ventilation. By adopting a somewhat similar arrangement of partings for headings No. 1 and No. 2 in panel 8-1, as proposed for headings No. 1 and No. 2, Fig. 1, No. 2 heading overcast could be located within the panel, thus reducing the number of overcasts on the eighth cross-air course, while not reducing the total number. The saving in expense should in part assist in paying for the additional entry yardage, as the overcast within the panel would not need to be shot as high as on the eighth cross-air course; furthermore, any leakage would only affect No. 2 heading, instead of all the workings above, which, as illustrated in Fig. 4, would be no small object.

If main-entry overcasts are called first class, cross-entry overcasts second class, and heading overcasts third class, it would seem preferable on the score of ventilation, to replace second-class overcasts by third-class, wherever the expense involved admits of it, which also seems more in line with the panel idea on the score of haulage. There would thus be but one break in the cross-entry motor tracks for each panel, instead of two, as illustrated. Where the roof is such as to admit of No. 1 room on No. 1 heading, panel 8-1, Fig.

3, being used as a slab parting for No. 2 heading, and, say, No. 5 room on No. 1 heading as the return-air course for No. 2 heading, there should be no material increase in cost involved in the proposed arrangement.

SCHEME OF VENTILATION

While unquestionably the general scheme of ventilation should be arranged as far as practicable, to throw the entire force of the fan into each and any of the ventilated sections at suitable intervals, particularly in winter time when the mines are dry, it is possible that a movable, quick-running fan might be of material assistance in cleaning out the loose dust that would be likely to be dislodged by an explosion, the idea being to imitate—and thus anticipate—an explosion as far as possible. It would be interesting to determine the different amounts of dust dislodged by increasing the velocity of the air currents. The recurrence of explosions due in part at least to dust, would seem to warrant a bona fide serious effort to prevent the distribution of dust by the mine cars, more particularly along the motor haulways. Such action should be neither difficult nor expensive, and in cases where the slack is coked, should pay handsome returns in the amount of slack saved. Black strap put in the cracks that are not too wide, light strips of sheet iron over the wider cracks, and cleats nailed to the sides of the car around the end gates of badly spread cars, should hold most of the slack or dust; watering the loaded cars also answers well, but represents a considerable outlay in pipe lines, while somewhat objectionable in cold weather at the tippie; preventing the dust accumulating along the haulways would seem preferable to watering the dust after it has accumulated.

AIR VS. ELECTRICITY

One of the interesting questions in regard to equipment is the selection of air or electricity. Notwithstanding the enthusiasm and arguments of the adherents of electricity, it does not seem good business judgment to disregard the many favorable points of the puncher machine, whatever may be said against a straight air equipment. In high soft coal readily undercut, where the large mules available quickly and easily move the chain machine from place to place and where high voltages, say 500, are practical, a straight electrical equipment has rather the advantage of the argument; but as the coal gets lower and harder, lower voltages are certainly desirable, if not necessary; large mules for the ready handling of the heavy chain machines are no longer available, and the light, easily moved, almost indestructible puncher begins to appear as a serious rival to the chain machine. While in low coal proper, the puncher at least, if not the compressed-air system,

seems to have the best end of the argument, the solution may likely be a compromise between the two, although this is thought to involve the use of the motor-driven air compressor, which does not seem to have met with popular approval.

In spite of the many advantages of the puncher, its lightness and simplicity, its insignificant cost of repairs compared with the electric chain machines—depending somewhat, however, on the voltage, the hardness of the coal and the number of sulphur balls—the ease with which it is moved from place to place, the large per cent. of lump coal turned out by the places undercut, and the loss of pressure due to friction in the long air lines, the leakage and careless waste, may easily be sufficient to put the puncher out of service; furthermore with coals having high sulphur contents and extremely acid mine waters, the additional cost of maintenance of the pipe lines may become a serious item. With a straight compressed-air plant, scattered mine workings should be carefully guarded against; no matter how well the rooms and entries may be kept together, the workings may have advanced to such a distance from the power house, as to be beyond what may be called the puncher limit.

Except in the case of small properties that can reach no great limit, a central electric plant, with a motor-driven air compressor at the drift mouth, would seem a safer form of installation; as the workings advance, the compressor can be moved up. On the score of economy alone, as workings advance, all open work as far as practical should be cleaned up behind, and any coal left should be solid and of sufficient width to necessitate working a considerable number of men. If the workings become scattered, or if more extensive developments are decided upon than first contemplated, a relay air compressor can be added to the circuit; additional units can be added to the central electric plant, usually without material loss as far as the original unit is concerned.

Just why the electrically driven air compressor has not become more popular is not quite clear; it is doubtless looked upon by many as one form of decentralization, which in a sense it no doubt is; located at a considerable distance from the drift mouth, particularly in low coal, its accessibility to constant inspection is a handicap, although telephone connections should obviate this objection to some extent. The extra salary is also an item, although the repairs on, say, five chain machines will ordinarily require, depending in part upon the carefulness of the runners, etc., a material part of one good workman's time, while the cost of the supplies for the repairs will easily make up the balance of the salary of an air-compressor man.

Almost any miner can run a puncher—

and without much damage to the puncher either—while careful (chain) machine runners are certainly scarce in some sections of our country. Handling the chain machine, particularly in low coal, is heavy laborious work, and labor in low coal usually costs more than the same amount of work in high coal; the additional cost does not always appear on the face of the cost sheets, the difference being at times, that a class of labor is welcomed that would not be tolerated under better conditions. The weight of the chain machine is nearly equal to that of the loaded mine car in a low seam; the mule that often with difficulty gets the empty car back up to the face of a room or entry, has to pull the chain machine—practically a load—up the same grade; the resulting damage to stock is considerable. Although the self-propelling attachment obviates the disadvantage of the great weight of the chain machine as far as moving it is concerned, this is a rather slow way of getting around, compared with the puncher; the chain machine is often brought down the room to the entry and back up the next room, while the puncher runner frequently prefers to roll the puncher through the last breakthrough, rather than wait for the driver.

The favorable effect of the puncher on ventilation is something of an object, while the larger per cent. of lump coal gotten by the puncher often nets quite a nice sum in the run of a month, especially is this true when lump coal is in demand. The number of serious accidents to the runners of the chain machine is much larger than in the case of the puncher. With motor-driven air compressors, there should not be the same objection to say 500-volt motor haulage in low coal, it being comparatively easy to make the main motor roads safe for men and mules, which, however, is quite a different proposition in the case of the general wiring necessary for chain machines. Notwithstanding all this, the electric chain machine has unquestionably displaced the puncher, while parties who have seemed thoroughly familiar with the performance of the puncher have installed straight electric plants. The chain machine no doubt drives entries somewhat faster than the puncher and is better adapted to scattered mine workings, however, it is a question whether we should allow the mine workings to become scattered.

Even after installation, the punchers and compressor part of the motor-driven air compressor require few repairs that cannot be made in the nearest machine shop; however, the manufacturer of the electrical part of the equipment is always in close touch with the purchaser, if only on the score of supplies, and in a good position to discredit the performance of the puncher, no matter what may be the real merits of the case.

The Pneumatic coal puncher will quite likely prove to be the "missing link"

connecting air and electricity in coal-cutting machinery. Comparing this cutter with the electric chain machine, the general design of the Pneumatic seems to indicate materially lower costs of repairs, and the price is little more than half that of the chain machine. In weight, this new cutter approximates closely that of the puncher, being but 210 lb. heavier than the Sullivan, and 360 lb. heavier than the lighter punchers. Although the Pneumatic puncher appears to have a bright future, like the gathering motor, it has yet to prove its merits in general service.

RELATION OF OPEN WORK AREA TO WORKING COSTS

It has long seemed that there is a clear and certain relation between working costs and the extent to which the mine workings are concentrated. Costs go down as the workings become concentrated and *vice versa*, while on the other hand costs generally go down as output goes up, or up as the output goes down. Costs and area of open work are in direct ratio, while costs and output is an inverse ratio.

While no doubt these two axioms are self evident truths to the practical mine foreman, superintendent or manager, the question is, are they regarded, and is there not room for improvement in the actual practice of today. In many instances there seems to be an impression that a large output necessitates an immense area of open work, sometimes even with extremely vague ideas as to when the pillars will be pulled. Maximum output necessitates the pillar work being kept close up on the heels of the advance work, and usually requires breaks in the solid; the barriers should be of ample dimensions, sufficient to work an economical number of men, rather than have them the minimum dimensions for bare safety.

ELIMINATING THE "DIP" BARRIER

Concentration, or maximum output from minimum area of open work, while desirable on many points, appears to involve one objectionable feature in the "dip" barrier. This may seem a minor objection, compared with the advantages that may be gained; the question is, can we gain the same advantage in regard to concentration, etc., by some other plan, at the same time, avoiding the "dip" barrier.

One form of "angle" work is illustrated in the accompanying illustration, Fig. 6. This plan is clear of "dip" barriers, the numerous barriers shown being all recovered on the usual favorable grades of the room work; the only dip coal is the small triangles next the main, and even this dip coal could be recovered on favorable grades were it not for the awkward reversing of the break line, that would thus seem to be necessary. The question, therefore, is what price must we pay in this instance, for the elimination of the "dip" barrier?

Except in the case of flat work, say, under a 2-per cent. maximum rise of the coal seam, grades are an important item in the economies of coal mining; a detailed consideration, however, of the question of grades, will require more space than it is possible to give this point at present. Under the conditions illustrated, with the maximum rise of the coal seam of 3 ft. per hundred, with the direction of the main drive 30 deg. up the pitch, and with the cross headings 60 deg. right off the main, the mule hauls on all cross entries will be 3 per cent. in favor of the loads.

A 3-per cent. grade in favor of the loads, has never appeared objectionable in rooms. With the brakes set hard, or the wheels spragged, the mule having been cut loose, the mine car can be run from the face of the room to the entry, with the certainty that the car will stop at the mouth of the room. If the grades on the cross entry are as flat as illustrated in the square panel work, the balance of the run to the motor partings, under these conditions, is an easy proposition. With gathering motors, the 3-per cent. grades in the rooms is a positive advantage, the loads being simply dropped out, thus saving either one room run per car loaded, or considerable switching.

As illustrated in Fig. 6, we have the flat grades in the rooms; the difference between a 1.5-per cent. and a 3-per cent. grade in favor of the loads, has not seemed of practical importance; when we come to the mule hauls on the entries, however, the difference in the two grades has seemed clearly a different proposition.

PROPER ARRANGEMENT OF GRADES

To start down an entry on a 3-per cent. grade in favor of the loads, when the mule is hitched to the car, with even a good type of brake, is usually a mule-killing proposition; sprags are much safer, although reducing the number of cars per day per driver. The number of mules killed in this way will come near paying for a trapper to follow and ride the mule. A saving of 75 cents per day per driver, will make an appreciable addition to the annual dividend; the reduction in the number of cars per driver with spragging, has seemed to amount to about this same amount in cash.

With the common run-of-mine cars, and with a 3-per cent. grade in favor of the loads, there will be considerable coal lost on the partings, due to the severe shock on stopping, which also results in no little damage to the mine car; both of these items, however, are practically negligible.

The disadvantage of the grades on the entry mule hauls, as illustrated in Fig. 6, is of little importance, when the maximum rise of the strata is reduced to less than say 2 per cent.; however, in such cases, it is not evident why the objection to the "dip" barriers, as illustrated in the

square panel work, is not also reduced to the same extent. The plan shown in Fig. 6 seems open to the same criticism, on the score of the large amount of open work, as that illustrated in Fig. 2, p. 505 of the *ENGINEERING AND MINING JOURNAL*, for March 7, 1908.

As will be noticed from the dimensions given in Fig. 6, each 2 ft. of advance of the cross entries in the direction of their drive, only results in one foot of advance in the direction of drive of the main entry; either the main entry must stand idle one-half the time, or it will quickly leave the productive area far behind; in time this advance will permit the opening up of a second working section, similar to that illustrated in Fig. 6, although this plan will double the already large amount of open work.

If only one section of open work is maintained, and the pillar work which follows can advance in the direction of the main drive, at but half the rate at which the main entry advances (which also applies to cross entries), it is not evident how the output can be more than half what would be obtained when employing the system shown in Fig. 2. If we restrict the area of open work in Fig. 6 to that indicated in Fig. 2, we reduce the output to one-half.

The plan shown in Fig. 6 somewhat resembles the method of mining in common use in the Georges Creek field, in western Maryland, as far as the general arrangement of rooms and entries is concerned, although the angle between the main and the cross entries has been made much larger. It should perhaps be stated that it seems possible, by changing the plan, to double the output, without increasing the area of open work, over and above that shown; neither time nor space will permit further discussion of this point, at present.

"Angle" work will generally result in a larger loss on the pillars, and a decrease in the percentage of coal recovered is a cash loss, although this item does not usually appear in the balance sheet.

There are certain items in the working costs of a mine that may be considered as fixed for any given date, and not affected by the area of open work; among these are, the rate paid the miner for digging and loading coal, and the interest charges and depreciation on the plant already installed. In regard to the variable items in the cost of mining, an arbitrary rule is, that costs vary directly, not in proportion to the area of the open work, but rather as the square of the open work, and much the same proportion seems to apply to the relation between costs and output.

For every ton of coal coked in beehive ovens, from 80c. to \$1 worth of by-product is carried off as waste.

Colliery Notes

Coal tar applied with a brush to mine timber to act as a preservative is not very effective, as the timber is sure to be cracked by the heat.

Exposed electric cables should not be used where mules and boys have to stand to wait for cars. All such cable should be inclosed in wood casing or light steel tubing; the latter is not suitable for damp mines.

The diameter of a drum or sheave for a chain hoist should not be less than 30 times the diameter of the bar of chain iron. All chains for hoisting purposes should consist of short links so as to wrap snugly around the drums without bending. They should also be oval sided so that the surge of the chain links will act as a spring, yielding a trifle with each surge.

Chains used for hoisting and sling work should be tempered at least once a year and then carefully examined before being used again. The chains used at the foot of a shaft, such as are employed on empty car planes, etc., should be oiled with a brush, once a week, or oftener if the place is wet and damp. When oiling, the chain should be slacked so as to get the oil well between the links.

While carbon dioxide has been used with more or less success in extinguishing mine fires, the danger of producing carbon monoxide by the process of reduction from heated carbon, and thus causing an explosion, has rendered its use uncertain; furthermore, the cost of producing carbon dioxide has helped to place the process in the theoretically good, but doubtfully practical methods of handling mine fires.

The mines of the Takashimi coalfield of Japan extend under the sea and cover an area of about 2775 acres. A depth of 1600 ft. below sea level is reached in some places. In spite of this fact, but little water penetrates the mines. In the absence of fresh water, sea water has to be used as feed water for the boilers, and salt is being produced from the water used for this purpose, the production exceeding 5 tons per day.

A new patent slate picker recently installed at the Treverton colliery of the Philadelphia & Reading company has proved a success, and is said to do the work as well as the human pickers. It is a cylinder-shaped drum which revolves and separates the heavy slate and rock from the lighter coal. The work that formerly required nineteen men and boys is now done with six. Other mining men are studying the invention and watching the results.

When no anemometer is at hand the velocity of an air current can be measured by noting the time between the flash

of a small amount of gunpowder at one end of a piece of straight entry of uniform section and the appearance of the smoke, caused by the flash, at the other end of the entry. Divide the distance traveled by the smoke, by the number of seconds it took it to appear at the other end and the result will be the approximate velocity of the air current in feet per second.

On account of moisture and the liability of damage from objects falling in the shaft, electric-power cables should be encased in iron piping. The protected cable can be easily supported from the timbers. Where the shaft is deep and the cable heavy, the line can be supported by fastening the cable to the pipe and then lowering sufficient slack in the pipes so that the cable will twist and coil and come in contact with the iron pipe. Friction between the cable and the pipe is then great enough to support most of the weight of the cable, and the remainder can be borne by fastening the top end of the cable.

The waste of our natural gas supply has been estimated at one million cubic feet daily, or the equivalent of ten million tons of coal a year. The record for petroleum is not much better. In the case of coal, there has been waste at every stage of mining and consumption. For each ton of merchantable coal brought to the surface, at least half a ton has been wasted by being left in the ground or thrown upon the culm pile. It is also a fact that less than 10 per cent. of the heat units of coal are utilized under the ordinary steam boiler, and in the locomotive, the waste is said to be not less than 95 per cent.

When contemplating the installation of rescue apparatus, thorough tests should be made before the final decision is reached. It is advisable to purchase one set each of three or four approved types of apparatus and experiment with them over an extended period under all possible conditions and with a variety of men. The last factor is the most important, as it is the men who have to wear the apparatus, and the appliance which is most likely to be successful is that which is worn with the maximum of confidence and ease; this point can only be decided by independent and prolonged experiment.

Mine workings and shafts are not only liable to be filled temporarily with foul air, but also with water, and often some means of penetrating this water is a vital necessity. The subject of diving, therefore, should be of considerable interest to mining engineers. In Westphalia, Germany, where breathing appliances have been so fully developed, a diving apparatus has also been provided at the Bochum Mining School and at one large colliery. During 1907, divers from the Bochum school were called upon 16 times to do important work under water, chiefly in connection with accidental irruptions of water during the sinking of shafts.

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Demand and Supply

In a recent number of the *Quarterly Journal of Economics*, Prof. E. S. Meade, of the University of Pennsylvania, discussed "The price policy of the United States Steel Corporation," the essence of his views being that the Steel Corporation was justified in refusing to reduce prices, its attitude toward the market in this respect having been a subject of much discussion several months ago. The effect of Professor Meade's conclusion is destroyed by the fact that subsequent to the appearance of his paper, the Steel Corporation did in fact bow to the adverse conditions and reduce prices. This practical refutation of his arguments is so complete that it would be scarcely worth while to refer to them, were it not that he attempts to show that the well proved law of supply and demand may cease to be operative under certain conditions, and he presents a brief in favor of his theory so seductive that even so sound a critic as the *New York Evening Post* was led to admit that the theory might be true.

This extraordinary conclusion is based upon the idea that demand being apparently non-existent, nothing advantageous is to be gained by a reduction of prices, while on the other hand the result of a reduction will probably be demoralization which is disadvantageous. Professor Meade says that the facts recited by him "Show that the necessity of adjusting prices to changed conditions of demand, which is generally believed in as one of the economic axioms needing no demonstration, does not exist in the field of materials and machinery. Iron and steel products, aside from the limited amount needed for household purposes, are bought to make money from their use. . . . In this respect, iron and steel differ radically in the conditions of their production and demand from flour and meat, and oil and sugar, which are bought because they minister directly to human wants. The purchase of iron and steel is primarily a question of the condition of trade rather than the price of the article purchased."

It seems to us that it would be more logical to reverse this argument. Flour and meat and oil and sugar are immediate necessities. Important building operations requiring iron and steel may be deferred, but human beings must continue to eat without any substantial restriction of the

amount; consequently, the prices for the foodstuffs ought to be the ones which could be held up according to the theory of Professor Meade, while the prices for iron and steel, like the prices for the other metals ought to be reduced in order to tempt buying. It is well known that buying for consumption diminishes upon a declining market, but nevertheless it is an axiom that a point is reached where the low price will be attractive.

For example, take the case of copper in 1907; upon the decline from 25c. per lb. to less than 12c. per lb. the buying was comparatively small, and in October there was a great accumulation of unsold stock, but in the neighborhood of 12c. per lb. there ensued immense buying, which absorbed a large part of the surplus and led to a sharp recovery in the price. That concessions in price do inspire purchases even in the case of iron and steel is illustrated by many new undertakings that are inaugurated when there is the ability to effect an important saving in the cost of construction. What better example of this can there be than in the history of the steel trade previous to the advent of the Steel Corporation? The most important constituent of the latter is the Carnegie Steel Company. Much of its success is attributed to the policy of Andrew Carnegie in keeping his plant in advance of every competitor and doing his construction work during periods of depression when materials and labor were cheap; on the other hand, the failure of Milliken Brothers, a competitor of the Steel Corporation, is attributed partly to the fact that it did its construction when labor and materials were dear.

We have had lately a great deal of academic and specious reasoning that the advent of the trusts created a new condition of things insofar as the law of supply and demand is concerned. It is undeniable that they have had an effect upon the markets; they have clearly showed their ability to control prices upon a generally rising market; but it has been shown with equal clearness that so long as there is any competition worth mentioning (in most cases there is) prices cannot be controlled upon a generally falling market. This has been demonstrated by the experiences in copper and lead. There was no reason to anticipate that iron and steel would be an exception, and the result showed that it was not an exception. Instead of the return of prosperity being

seriously delayed by an abandonment of the settled policy on the part of the Steel Corporation, it was the practical opinion at the time that the stand-pat policy of the Steel Corporation and the labor unions was the great impediment to recovery in business activity. Results appear to be bearing out this opinion, although the concession of the Steel Corporation was but a grudging one and of comparatively small account.

"What is needed for the return of good times," says Professor Meade, "is the restoration of confidence, a general conviction that industrial and financial conditions are becoming settled, so that business men can plan for the future in the belief that their calculations of profit will be confirmed by the event." This is undoubtedly an element of the case, but we fancy that no man in business has imagined that a return of confidence is all that has been necessary to secure what the country has been waiting for. Many men have regained their nerve and are exuberant in their confidence, but they are unable to realize, except at a loss, upon their investments in land, factories, railways, etc., entered into upon the inflated basis of some time back, and consequently are temporarily unable to engage in new enterprises. What the country has been waiting for is to save and lay up sufficient money to catch up with the over-extension of interests during the last boom. This natural course of recuperation is facilitated by putting things down to an economical basis, and not trying to hold industry by the throat, which Professor Meade pronounces the Steel Corporation to have been right in doing.

It sometimes appears as if the law of supply and demand were not operative owing to a confusion of ideas as to the identity of the consumer. It is a common error to speak of the rollers of sheet metal, the drawers of wire, etc., as the consumers. Their true position is that of manufacturer. They are only one step ahead of the refiner, just as the refiner is a step ahead of the smelter. The real consumer is the person who ultimately makes use of the finished product and takes it out of the market. The identity of the ultimate consumer cannot always be easily determined. In the case of a large part of the consumption of pig lead, for example, the sequence of hands is clear, the ultimate consumer being the man who makes use of white lead in the painting

of his house. On the other hand, the ultimate consumption of the copper drawn into wire, which is used for the construction of a street railway line is uncertain; perhaps it is the person who pays a 5c. fare for a ride. By the time the metal reaches its ultimate consumer, fluctuations in price have been spread over so many interests that individual effects may be imperceptible. Obviously, copper may fluctuate between wide limits without the majority of people knowing anything about it.

Moreover, a change in the price of one commodity may be neutralized by a change in something else. We have seen during the last six months of depression the development of much activity in the trade in white lead. In the painting of an ordinary house, 1000 lb. of white lead at 5c. per lb., or \$50, may be required, but this may be only 25 per cent. of the total cost, the remainder being the cost of the oil and the labor, chiefly the latter. A change of 1c. per lb. in the cost of white lead alone does not affect the painting bill very largely, and may easily be offset by a change in the cost of labor. Thus we have seen many persons take advantage of the favorable opportunities of last spring to repaint their houses, and the market for white lead has benefited from the improved demand.

These simple illustrations show how complex are the conditions which govern consumption and prices at the present time. We have seen prices for commodities rise to high figures without restricting consumption. Three years ago it was the belief in the trade that if the price for copper should rise to 18c. consumption would be sharply restricted, but we saw it go to that point and much higher without restricting consumption. However, there came a time when the cumulative effect of high prices for many commodities created a burden which the ultimate consumer could no longer bear, consumption was restricted and prices fell. Professor Meade in upholding the late policy of the Steel Corporation disregarded the condition of general average, so well reflected in the index numbers for commodities, which are computed monthly by several authorities. If among 100 persons, 99 could be made to bear the burden, it would be easy and pleasant for the hundredth man; if upon a rising market for copper, *A* could greatly increase his production while *B*, *C*, *D*, and all the others

were restrained from doing so, it would be very profitable for *A*. However, this is not the way that trade works. It is impossible to escape the general average of conditions. The law of supply and demand is as immutable as the law of the conservation of energy. Even the Standard Oil Company, which is nearer to having a monopoly in a great trade than any other trust, shows its wisdom in reducing prices in times of depression in order to stimulate consumption. However, it appears that the law of supply and demand may have the corollary that prices may rise without restricting consumption in the cases of commodities for which there are no substitutes, and when the general average of prices for commodities is stationary, or nearly so. But this is a condition which does not often exist in the trade in the great staples.

An Extension of the Witwatersrand

The exhaustion of the gold mines of the Witwatersrand, which some people have predicted, may be further in the future than these prophets have assumed, if the latest news from the Transvaal is substantiated by fuller reports. The cable announces that shaft No. 2 of the Brakpan Mines, Ltd., has struck the reef at a depth of 3695 ft., finding it at that point nearly 7 ft. wide, undisturbed and fairly regular in values. The dip is only 8 deg., giving a good area to the claim, and samples taken all around the shaft, which is 42x9 ft., hold well up to an average of \$16 gold per ton.

The Brakpan is well out on the east flank of the Witwatersrand, and this discovery will give new hope to the mines in that part of the field, concerning which there has been much doubt. "Even Methuselah took a long time in dying," as a distinguished mining engineer once said, and the Rand may follow his example.

TWO IMPORTANT EVENTS in railway building have been chronicled this week. One is the driving the last spike in the St. Paul extension to Butte, Mont., giving that important mining center the advantage of another railway connection. The other has been the consummation of arrangements whereby the Rhodesian railway is to be extended into Katanga, which will provide transportation facilities for the great copper mines of that region.

Views, Suggestions and Experiences of Readers

Comments on Questions Arising in Technical Practice and
Debatable Points Suggested by Articles in the Journal

CORRESPONDENCE AND DISCUSSION

Machine Sampling

I have read with much interest the able article on "Ore Sampling by Machines," by John A. Church, which appeared in the JOURNAL of July 18. The Great Cobar sampling mill described in the JOURNAL (May 9, 1908, p. 950), is used by Mr. Church to illustrate his criticism on modern sampling works. The points raised by Mr. Church regarding the use of long spouts, high-velocity ore currents and excessive fall are, it appears to me, well taken; while the alleged ill effect due to retardation of the coarse ore in the crushing machines and the fine ore in the spouts, are at least debatable, I believe these points, even to the extremes stated, are not detrimental to accurate sampling, and that in the crushing machines may even prove beneficial, to the extent that retardation serves to mix the ore.

I can see no good reason why ores should be sampled in any definite order, each coarse particle with its associated fine for example, on which Mr. Church appears to lay much stress; to me it appears that the thorough mixing of the ores is, on the other hand, a prime requisite to good machine sampling, and the crushing machines, elevators and even the spouts help in this mixing process. In addition to this, modern works are usually provided with mixing machines which serve the double purpose of thoroughly mixing the ore, and giving a fairly uniform and continuous feed to the sampling machines.

In the first Simplex sampler with two scoops, the spouts cut the ore stream, say, every 27 seconds, giving a rather intermittent feed for the second gyratory crusher and following machines; and while the crusher and rolls help somewhat to lengthen out this stream, it is well known that with a varying feed they cannot make it continuous. So we have the certainty of other sampler scoops passing the spouts at various times between the successive ore waves and obtaining no sample, and to that extent vitiating the whole result.

EVILS OF INTERMITTENT ORE STREAM

Here, in my opinion, lies the chief defect in the Great Cobar sampling works, a defect that could in great part be cured by the use of feeders on the rolls. An intermittent ore stream is obviously inimical to mechanical sampling, and as each sample cutter gives precisely that kind of stream, means are usually pro-

vided in modern works to make it continuous. Probably the best device for the purpose is the conical mixer introduced by the late Henry A. Vezin, in connection with his well known sampler. It consists of a small sheet-iron cone set at slight inclination and rotated slowly; the ore is fed at the base of the cone and emerges from the smaller end in a well mixed, continuous stream which drops vertically over the sampler. The apparatus is simple of construction, easily operated, readily cleaned out and practically indestructible.

Haphazard retardation in mill sampling as developed by Mr. Church, can have little, if any, effect on the final sample, provided the percentage cut out by the scoops is sufficient to give a correct sample of the maximum ore cubes passing the machines, that the sampling machines are fed with a continuous stream, and that the cuts (samples) are taken with sufficient frequency. Should the maximum cubes, for example, be as large as 3 in., and it has been demonstrated that 25 per cent. of the ore is required for a safe sample at that size, it is manifest that a machine cutting but a 15-per cent. sample cannot give correct results on 3-in. cubes. Reduce these cubes to 1 in. and a 1-per cent. sample would probably suffice; to $\frac{1}{2}$ in. and $\frac{1}{12}$ per cent. would probably give a correct sample.

Under these conditions a machine cutting a 25-per cent. sample (assumed to be correct for 3-in. ore) will take over 200 times more ore than is required for a correct sample, when the same ore is reduced to $\frac{1}{2}$ -in. cubes and well mixed before passing to the sample cutters (scoops). Therefore, I hold that ore crushed to a maximum 3-in. cube, with 25 per cent. as a safe sample of these cubes, it matters not whether we screen the ore to pass $\frac{1}{2}$ -in. apertures and run through the coarse at one time and the fine ore afterward, making but one sample, or, following the standard practice, run the ore as it comes to the mill, coarse, medium and fine together; the final samples in either case with an initial 25-per cent. cut, would be similar under the sampling conditions stated.

ESSENTIALS OF SAMPLING

I would point out in passing that the selection of every fifth car for sampling at the Great Cobar plant can scarcely be called good practice, even though the ore may have been slightly mixed at the

breaker plant at the mine. Should it not be possible to complete the sampling at the mine, it certainly would be preferable to cut out by automatic samplers the percentage of ore required for the sampling mill proper. The haphazard selection of the ore in every fifth car on the assumption that it has the same composition and value as that contained in the other four, is not sampling.

The "Tower" form of sampler, of which the Great Cobar plant is an example, has numerous advocates, particularly as a custom sampler where many lots are sampled daily. The one ore elevator offers some facilities in cleaning up between successive lots. I believe, however, that the advantage is counteracted by the excessive wear of spouts, a very large item in the course of a year, the extra cost of the building and the maintenance of the long elevator. For my part, I would prefer in the case under discussion to use two elevators and reduce the height of the building by half, placing part of the machinery in the very poorly furnished space now occupied by a solitary sample grinder.

Permit me to summarize the conditions I consider necessary to accurate sampling by machines: (1) Take out a sufficient amount in the first cut to form an accurate sample of the maximum cubes; (2) cut the sample from a vertical, free-falling stream with a frequency varying from 25 to 50 cuts per minute depending on the character of the ore, each cut taking the entire stream; (3) crush finer after each cut, thoroughly mix the ore, and feed it in a uniform and continuous stream to the following sample cutter, and so on.

PHILIP ARGALL.

Denver, Colo., July 15, 1908.

Table for Ready Calculation of Matte Value

I have devised a form of table for the convenience of those who find it necessary frequently to calculate the value of copper ore or matte of a certain percentage at the market price. The method of preparing the table and its use is obvious. In a column headed by the given market price, are given the values per ton opposite different percentages of copper. The percentages are given for each unit up to ten, and above 10 per cent., by tens to 100 per cent. Intermediate percentages are found by shifting the decimal point in the value found opposite the numeral of

the decimal of the percentage. Thus, to find the value of a matte carrying 52.84 per cent. copper at 13¼c. per lb., reference to the table gives the following:

Per Cent.	Value.
50.0	\$132.50
2.0	5.30
0.8	2.120
0.04	0.106
52.84	\$140.026

Again suppose the value per ton of 8.37 per cent. copper ore is desired, the market price of copper being 12½c. per lb. Then reference to a table such as I have described gives:

Per Cent.	Value.
8.0	\$19.40
0.3	0.7275
0.07	0.16875
8.37	\$20.29725

A. J. EVELAND.

Manila, P. I., June 30, 1908.

Estimation of Cyanide Effluents *

BY DR. W. J. SHARWOOD

A system of "alkalinity numbers" which has been found easy of application and of great convenience, has been employed for the last 10 years, at the Homestake cyanide plant at Lead, S. D. The numbers are based upon the number of cubic centimeters of decinormal acid required to neutralize 100 c.c. of solution. The system does not presuppose the existence of any particular compound, such as CaO, in expressing the alkali present. The alkali, however, may at once be translated into percentage of CaO or NaOH by multiplying by the equivalent weight of either compound. One unit of alkali is equivalent to 0.0028 per cent. CaO or 0.056 lb. per ton; 0.0056 per cent. KOH or 0.112 lb. per ton; 0.0040 per cent. NaOH or 0.080 lb. per ton; 0.0065 per cent. KCN or 0.13 lb. per ton.

A saturated solution of lime in water has an alkalinity of about 45. In a solution of known cyanide strength and with the alkalinity estimated by the above standard the "protective alkali" in pounds CaO per ton can be calculated by the formula: $0.056 a - 8.6 k = \text{pounds CaO per ton}$, where $a =$ the alkalinity by the above standard and $k =$ the percentage of KCN.

DETERMINING ALKALINITY

In daily practice at the Homestake mine the solution man takes samples of 20 c.c., adds a few drops of a 1-per cent. phenolphthalein solution, and titrates with N/5 sulphuric acid. Each 0.1 c.c. acid used represents one unit of alkalinity. When the "protective alkali" value is required to be expressed in pounds of lime per ton it is read from a table which has been pre-

*Abstract from "Laboratory Tests on the Use of Coarse and Fine Lime for Cyaniding," *Journ. Chem., Met. and Min. Soc. of South Africa*, April, 1908, p. 295.

pared from calculations based on the formula given above. It has been shown by synthetic tests that this method, while not strictly accurate in the presence of the double-zinc cyanide, is liable to no greater errors than are those methods which are based on titration after precipitation with silver nitrate.

The standard sulphuric acid employed in this process is prepared by diluting strong acid to form a stock solution of a medium strength slightly greater than 4N. Exactly 100 c.c. of this is diluted to 2000 c.c. and the H₂SO₄ in a sample of this diluted acid is determined gravimetrically with the greatest care. If, for example, it proves to be 0.2055 N, another 100 c.c. of the stock acid must be diluted up to 2000 to which is added 55 c.c. more in order to obtain standard acid of exactly one-fifth normal strength.

Pig Iron Production in 1908

The American Iron and Steel Association has received from the manufacturers complete statistics of the production of pig iron in the United States in the first half of 1908. The figures show the sharpest fall on record in the history of our iron trade. The production of pig iron in the first half of 1908 was 6,918,004 gross tons, against 12,303,317 tons in the last half of 1907 and 13,478,044 tons in the first half of 1907. The production of pig iron in the first half of 1908 was a little over 51.3 per cent. of the production in the first half of 1907, during which period the iron trade was, not affected by panic conditions. The decrease in production in the first half of 1908 as compared with the second half of 1907 amounted to 5,385,313 tons, and as compared with the first half of 1907 to 6,560,040 tons. The production in the first half of 1908 was the smallest in any half year since the last half of 1900, when 6,146,673 tons were made.

CLASSIFIED PRODUCTION

The production in the first half of 1908, classified according to the uses for which the iron was intended, and compared with the first half of 1907, was, in long tons:

	1907.	1908.	Changes.
Foundry and forge	3,242,559	1,832,688	D. 1,409,871
Bessemer pig.....	7,185,878	3,388,491	D. 3,797,387
Basic pig	2,671,136	1,481,612	D. 1,189,524
Charcoal iron.....	205,796	129,720	D. 76,076
Spiegel and ferro..	172,675	85,493	D. 87,182
Total	13,478,044	6,918,004	D. 6,560,040

Bessemer pig includes special low-phosphorus iron. Charcoal iron includes a small quantity of basic iron; also a few tons made with charcoal in the electric furnace. The production of spiegeleisen alone in the first half of 1908 was 67,021 tons. Of ferro-manganese alone the production was 18,472 tons. The total decrease this year, as compared with 1907, was 48.7 per cent.

PRODUCTION BY FUELS USED

The production according to fuel used in the first half of 1908, was as follows:

Fuel.	Long Tons.	Per Cent.
Coke and bituminous coal.....	6,547,439	94.7
Anthracite and coke mixed.....	239,151	3.5
Anthracite alone	1,694	.....
Charcoal.....	129,720	1.8
Total.....	6,918,004	100.0

The production with anthracite alone is now very small. Nearly all the so-called anthracite furnaces use some coke mixed with the anthracite. Allowing for this proportion, coke was the fuel from which 96.4 per cent. of all the pig iron made. Very little raw bituminous coal is used.

THE PRODUCTION BY STATES

The total production by States for the first half of the year was as follows:

States.	1907.	1908.
Massachusetts and Conn.....	8,746	5,220
New York.....	859,115	376,268
New Jersey	195,245	125,143
Pennsylvania.....	5,964,884	3,032,297
Maryland.....	221,145	82,785
Virginia.....	260,912	137,356
Georgia and Texas.....	26,173	5,260
Alabama.....	861,771	605,617
West Virginia.....	151,643	27,901
Kentucky.....	79,013	21,357
Tennessee.....	193,371	115,219
Ohio.....	2,815,174	1,209,399
Illinois.....	1,263,258	782,865
Indiana and Michigan.....	197,330	167,063
Wisconsin and Minnesota.....	160,045	69,303
Mo., Colo., Oregon, Wash. and California.....	220,209	154,981
Totals.....	13,478,044	6,918,004

The decreases in Pennsylvania, Ohio and Illinois were larger in proportion than in the Southern States. This agrees with the larger proportionate fall in bessemer pig, which is not made in the South.

BLAST FURNACE CONDITIONS

The whole number of furnaces in blast on June 30, 1908, was 168, against 167 on Dec. 31, 1907, and 359 on June 30, 1907. The number of furnaces idle on June 30, 1908, was 283, against 276 on Dec. 31, 1907, and 83 on June 30, 1907. During the first six months of 1908 the number of furnaces actually in blast during a part or the whole of the period was 250, as compared with 388 during the last half of 1907 and 382 during the first half of that year.

On June 30, 1908, there were 24 furnaces in course of construction, of which 23 will use mineral fuel and 1 will use charcoal, as follows: New York, 2; Pennsylvania, 6; Ohio, 6; Indiana, 8; Illinois, 1; and Michigan, 1 stack.

On June 30, 1908, there were 17 furnaces being rebuilt, all mineral fuel, as follows: New Jersey, 1; Pennsylvania 11; Alabama, 1; Ohio, 2; Illinois, 2 stacks.

An authority on copper and brass states that thin sheets of brass or copper cannot be heated to as high a temperature as thick sheets of the same composition.

During 1907 there were 26,771 short tons of copper, valued at \$294,481, produced in the United States as compared with 22,839 tons, valued at \$228,390, in 1906.

Questions and Answers

Inquiries for information are answered in this department as promptly as possible, but more or less delay is often unavoidable. Many inquiries involve a good deal of investigation and these can be answered only when the general interest in the subject is conceived to justify the expenditure of the time required. Correspondents should refrain from asking for advice that ought to be obtained by professional consultation with an engineer. We will not answer questions pertaining to the value of specific mining enterprises. Inquiries should be framed concisely.

MARKET FOR CRUDE BARYTES

Can you furnish me the names of firms which buy crude barytes?

W. G. I.

The following companies utilize crude barytes, which they obtain from their own mines or from other sources; as you do not state what part of the country your product is obtained from, we suggest that you write to the company or companies operating nearest your property: Nulsen, Klein & Krausse Mfg. Company, St. Louis, Mo., and Lynchburg, Va.; Point Mining and Milling Company, Mineral Point, Mo.; Pittsburg Baryta and Milling Corporation, Richlands, Va.; John T. Williams & Son, Bristol, Tenn.; Carolina Barytes Company, Stackhouse, N. C.; Delaware Barytes and Chemical Company, Dover, Del.; Barium Production Company, New York, N. Y.; Dix River Barytes Company, Lancaster, Ky.; Hammill & Gillespie, Stamford, Conn.

MICA

What is the price of ground mica in ton lots, f.o.b. New York City or Philadelphia? What is the chemical purity required for electrical work? Who are the largest mica buyers? What is the size of the product when ground?

W. A. P. D.

Ground mica in ton lots f.o.b. New York City is quoted at $1\frac{1}{4}$ @3c. per lb., depending on quantity, delivery, etc. For electrical uses, mica should be free from iron. Correspondence with some of the larger electrical concerns will doubtless elicit more definite information in this regard. The largest buyer of ground mica is the National Gum and Mica Company, 502 West Forty-fifth street, New York City. Sheet mica for electrical purposes and stoves is handled by Eugene Munsell & Co., 68 Church street, New York City, and A. O. Schoonmaker, 221 Fulton street, New York City. The size to which mica is ground depends entirely on the specific use for which it is intended; the sizes range all the way from 8 mesh to the finest powder.

MARKET FOR MOLYBDENITE

Where can I find a market for molybdenite? In what form is the ore bought?

W. A. D.

Molybdenite is usually marketed in the form of a concentrate carrying from 90 to 95 per cent. MoO₃. Buyers of concen-

trates are Primos Chemical Company, Primos, Delaware county, Penn.; De Golia & Atkins, San Francisco, Cal.; E. P. Earle, 31 Nassau street, New York, and Fried. Krupp, Essen, Germany.

ALUM AND ALUMINUM SALTS

What are the uses for alum and what is the yearly production in the United States? Any other information you can give will be appreciated?

B. B. H.

The greatest use for alum is probably in the paper trade, where it is utilized for sizing or giving a hard finish to paper. Aluminum sulphate and also crystals of potash alum are used in water purification. Crystals of potash alum are used in the dyeing trade. A small quantity of alum is used in medicines. Recent experiments have shown the possibility of making carbonate of aluminum from alum.

During 1907, there were 10,404 short tons of alum, valued at \$391,900 (average value \$34.78 per ton) produced in the United States; this was an increase of over 15,000 short tons as compared with the production of 1906. There were also 106,821 tons of aluminum sulphate produced, valued at \$2,008,046. The imports of aluminum salts during 1907 were 1562 tons, valued at \$35,191.

The market for alum and aluminum salts is fairly good and, as may be seen from the above figures, the supply comes chiefly from the United States.

TUNGSTEN ORES

In what parts of the United States are tungsten ores mined? How much tungsten ore was mined during 1907, and what was its average value? What disposition was made of this ore? What foreign countries produce tungsten ore?

A. K. B.

Colorado is the largest producer of tungsten ores, the output during 1907 being 1170 short tons, valued at \$569,905. California and Idaho also produced small amounts. More or less work was done on known deposits in Nevada, South Dakota, Arizona, Montana, Washington, New Mexico and Connecticut. The total production of the United States during 1907 was 1468 short tons, valued at \$715,031, or \$487 per ton. A large part of this ore was smelted by one or two domestic concerns; a smaller quantity was exported to German smelters.

We have reports of production from foreign countries during 1907 as follows: Queensland, 87 tons, valued at £10,220; Tasmania, 41 tons, valued at £4411; New South Wales, scheelite to the value of £23,781, and wolframite to the value of £26,235; United Kingdom, 312 long tons. Mining and discoveries of tungsten ore were reported from other countries.

VANADIUM ORES

What districts supply the vanadium ores consumed in the United States? What

companies are chiefly interested in vanadium ores?

H. E. B.

The consumption of crude vanadiferous ore in the United States is supplied chiefly from two sources; the roscoelite-bearing sandstone in southwestern Colorado, and the recently discovered patronite deposits in the Cerro de Pasco district of Peru. At Newmire, in the Colorado district, the Vanadium Alloys Company has a reduction and mining plant. The American Vanadium Company, of Pittsburg, imports crude material from the Peruvian deposits. Other companies interested in vanadium ores are the Primos Chemical Company, Primos, Penn., and the Electro-Metallurgical Company of America, Niagara Falls.

MANGANESE ORES

What is the source of the manganese used in the United States, and what States does the product come from? What are the uses for manganese?

W. P. F.

The greater part of the manganese used in the United States is obtained from the manganiferous iron ores of the Lake Superior district, Colorado, and Arkansas, these sources being named in the order of their prominence. The production of manganiferous iron ore in the Lake Superior district during 1907 was over 1,000,000 long tons. Considerable manganese is obtained from the manganiferous zinc ores of New Jersey, the production from this source during 1907 being 95,243 long tons.

The mining of true manganese ores is only of secondary importance. During 1907 there were 5604 tons produced, the bulk of which came from Virginia. The superiority of foreign manganese ores, and the small cost at which they can be laid down in this country, are a handicap to the industry here.

The bulk of the manganese ore produced is used in the iron and steel industry, in which it is smelted to form an alloy with iron to be used in the manufacture of steel.

Some of the manganate and permanganate salts are employed, on account of their oxidizing power, as disinfectants and as dryers in oil varnishes. Natural ores high in oxygen are used to decolorize greenish glass by converting the ferrous into ferric oxide. In this country inferior grades of ore are used for coloring brick. There are several other non-metallurgical applications of manganese, but they are of little importance.

CALCINED MAGNESITE

Where can I buy calcined magnesite?

F. S.

The following firms are dealers: Hammill & Gillespie, 240 Front street, New York City; H. J. Baker & Co., 100 William street, New York City; Fuerst Brothers, 2 and 4 Stone street, New York City.

New Assay for Cyanide Solution

W. H. Barton (*West. Chem. and Met.*, IV, pp. 67-68) has rescribed a modification of the Chiddey method of assaying cyanide solutions that overcomes a good many objections to this well known method. Among the objections to the Chiddey method are the following: (1) Each assay requires special attention to avoid having low and uneven results; (2) the attention necessary at the point when the solution of the zinc is complete, for if carried beyond this point the lead will dissolve and break into flakes, which are hard to collect; (3) if the operation is interrupted before the point first mentioned, the retained zinc causes increased cupellation losses. The author's remedy is simply a small piece of aluminum foil dropped into the solution just after the bulk of the lead sponge is formed.

Take 5 to 10 a.t. of solution in a beaker or flask and bring nearly to the boiling point; add 10 c.c. of a saturated lead acetate solution, which is strongly acid with acetic acid, and 0.5 gram of zinc dust. Allow the solution to stand about 2 min. and add 10 c.c. of hydrochloric acid.

The small square of aluminum foil is added when the sponge is fairly well formed and will precipitate any remaining lead and prevent the sponge already formed from disintegrating. Another 10 c.c. of hydrochloric acid may be added after the excess of zinc is apparently dissolved and the whole operation may be carried out on the hot plate. The operation is complete when action appears on the aluminum foil only. The liquor is poured off, the sponge collected with a rubber policeman placed on a 2-in. square of lead foil, rolled with a piece of large glass tubing to squeeze out the moisture, folded and rolled into a ball, punctured to allow the steam to escape and cupelled. The whole assay requires about 45 min. and shows good gold and silver results; it needs no extra precautions and will work equally well on solutions, clean or foul, weak or strong.

The Latest Strike on the Witwatersrand

The secretary of the Brakpan Mines, Ltd., on July 21, received the following cable from W. L. Honnold, the company's engineer at Johannesburg:

"Shaft No. 2 has struck the reef at a depth of 3695 ft. Size of shaft is 42x9 ft. Sampled all around and found average value 16 dwt. 4 grains gold—or \$16—per ton over a width of 81¾ in. The reef dips at an angle of 8 deg., and is undisturbed and regular as to values."

As the Brakpan mine is well out on the eastern end of the Witwatersrand district, this strike is of much importance

and indicates a possible extension of the accepted limits of the district.

Size of Lime Grains Used in Cyaniding

A series of experiments to ascertain the relative rapidity with which commercial lime, in varying states of division, is dissolved when distributed through a charge of inert sand subjected to the action of percolating water, or cyanide solution, was recently conducted by W. J. Sherwood at the Homestake mine.¹ The results confirm the general practice at the Homestake cyanide plant, which shows that the lime should be neither very coarse nor very fine.

The tailings treated at the Homestake mill are pyritic, and require the addition of about 3.5 lb. of lime per ton of sand, through which the cyanide solution percolates at the rate of about one ton of solution in five days for each ton of sand. Great importance is attached to the aëration of the charge during treatment in the vat and much attention is paid to preventing the slimes from being deposited with the sands. It is found that a free access of air into the interstitial spaces between the sand grains is essential to secure an "envelop aëration."

When the lime granules are coarser than 20-mesh, most of them will remain undissolved at the end of the treatment. Previously slacked lime and particles finer than 100 mesh yield about 90 per cent. of their available alkali in five days leaching; but they yield it at a rate which is not sufficiently uniform. When the lime is so highly comminuted it causes the cyanide solution, at the earlier stages of leaching, to become too highly alkaline, a condition which, with pyritic ores, is very detrimental to the solution of the gold. A "protective alkali" higher than 0.3 lb. per ton of solution gives decidedly low extractions. Moreover, the acidity of the tailings is found to be distinctly cumulative, there being from 5 to 10 per cent. sulphide of iron present.

The experiments were conducted upon an inert charge, but it is believed that in practice with an acid charge—especially with a charge constantly developing acidity—the CaO added would have disappeared even more rapidly. In the experiment the whole of the lime was added to the charge, whereas in actual work this is not done.

When the lime is too finely divided a large amount of it either dissolves or remains suspended in the water, conveying the tailings, while the vat is filling and so passes off at the peripheral overflow. In some cases such overflow water has been found to be nearly a saturated solution of caustic lime.

¹*Journ. Chem., Met. and Min. Soc., of South Africa*, April, 1908, p. 293.

Grecian Chrome Iron Ore

The following description by the late A. Habets (*Rev. Univ. des Mines et de la Metallurgie*, Feb., 1908), relates to the chromiferous iron ores of Greece. They are not rich ores, rarely containing 50 per cent. of iron, but they are abundant enough to form the basis of substantial mining industries in certain localities where the deposits lend themselves to exploitation.

The chief locality is to the north of Athens, particularly in Boetia and Locrida. Here large masses of serpentine have been injected among white and yellow limestones; the iron ores are associated with the serpentine, being found in veins, sometimes in the serpentine itself, sometimes at the contact of serpentine and limestone, and sometimes in fissures in the latter rock.

The concessions of the Société Hellenique des Mines are situated north of Mt. Ptoon. The principal deposit, over 2 km. long, is in the form of a vein between a roof of yellow limestone and a foot-wall of white limestone. The vein dips 45 deg. to the southwest and its width varies from 12 to 18 m. In another deposit north of the first, the vein reaches a width of 110 m., but includes a limestone horse. This deposit is now in operation. These concessions are connected with the wharves at Larymna, on the Atalanta canal, by a railroad 16.5 km. long.

Two partial analyses of the ore, dried at 110 deg., follow:

	I	II
	per cent.	per cent.
Iron	47.50	49.10
Manganese	0.56	0.05
Chromium	2.19	2.49
Nickel	0.70	0.56
Alumina	12.35	n. det.
Lime	0.99	0.32
Magnesia	1.61	0.70
Silica	6.38	5.39
Titanic oxide	0.60	0.45
Sulphur	0.016	n. det.
Phosphorus	0.03	0.024
Arsenic	0.01	0.029
Copper	0.01	0.017

The output of the Société Hellenique in 1907 was 185,000 tons.

Mining of the deposit is accomplished by a combination of open-pit and milling methods. While the terraced slope of the open pit is advancing along the strike of the orebody, a shaft is sunk beyond the head end of the pit, connecting with a drift coming out at the bottom of the open working. Ore is then shot down this shaft into cars in the drift, forming a funnel-shaped excavation. Owing to the inclination of the vein, part of this work can be carried on in the hanging wall, and a large part of the barren material which must be removed when the open workings reach that point can be thus disposed of. There comes a time when the thickness of rock overburden becomes prohibitive, and then regular underground working has to be adopted.

Personal

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

D. Z. Ivorton, of the firm of Oglebay, Norton & Co., has sailed for Europe.

W. F. Robertson, of the Robertson Iron and Steel Company, of Cincinnati, has sailed for Europe.

E. H. Gary, chairman of the board of directors of the United States Steel Corporation, is in Europe.

W. L. Kauffman has resigned as general manager of the Youngstown works of the National Tube Company.

James F. McClelland, consulting mining engineer of Palo Alto, Cal., is at Tonopah, Nev., on professional business.

W. R. Strickland has been appointed mechanical engineer at the Detroit plant of the American Radiator Company.

C. W. Landrum has been appointed superintendent of the Wisconsin Zinc Company's properties in southwest Wisconsin.

Wm. J. Quigley, manager of the Chihuahua Mining Company, has returned to Chihuahua, Mexico, after six weeks in California.

James W. Abbott, consulting mining engineer, of Pioche, Nev., passed through New York, on his way home, after spending several weeks in Maine.

Major E. L. Zalinsky, U. S. A., retired, has been made president of the Bureau of Illuminating Engineering, which is a corporation of illuminating engineers, of New York City.

A. Chester Beatty has severed his connection with the Guggenheim Exploration Company as head of its engineering staff, but continues to act as consulting engineer for the Guggenheims.

H. A. Guess, milling superintendent for the Guggenheim interests, has completed the series of metallurgical tests at the Esperanza mill at El Oro, Mexico, and is now at Flat River, Mo.

E. H. Skinner, mining engineer, has resigned from the engineering staff of the Guggenheim Exploration Company and is now with W. B. Thompson, 25 Broad street, New York City.

Frank J. Llewellyn, division contract manager of the American Bridge Company, Chicago, has recently returned from a five months' trip to China, Japan, and other points in the far East.

William A. Pomeroy has left Palo Alto, Cal., to accept the position of general manager of the Lustre Mining and Smelting Company, Santa Maria del Oro, Durango, Mexico, via Parral.

Donald B. Gillies, general manager of the San Toy Mining Company and other Schwab interests in Mexico, recently underwent a successful operation for appendicitis, and is now convalescing at El Paso, Texas.

M. W. Summerhayes recently returned to Nogales, Arizona, from a visit to the property of the Compañía Minera Juarez, near Caborca, Sonora, where he was investigating the present cyaniding and reduction operations, with a view to increasing the capacity, and making changes to improve extraction.

Obituary

Thomas Chalmers, Jr., died July 21, 1908, in Chicago. For many years he was associated, with his brother W. J. Chalmers, with Frazer & Chalmers, which later became the Allis-Chalmers Company, of Milwaukee, Wis. Mr. Chalmers was 51 years old at the time of his death.

Donald Ray Morgan, one of the best known mining men of northern Mexico, died in the town of Iguala, Guerrero, July 25, of smallpox, a disease from which perhaps no part of Mexico is ever entirely free. Mr. Morgan, a native of the State of Massachusetts, came to Mexico about 15 years ago with an engineering corps operating in the southern part of the Republic. But he soon turned his attention to mining and was successively with the American Smelting and Refining Company, the Mexican Metallurgical Company, and the Torreon Metallurgical Company; and it was with the last-named company that he became best known, for to him, more than to any other one man, is due the building up of that company's mining department, of which he was general superintendent for a number of years. About two years ago Mr. Morgan severed his connection with the Torreon Company to take up several promising propositions near Chihuahua and Monterey, for the handling of which he organized the Mexican Mines Syndicate, with offices in both Chihuahua and Monterey. The work seemed to meet with remarkable success; but the panic of last fall found the company with heavy bills on its hands for new machinery and supplies, which it was not able to meet and the properties were taken over by the creditors. Since that time Mr. Morgan had given his attention to the States of Michoacan and Guerrero, with marked success, and it was while attending to affairs in the latter State that he contracted the disease that caused his death after but a short illness. He leaves a wife, who was with him at Iguala. A host of friends and acquaintances throughout Mexico recognized his sterling worth and unremitting energy in the pursuit of his profession.

James Duncan Hague, for many years prominent as a geologist and mining engineer, died at his summer residence at Stockbridge, Mass., Aug. 4, aged 72 years. He was born in Boston in 1836, and was educated in private schools and spent the year 1854 at the Lawrence Scientific School, Harvard University. Then he

went to the University at Göttingen, Germany, and to the Royal School of Mines, at Freiberg, Saxony, where he remained from 1856 to 1858. He married Miss Mary Ward Foote at Guilford, Conn., in 1872. Before that, however, he made a long trip of exploration to the South Seas, in 1859-1861, and in 1862-1863 he had a period of service in the United States Navy. For three years, until 1866, he was a manager of copper mines in the Lake Superior region. While there he participated in the discovery and development of the Calumet & Hecla property. Next he was an assistant geologist on the United States Geological Survey, and from 1871 to 1878 he was a consulting mining engineer in California. He was United States commissioner to the Paris Exposition of 1878. In 1879 he settled in New York, though his work took him to many parts of the country, and he passed much of his time in the West, especially in California. His advice as a consulting engineer was widely sought and highly valued. He was president of the North Star Mining Company, of California, and was connected with other companies. At the time of the San Francisco earthquake he represented the New York Chamber of Commerce in the distribution of the relief funds. He was a member of the New York Chamber of Commerce, American Museum of Natural History, Metropolitan Museum of Art, American Geographical Society, American Institute of Mining Engineers, and various other organizations, as well as the Century, City, Metropolitan, Union League, and Downtown clubs. He was author of several books, and often contributed articles to the *Proceedings* of the Institute of Mining Engineers; to this JOURNAL and other periodicals. He leaves one son, also a mining engineer, and two daughters.

Societies and Technical Schools

American Foundrymen's Association—The secretary announces that, by special arrangement, the *Transactions* of this association and of the American Brass Founders' Association will be sent out together to members of both societies. The paging will be separate and continuous in each case, the index making proper allowance for this when issued at the end of the year. The first instalment consists of the papers read at and contributed for the Toronto convention. These include, besides others of special interest to iron founders, papers on "Chemical Reactions in Foundry Cupola Practice," by Jules de Clercy, Montreal; "Ferro Alloys in the Foundry," by W. M. Saunders, Providence, R. I.; "By-product Coke for the Foundry," by George A. T. Long, Chicago; "Titanium in Cast Iron," by Dr. Richard Moldenke, Watchung, N. J.; "Cupola Thermics," by S. H. Stupakoff, Pittsburg.

Special Correspondence from Mining Centers

News of the Industry Reported by Special Representatives at
San Francisco, Salt Lake City, Denver, Goldfield and Toronto

REVIEWS OF IMPORTANT EVENTS

San Francisco

August 1—On Thursday last the district attorney of Solano county, in company with a committee of supervisors and prominent residents of Benicia, visited the plant of the Selby Smelting Company at Selby, on the opposite side of Carquinez straits from Benicia and met General Manager Braden and Superintendent Englehardt for a conference on the smelter-fume question. They were shown all over the plant and examined the bag-house and the Cottrell apparatus both of which are designed to condense and do away with the smelter smoke nuisance. Subsequently these gentlemen called upon Henry Underhill, president of the company, at the offices in San Francisco, where another discussion of the subject took place. Ultimately the party returned to Benicia for a conference which resulted in a request for the district attorney to have the permanent injunction granted over a year ago, enforced immediately. This closes down the works until the matter of a rehearing is settled, and meantime a large number of men will be thrown out of employment.

It is evident from this action that the people representing Benicia and Solano county were not properly impressed with the fume-arresting devices at the smelter, upon which the Selby company has already expended about \$100,000. None of them are, of course, experts in this matter, but consider themselves damaged by the smoke conditions which have existed. The Cottrell device is perfectly satisfactory to the Selby company. The serious illness of Mr. Cottrell has delayed matters to some extent, but he has left the hospital for the country, and will endeavor to return to the Selby works by Monday next. After that it is expected that the smelter will be fully equipped with the Cottrell appliances, patents for which have now been obtained in the United States, and in foreign countries. The Western Precipitation Company, of this city, will handle the introduction of the device in other smelting plants. It seems probable that when its efficiency is proved beyond question arrangements will be made so that work can again proceed on the extensive Guggenheim smelter at Point San Bruno, in the southwestern portion of San Francisco bay, where large sums have already been expended.

Bert Hill and James Hart, the original discoverers of the new camp of Hart in San Bernardino county, got into a controversy with Peters, Johnson and

O'Keefe over a lease in the Big Chief mine, one of the big properties of the district. It was finally agreed by all parties concerned to submit the matter to arbitration, three well-known mining men of the district being selected to act as arbitrators. Two out of the three settled on a stated amount as due the lessees. Hill and Hart appealed from this award and went to the courts. Now Judge Orter revokes the order staying judgment for the plaintiffs and said that as all parties had agreed to abide by the decision of their friends and neighbors, a just decision had probably been made.

The Standard Oil Company is continuing its recently adopted policy of purchasing oil lands in this State outright. It has recently acquired the Talara Oil Company's 80 acres in the Midway field of Kern county for a stated price of \$100,000. The holding is a lease owned by W. S. Porter and A. Scribner, the land belonging to J. W. Jameson, of Los Angeles. There are four producing wells in the south end of the property yielding light oil which the Standard has been buying under contract. All the territory is proved. It is thought more offers will be made by the Standard for specially desirable holdings.

Both the O'Hara quartz mine near Sonora, Tuolumne county, and the Tightner mine at Alleghany, Sierra county, which have been in wonderful bonanza ore for several months past, not only continue to yield largely, but the output is increasing as depth is attained in both properties. In the lower levels of the Tightner the owner, H. L. Johnson, has found the ore richer in the south winze than it was up above. It is now thought that the rich shoot continues to the lowest level, where a tunnel is being run to tap the ledge. Only a portion of the newly discovered deposit has been removed, the shaft being kept filled with water to safeguard the balance until it is desired to remove it. The old Gillis property at Jackass Hill, Tuttletown, long famous as a pocket mine, is also again in bonanza, and is yielding exceedingly rich "picture rock." These are all private properties, worked by their owners, and only two or three men are at work in any of them.

In addition to the regular miners employed by the company, there are 14 crews of tributers at work in the old Champion mine at Nevada City. None of these men are making less than \$3 per day, and most of the crews are earning \$5, 6 or \$7 per day, and one crew gained \$11.50 per day.

Most of the ore being recovered is from the 800 level upward. The mine was for a long time in litigation and unproductive, and is now under bond. The company owns 25 or 30 claims, most of them at Nevada City.

Goldfield, Nevada

July 28—There have been "things doing" in Goldfield during the past week: the largest production for more than a year; the settlement of litigation which releases two rich producing leases; a strike of ore which extends the known ore zone considerably to the north; almost a boom in the stock market; and a practical solution of the problem of treating the Consolidated concentrates in the company's own plant.

The most important event of the week was the compromise agreement between the Consolidated and the Jumbo Extension, thus ending the apex litigation brought by the former company about the Gold Wedge claim of the Jumbo Extension. This small fraction of very rich ground lies between the Mohawk and the Jumbo and the two leases, the Mohawk Ledge and the Mohawk Jumbo, were stopped from mining pay ore during the dispute. These two leases will now resume, each being given a maximum of 30 days in which to repair the underground workings and put the equipment in shape. The Mohawk Ledge has 221 days to run, and the Mohawk Jumbo has 100. This latter lease had a 10-c. dividend posted when the injunction was granted and its dividend money amounting to \$60,000 was tied up. The checks will now be mailed to stockholders of record of October 20, 1907.

By the terms of the compromise agreement the Consolidated waives all damages as regards ore extracted from the Wedge claim to date by the Jumbo Extension and the Jumbo Extension deeds the claim to the Consolidated subject to the leaseholds of the Mohawk Ledge and the Mohawk Jumbo.

Either the Consolidated or the Jumbo Extension may develop the Poleverde claim of the latter company charging a maximum of \$10,000 against joint account for development purposes. The net proceeds from any ore which may be found apexing on other consolidated ground, are to be divided equally between the two companies. The title to the ground is to remain in the Jumbo Extension.

The Consolidated company reserves the

right to mine the ores of the Vinegerone claim, the net proceeds of the ore extracted to be equally divided. The title to this claim is to remain undisturbed; the Consolidated owns a one-fourth interest and the Jumbo Extension three-fourths.

Receiver Frank L. Wildes has made his first report on the affairs of the State Bank and Trust Company, which closed its doors last fall. He alleges gross mismanagement, extravagant use of depositors' money, loaning of funds to depositors who did not give "twenty-five cents worth of security" and practical embezzlement by the president and directors. The receiver's statement disagrees with the cashier's statement, showing a discrepancy of over \$900,000. The grand jury at Carson has resumed its investigation of the bank's affairs as a result of this report.

Thirty-four sacks of ore worth close to \$100,000 were sent to Denver this week under a heavy armed guard to be used as evidence in a high-grade case being tried there. The ore is said to be of the same kind and value as the ore stolen from the Mohawk Mining Company while in transit to Denver under care of the Wells Fargo Express Company. The suit is brought by the Goldfield company against the express company to recover the value of the ore stolen.

Wallace, Idaho

July 31—The purchase of the control of the Panhandle smelter by the Greenough Brothers, thereby making the Snowstorm mine at Mullan an entirely independent concern, the erection of a reduction plant by the Stanley Consolidated Company at Burke, and the settlement of the dispute between the big dividend payers and the commissioners of Shoshone county with regard to assessed values, form the chief features of interest connected with the mining industry of the Cœur d'Alene district during the past week. Under supervision of Manager Titus work on the Panhandle smelter is being rushed to completion. It is expected that the plant will be in full operation within the next 30 days. Most of the ore to be smelted will come from Montana mines and the plant will handle about 250 tons a day. Enough ore has been guaranteed to keep the plant in steady operation.

The Stanley mine at Burke, which has been closed since June, is to be equipped this fall with a reduction plant of a capacity of from 40 to 50 tons a day, and the lease and option on the mill of the New Jersey company, which expired recently, has been given up. The mine will not be started again until its own mill is completed and this, it is expected, will be in about 60 days. The company is now waiting for a settlement of its suits against the Hercules by which it seeks to restrain the latter company from dumping tailings on the patented land of the Stanley company above the millsite.

Butte

July 30—The mines of all the sub-companies of the Amalgamated, with the exception of those of the Boston & Montana, are operating to their full capacity. Of the latter company the Leonard, East Colusa and West Colusa mines are producing approximately two-fifths of their normal output and are shipping to the Washoe smelter at Anaconda, while the Boston & Montana smelter at Great Falls is being repaired. The repairs at the smelter are taking longer than was expected at first and the latest report given out by the company is that no ore will be received before Sept. 1. The line of the Chicago, Milwaukee & Saint Paul railway between Butte and Saint Paul was completed within the past week. It is expected that the completion of the road will give added impetus to the mining industry of Fergus and Meagher counties, inasmuch as the railroad facilities in those counties have heretofore afforded but little opportunity for shipment of ore, while the new road will bring the mines in closer touch with the smelters.

Denver

August 1—The inventors and patentees of the various machines designed to drive tunnels in rock without the use of explosives, are industriously endeavoring to perfect their inventions, and as industriously exploiting them in the Denver papers. The principal ones are the Karns, Sigafoos, Procter and Bennett. All of them are ingenious, and the result of years of mechanical study and work, and that ultimately one successful tunneling machine will be evolved from the many is more than probable. The most difficult part of the matter is that while some of these machines may, and indeed have, driven short distances at a high rate of speed, their efficiency will never become certain until it has been shown that they are capable of sustained effort for long distances, equal to the unexpected emergencies and occurrences which happen; and last, but not least, that it will be possible to convey the cuttings, or muck, to the surface in the heavy tonnage, and with the rapidity with which it will be produced according to the rate it is asserted these machines will bore. As shown in the article on rock-boring machines in the JOURNAL of Nov. 23, 1907, the automatic mucker must be an integral part of the tunneling machine, and should be shown at work successfully.

The miners who draw wages and steal their employers' ore, have invented for themselves the name of "high-graders," ore thieves being too harsh a term to suit them. In the Federal court here, the jury has returned a verdict in favor of the Mohawk Mining Company, of Goldfield, Nev., restoring to that company \$16,000 worth of ore stolen from the mine, and shipped to Pueblo by the "fence" assayers,

who bought it from the miners. It does not appear, however, that anyone was punished, but simply that the company got back what had been stolen from it. All this, I fear, will tend to encourage the robbers.

In the Cripple Creek district, it is reported that a cyanide mill will be erected on the Portland mine, to treat the old dumps and the low-grade ore from the mine.

The production of the Cripple Creek camp is given at about \$9,000,000 for the seven months ended with July.

Indianapolis

August 3—E. T. Willard, geological expert sent out by the Government to inspect mines and to collect specimens of coal and fossil formations from coal mines spent last week in the Indiana coal-field, most of the time in Sullivan county. He shipped to Washington a number of coal specimens and fossils taken from the 50 mines of that field. Mr. Willard said that Indiana coal mines are better kept and equipped for operation than the coal mines of many other States. Mr. Willard said he had not found many mines as well kept and as nearly properly operated as the mines of Sullivan, Greene and Clay counties. "They are models of soft-coal mines and are the equals of the best mines to be found in the country in method of operation."

"Surface and other indications" Mr. Willard said, "that mean nothing to the farmer or the untrained man indicate that there is a great deal of good coal territory in Indiana that has not yet been touched. This being true the mining business of Indiana is bound to improve."

Toronto

Aug. 1—Interest in the Larder lake district has been revived by the discovery of placer gold by Professor Willmott, Canadian government geologist, who was examining a number of locations for the owners, residents of Ottawa. The gold was found in a bed of black sand from 2 to 3 ft. deep, covered with a layer of gray sand one inch deep, under 2 ft. of mud. It is said to yield one ounce gold to the ton. A rush to stake swampy claims, covered with muskeg and hitherto supposed to be valueless, is anticipated. The Larder City Gold Mines, Ltd., which owns some claims of this character proposes to work them in the winter after the methods adopted in the Yukon for frozen gravel.

T. H. Crowley, prospector, of Peterborough, Ont., who recently arrived at Port Arthur, reports the discovery of an extensive nickel deposit north of the Grand Trunk Pacific Railway and about 100 miles west of Port Arthur. He brought specimens of nickel and also of silver and free gold secured in the area north of Wabigoon and Sturgeon lakes.

Mining News from All Parts of the World

New Enterprises, Installations of New Machinery, Development of Mines and Transfers of Property Reported by Special Correspondents

THE CURRENT HISTORY OF MINING

Arizona

GILA COUNTY

Miami—According to J. Parke Chan-ning, this company has now developed on three levels 4,500,000 tons of ore, and it is estimated that there are 2,250,000 tons additional near the ends of the various drifts and crosscuts. The orebody has been opened 1050 ft. in length, 700 ft. in width, and 400 ft. vertically.

GRAHAM COUNTY

New York and Arizona Gold and Cop- per Company—The company is increasing its force of miners as fast as there is room in the workings. The miners in the Lillian and Buzzard tunnels have been working under difficulties, as the hot and rainy weather has made the air very bad. The engine purchased some time ago for the big blower at the mouth of the Lillian tunnel did not give satisfaction and the company has purchased another which will be installed in the next few days. Another very rich ore-chute has been struck much richer than the surface ore. The company will let a contract to sink and raise on this ore-chute. In two months the Lillian will be directly under the Black shaft at a depth of 245 ft. There is a large body of good milling ore on the surface which has been developed consid- erably. Plans are being made for the erection of reduction works.

Ash Peak Mining Company—This com- pany is working a large force of men. They are down 200 ft. and have found rich ore, mostly gold and silver. The company has been shipping ore from this mine to the smelter at Douglas.

Clifton—This camp now has improved reduction works and has been increasing its shipments of copper. Two new water- jacket furnaces have arrived and are now being installed, one for the Arizona Cop- per Company and the other for the De- troit Copper Manufacturing Company, whose works are on the Frisco river. About 600 men are working at present in the mines of the district, and within six months the number is expected to be doubled.

SANTA CRUZ COUNTY

Four Metals—The Red Hill adit at this mine, in the Mowry district, now in 515 ft., has cut into the body of sulphide cop- per ore a distance of 75 ft., without reach- ing the hanging wall.

Morning Glory—The incline shaft at this copper mine, in the Harshaw district, is down 140 ft. The vein at the depth is a little more than 6 ft. wide.

California

AMADOR COUNTY

Central Eureka—At this mine, Sutter Creek, E. C. Voorheis, superintendent, the machinery is being put in running order, and the shaft is being repaired.

Mitchell—This mine at Pine Grove has been bonded to John Crammer, who is un- watering it and putting the 10-stamp mill in order.

Apropos Mining Company—The Hoff- man ranch adjoining the Argonaut mine at Jackson, has been deeded to this com- pany.

CALAVERAS COUNTY

Dutch Bar—To this mine in Grapevine district the men have completed the road from the Union Construction Company's road. Heavy machinery will now be hauled to the mine.

Reiner—A new hoist is being placed over the new three-compartment shaft of this mine, and grading is completed for the compressor.

Hamburg—At this mine, near Moke- lumne Hill, repairs are being made on the 20-stamp mill and new buildings are being erected under the supervision of G. Steckel.

Bald Hill—This mine has been bonded by Nevada operators, who intend install- ing new machinery and beginning work shortly.

EL DORADO COUNTY

Gilbert—Lee Brothers have made a rich strike in this mine 16 miles north of Placerville, and are sacking the ore. There is a small mill on the property.

KERN COUNTY

Uncle Sam—J. L. Thompson, of Lan- caster, has purchased a half interest in this mine, near Mohave, adjoining the Karma on Soledad hill.

Sidney Group—This group at Johannes- burg, recently purchased by D. V. Wil- liams, of Montana, made a satisfactory first clean-up, and new machinery is to be installed.

MARIPOSA COUNTY

Moonlight—This property at Mariposa has been bonded by Wm. Harris and Geo. De Sallier and contracts have been let for a ditch and wagon road. A 10-stamp mill will be erected.

NEVADA COUNTY

Morydena—This mine, near Grass val-

ley, idle for two years, is being reopened by J. W. Jaquith and E. F. Hilton.

Lecompton—In the unwatering of this mine, the water was lowered 280 ft. in the first nine days of pumping. The mine is under bond to H. S. Abbott; Samuel Colt is the resident superintendent.

Murchie—At this mine, Grass Valley, the bottom of the shaft is 1075 ft. from the surface, and it is being sunk to 1500 ft. There are 50 men on the payroll, and the 20-stamp mill is kept running night and day.

SAN BERNARDINO COUNTY

Hart—At this new camp local capital is to erect a 10-stamp custom mill, so that owners and leasers may realize on the ore already mined. Water is somewhat scarce.

SAN DIEGO COUNTY

Dulzura Group—At this new camp sev- eral sales of mining properties have re- cently been made. E. J. Waidan, of San Diego, has purchased the Mason group near the Buckhorn. H. Kruger has bought two claims from E. Paulsell near the Artery Consolidated mines.

Yellow Metal—This mine, at Banner, has been sold to Gibbons Brothers, of Reno, Nevada, who are installing a six- drill compressor plant, and will equip the property with a mill. The mine has been developed to 500 ft. depth.

SIERRA COUNTY

Miners' Home—This property, at How- land Flat, for some time idle, is running again.

Del Monte—This mine, which yields gold both from quartz and placer, is being put in shape for work by James Mackin. The property now embraces 340 acres. A crosscut is being run to undercut the old workings. The mine adjoins the Oriental on the west.

SISKIYOU COUNTY

Klondike Mining Company—This mine, nine miles below Hornbrook, J. D. Down- ing, manager, has its tunnel in 1500 ft. There is a new mill ready as soon as the electric power plant is completed. Power will also be supplied to two other mills in the vicinity.

Indian Girl—This mine near the Klon- dike, which has been worked as a pocket mine, a hand mortar being used for crush- ing specimen, is now to be equipped with machinery.

TUOLUMNE COUNTY

Water Lily—This gravel mine on the Stanislaus river, near Reynolds Ferry, has been bonded by Fitzgerald & Lyon to E. F. Johnson and associates, of Grass Valley.

Bagdad-Chase Mining Company—This company, at Soulsbyville, has recently bonded the Ralph mine at that place and is installing machinery to work the property.

Clio—This mine, which was sold for taxes, has been redeemed by the First National Bank of Sonora for Los Angeles men and will soon be actively worked.

Colorado

LAKE COUNTY—LEADVILLE

Dinero Tunnel—The breast of the tunnel, Sugar Loaf district, has reached a distance of 3,700 ft. That the tunnel is nearing its destination is shown by the change in the formation which is gradually getting out of the black lime and entering a mineralized matter of lime and porphyry. In addition the tunnel is making considerable water.

Cleveland—This property, South Evans gulch, is shipping steadily 50 tons daily of high-grade ore from the north and south drifts. The ore is shipped to the Ohio & Colorado smelter at Salida. The immense bodies of low-grade ore in the mine are allowed to stand until the prices of the different metals increase in value. The ore shipped runs from 2½ to 14 oz. gold per ton and is a sulphide. The property belongs to the New Monarch Mining Company; 75 men are employed.

Yak Tunnel—The bore has now passed the Ollie Reed territory in South Evans gulch and is heading for the Resurrection in Big Evans gulch. Recently a fissure vein was caught in the granite, several inches wide, that runs 1 oz. in gold. This is supposed to be a stringer from the veins owned by the New Monarch Mining Company. The tunnel is being driven at the rate of 300 ft. per month.

Little Jouny—The monthly output from this property, Breece hill, is about 7000 tons, and the bulk of it is high-grade ore. At the beginning of the month No. 4 shaft will be closed temporarily for repairs, which will be completed in about three weeks.

Penn—The different lessees on this property, Breece hill, are now in a position to ship daily 225 tons of iron, silicious and sulphide ores.

Starr—The lessees are shipping from the lower levels 30 tons daily of an excellent grade of iron-silver ore. Operations are being carried on at the water level and the bulk of the ore dips down.

Idaho

SHOSHONE COUNTY

Shutz Mining Company—This is a newly

organized corporation which will acquire and operate a group of seven claims in an unorganized portion of the Cœur d'Alene adjoining the Bullion and Wonder claims. The property is said to carry a 4-ft. vein of iron ore carrying also lead and silver. An adit has been started which will run 400 ft. to tap the lead at 200 ft. depth.

Bunker Hill & Sullivan—A new concentrator of 1000 tons capacity is now nearing completion, and it is hoped to start the first unit of 500 tons capacity by September 1. The second unit will be constructed as soon as possible. The old concentrator which handles 1100 tons of ore per day will be overhauled and improved. Electric power will be used.

Alice—This property, one of the old locations in the vicinity of Mullan, reports a strike of rich galena in the 500-ft. level. The extent of the discovery has not been made known. The mine has been developed at heavy expense and carries one of the best leads near Mullan.

Mineral Farm—Work on the new tunnel has already progressed 25 ft. The tunnel is being run along the footwall and, as the country is very broken, rapid progress is being made. Electric power is being installed for the drills to be used as soon as the formation becomes firmer. The tunnel is designed to strike the vein at 1300 or 1500 ft. from the portal. A working shaft will then be sunk.

Temple—Galena ore has been encountered in a shaft being sunk on this property to determine the position of the orebody. A crosscut will be driven to tap the ore at greater depth as soon as the position of the ledge is established.

BONNER COUNTY

Idaho Smelting and Refining Company—T. L. Greenough, one of the principal holders of the stock of this company, states that the plant will be ready for ore in 30 days. Work is being rushed with all speed on the buildings and on the installation of machinery.

Blacktail Mining Company—The Blue Bird mine on Lake Pend Oreille has made a carload shipment of ore that netted \$5400 in silver and lead. There are two adits, one of which crosscuts two leads. From the lower one 700 ft. of drifting has been done in the first lead. A supply of ore is now ready for the smelter.

Indiana

GREENE COUNTY

Little Giant—This mine near Linton, broke all previous records July 30, when it loaded 45 cars and hoisted 1453 tons of coal. There was a breakdown, which required 15 minutes for repairs.

WARRICK COUNTY

Bradley & Bridge Coal Mining Company—This company, with headquarters at Paradise, has incorporated, to do a mining business. The company has ample capital

and is composed of Wilson Bradley, I. L. Bridges, I. M. and S. V. Howes.

Michigan

COPPER

Keweenaw—The Phoenix stamp mill has gone into commission and will handle the rock from the Medora shaft. This mill has been thoroughly overhauled. It contains but one head with a capacity of about 400 tons daily. The Medora shaft is down 13 levels and has approximately two miles of underground openings. There is a stock pile containing between 50,000 and 60,000 tons of stamp rock taken from the development work. The shaft has been sunk in the lode which dips about 23 deg. from the horizontal. In sending rock to the mill part will come from the stock pile and the remainder from the shaft; in this way a thorough test will be obtained. The rock is exceedingly soft which makes it easy to mine and to mill.

Osceola—No. 2 shaft house of the Tamarack Jr. branch of the Osceola Consolidated was destroyed by fire, as was also the blacksmith and machine shop. The Tamarack Jr. has been idle for the last six years and when in operation it mined the Calumet conglomerate lode. The property also carries the Osceola lode and may, in the future, be again opened on that lode; the conglomerate workings are exhausted.

Rhode Island—The crosscut from the shaft toward the Franklin Jr., is encountering some favorable ground on the Pewabic lode. Developments on this lode at the Franklin Jr., property are encouraging and this lode is also being opened at the north.

Wyandot—A diamond drill has been installed on the lands of this company and a series of holes has been sunk to cut the favorable formations that have been exposed at the north. The company is also driving a crosscut from the shaft at a depth of 700 ft. This crosscut will cut the various lodes at that depth.

Isle Royale—Three shafts are producing and sending about 700 tons of rock daily to the mill. The mine is in fine physical condition especially the openings at the southern extension.

IRON

Chapin—The new Ludington shaft is completed and ore is now being hoisted. The shaft has four compartments and is 10 ft. 4 in. by 23 ft. 1 in. inside dimensions. The total depth is 1522 ft. Steel is used throughout except the sheathing, which is of heavy planks. The shaft is one of the largest in the Lake Superior district, and is surmounted by a modern steel shaft house containing four ore pockets. The Cornish pump, formerly at Chapin D shaft, has been installed at the new opening. The upper cylinder is 50 in. diameter and the lower is 100 in. The

stroke is 10 ft. Some of the other dimensions and weights of the pump are: Pumping bob, 50 tons; flywheel, 40 ft. diameter, 1500 tons; crank shaft, 27 in. diameter; pump rods, 7 in. diameter, 1500 ft. long; plunger, 28 in. diameter. The capacity of the pump is 319 gal. per stroke with 10 strokes per min. The guaranteed capacity is 3000 gal. per min. It is the intention of the company to hoist the greater part of the ore through this shaft.

Missouri

JOPLIN—ZINC-LEAD DISTRICT

Rex Land—W. H. and O. H. Picher, E. O. Bartlett and B. W. Lyon have started drilling the east side of this tract. This part of the tract has never been systematically drilled.

Picher Lead Company—Stockholders of this company and Cincinnati men have bought the D. D. & C. mine near Rewey, Wis., for \$50,000.

WEBB CITY

Yellow Dog—This mine has closed down on account of low ore prices.

GRANBY

Granby—This company has announced that it will inaugurate the same leasing system at Granby as that used in the Joplin district. The Granby company has heretofore aided the miners in prospecting by granting leases on very liberal terms and sharing the expense of prospecting.

Montana

BUTTE DISTRICT

Elm Orlu—The shaft on this claim, the property of W. A. Clark, Jr., situated north of Walkerville on what is known as the Rainbow lode, has reached a depth of 1000 ft., where a station is being cut, preparatory to crosscutting to the vein. The last crosscut to the vein was driven on the 700-ft. level where small bodies of copper ore were opened up.

Butte & Superior—A depth of 1200 ft. has been reached in the shaft and the cutting of a station at that level is nearly completed. From this station a crosscut will be run to the lead. Pumps of large capacity will also be installed on the 1200 station.

Tuolumne—The shaft on this property, which adjoins that of the North Butte, has reached a depth of 1000 ft. The management states that a crosscut, run north from the east drift on the 1000-ft. level, has intersected a vein and disclosed 14 ft. of ore which will average more than 3 per cent., and 6 ft. of ore which will assay 20 per cent. copper. Three 250-h.p. boilers have been ordered. A Nordberg hoist capable of working to a depth of 3000 ft. has also been ordered. Sinking will be resumed shortly and the orebody discovered on the 1000 will be developed at greater depth.

British-Butte—Work has been com-

pleted on a series of dams which will give a storage capacity of 10,000,000 gal. of water. The water to be stored will be pumped from the mine shaft and will be used in the operation of the gold dredge which is now being constructed.

Pittsburg & Montana—The building for the new 300-ton concentrator has been completed and machinery is now being installed. When finished, the concentrator will enable the company to work its lower-grade ores.

Copper Eagle Mining and Smelting Company—The mine is located north of Walkerville and carries principally silver ores, with some gold. After a shut-down lasting since December, operations were resumed a short time ago. It is reported that the capital needed for the development of the mine has been secured, and that the shaft will be sunk an additional 100 ft. before any shipments are made. Before the shut-down a rich body of ore was discovered on the 250-ft. level and this same lead will be worked at greater depth after the sinking has been completed.

Pilot-Butte—It is reported that the expert sent out by Milwaukee capitalists to examine the property which the company held under lease and bond has reported unfavorably, with the result that the money necessary for the resumption of activities will not be forthcoming. The company expects to lease its hoist and will probably dispose of its other machinery.

Badger State—This is one of the Boston & Montana properties and adjoins the Jessie claim of the North Butte company on the northwest. Sinking has recently been begun.

JEFFERSON COUNTY

Gold Crown Mining Company—Drifting is being done on the 225-ft. level, where it is reported good ore has been encountered. The management states that plans are now being considered for the erection of a concentrator on the property.

Nevada

ESMERALDA COUNTY—GOLDFIELD

Production—Goldfield is rapidly coming back to the condition that prevailed before the late labor trouble and the recent financial depression, as is shown by this week's production, which is the largest for more than a year, and while the figures do not come up to those of 12 and 15 months ago, the settling of apex litigation, thus permitting rich leases to resume shipments and the early completion of the Consolidated mill with the consequent production from the Mohawk, Combination, Jumbo and Red Top mines and the Florence mill with the starting of work on company account, all point to a production before the year ends which will exceed Goldfield's best record heretofore. The production for the week ending July 28 amounted to 2452 tons valued at \$313,275.

The Kinkead mill treated 25 tons of concentrates experimentally and the Combination treated 595 tons, all from Consolidated ground. The Western Ore Purchasing Company handled from the Engineers lease 451 tons; Mushett Lease 16 tons; Van Riper dump 50 tons; the average valuation being \$350 per ton. The Nevada-Goldfield Reduction Company handled from Mohawk Combination Lease 186 tons; Combination Fraction, 676 tons; Baby Florence, 38 tons; Hayes-Oddie, 40 tons; Consolidated Red Top, 25 tons; Daisy, 20; Hayes Frances Mohawk, 30 tons; Mohawk Jumbo, 12 tons; Little Florence dump, 12 tons; Frances-Gold Mountain, 1 ton. The average value of these 1040 tons was about \$100.

Consolidated Red Top Lease—This lease operated by the John Donellan Company on the north end of the Red Top claim has, after several months' operations, struck shipping ore. The ore was found in the 150-ft. level and a winze on the dip proved up still better ore than above. The 225-ft. level is being pushed to cut the vein and the same will be done on the 300. This extends the producing zone of Goldfield's inside district to the north and gives considerable impetus to all workers in this part of the camp.

Goldfield Merger—The merger, recently formed, comprising the Velvet, St. Ives, Gold Horn and Potlatch has completed a survey of its properties and is now making preparations to begin a main working shaft, which will be a double compartment and will be sunk 1000 ft. without stopping.

Baby Florence—Lewis H. Rogers, formerly of the Rogers Syndicate, has been given sole charge of the Baby Florence by the directors. J. F. Meikle, formerly superintendent of the Rogers Syndicate lease has been elected manager and superintendent of the Baby under a contract which returns to him one per cent. of the net earnings of the lease and no other compensation.

Mohawk Jumbo—This lease, no longer restrained by injunction, is already re- timbering and making extensive preparations for extracting ore. It has been idle since last fall when it shut down for a few days to allow a survey to be made underground. The strike followed immediately and when that was settled the injunction was secured. When the shut-down occurred the daily production was averaging about \$9000.

Engineers Lease—This lease, on the Florence, made its first shipment a little more than a month ago and has now declared its first dividend of \$90,000. The lease is shipping 75 tons per day. One shipment the past week averaged almost \$1500 per ton. The parent company, the Florence Goldfield, received from two leases last week, one of them, the Engineers, the sum of \$142,000 for ore shipments.

Kendall—Leases on the Kendall, one of the first producers of the camp, are shipping ore from a depth of 70 ft. which breaks across 2 ft. worth \$150 per ton without sorting. No work is being done on company account. The formation near the surface is very much broken and no workings have ever gone deep enough to get into unbroken ground.

Consolidated—The Consolidated authorities deny any rumors that owing to reduced freight charges they will ship their high-grade ore. They say that all their ore, high and low, will be put through the new mill. A recent run of 35 tons valued at \$1900 per ton put through their Combination mill proves the scheme feasible. Further their experiments on treating the mill concentrates which proved so satisfactory in the laboratory have been tried on a larger scale, in the Kinkead mill, where 25 tons were treated this week with such gratifying results that the company claims to be independent of railroads from now on.

Diamondfeed Black Butte—The Ellsworth-Baumgartner lease which has been at work only 10 weeks has just made its third shipment which averaged \$120.10 per ton. The first shipment averaged \$220.68 and the second \$1092.10 per ton.

Laguna—The Mushett lease has received settlement sheets for a 20-ton shipment which averaged a little above \$200 per ton.

Mohawk Combination Lease—A dividend of \$7500 has been paid to the owners of this lease, making a total to date of \$197,500. One or two more payments will be made as the odds and ends of the lease are cleaned up.

Red Top Fraction—Thanks to the strike on the ground of the Consolidated Red Top lease, the Red Top Fraction has taken a new lease of life and will sink its shaft to the 400-ft. level.

ESMERALDA COUNTY—RAWHIDE

The First Exchange bank has opened for business and has prospects for a good future. Another mill has reached camp and will be in operation in two or three weeks. This is the Watt mill with a capacity of 40 tons per day, which is being put up at Cypress Wells down on the flat a couple of miles from town. The 20-stamp mill of the Murray lease is promised to be ready for ore inside of a month. The Swiftwater Bill Gates, which has already worked to great advantage will have its capacity increased.

Grutt Hill Mint—This lease, on the Coalition property has made its first shipment which includes 20 tons of \$300 ore and 10 sacks of ore which will average nearly \$10 per pound. This high-grade comes from a stringer which varies in width from the thickness of a knife blade to nearly an inch and is yellow with free

gold. This stringer follows the shaft from 110-ft. to the 150-ft. level. Drifting both ways at this level has begun. A new hoist has been ordered and the shaft will be put to the 300-ft. level with all possible speed.

Queen Mascot—The Jordan lease has, this week, made its first shipment to the Selby smelter. This shipment contains two tons of ore valued at \$4000 per ton and several tons valued at \$500 per ton. This ore is broken down on canvas underground and carefully sacked. A hoist has been ordered and is expected to be running inside of two weeks when sinking will begin.

Czar Mines Company—This company, operating the Wagner-Putnam lease on block No. 4 of the Czar claim, this week shipped 400 sacks of ore amounting to about 15 tons. This ore will, like the previous shipment, net about \$100 per ton. A hoist has been ordered for this lease.

HUMBOLDT COUNTY—ROSEBUD

Durango Girl—Smelter returns from the last shipment from the Ford lease gave \$181.85 in silver and \$5.70 in gold.

LANDER COUNTY—AUSTIN

The Electric Power and Light Company, of Austin, will utilize the waters of Big creek, 12 miles from Austin, for electric power, which will be furnished to the camps of Skookum and Giveenah, the big Austin mill, and the large hoists to be installed on the Union and Frost shafts.

NYE COUNTY—BULLFROG

Keane Wonder—A gold brick worth \$8500 was sent in from Keane Wonder to the First National bank, of Rhyolite, this week. The output of the mine for June was \$15,200, the mill operating less than half the time.

Montgomery Shoshone—Nine large bricks weighing approximately 11,000 oz. were shipped the first of the week to the Selby smelter. In addition to this, which represented the June clean-up, about 35 tons of concentrates were shipped. The total produced for the month was close to \$70,000.

Beatty—The machinery for the 40-ton custom mill is en route from Denver, and the building is going up rapidly.

Rhyolite—The Homestake-King mill owners, owing to exceedingly favorable underground developments, are talking of increasing the new mill to 60 stamps.

NYE COUNTY—MANHATTAN

Security Reduction Company—This company, owning nine claims near Manhattan, is installing a gasolene engine, and in addition to the 20 stamps now in place is putting in a grinding mill and concentrating tables.

NYE COUNTY—TONOPAH

Production—Shipments for the week

amounted to 4930 tons valued at \$127,800, shipping ore averaging \$60, and mill ore averaging \$25 per ton. The shipments were: Tonopah Extension, 130 tons; Tonopah Mining, 2800 tons; Belmont, 700 tons; Montana Tonopah, 1000 tons; Midway, 100 tons; MacNamara, 150 tons; West End, 50 tons.

Montana-Tonopah—The Montana was shut down three days this week to make repairs on the hoisting machinery. The mill lost also one day for repairs.

Belmont—Prospecting on the 1000-ft. level is still going on. The main east crosscut is now about 200 ft. beyond the famous Mizpah fault, no large orebody having yet been found.

MacNamara-West End—The apex fight between the MacNamara and the West End has been settled by compromise, and both stocks have been very strong and active during the present week. Last year the West End proposed a consolidation of the two properties, offering the MacNamara five shares of the Consolidated stock for 14 shares of MacNamara. This the latter company declined to consider.

Tonopah Extension—Experts have arrived to make the independent examination of the company's property which was authorized at the last annual stockholders' meeting in May.

STOREY COUNTY—COMSTOCK

Ophir—A notice has been posted at the shaft house at Virginia City informing the miners that of all receipts over \$50,000 per month, which is about the present income of the mine, 10 per cent. will be set apart and divided among the miners and other employees. The notice frankly informs them that the offer is made as an incentive to increased effort.

WHITE PINE COUNTY—ELY

Nevada Consolidated—One unit of the big concentrator is running and the second unit is expected to start this week. One reverberatory furnace is in operation and it will handle all the product from the roasters for some time to come; when it falls behind another furnace will be blown in. The converters have been started this week and blister copper is now being turned out at Ely.

Veteran—This mine, near Ely, has 235 men on the pay roll at present and is increasing its force rapidly. The 300-h.p. hoist has been tested to satisfaction and will henceforth hoist 1100 tons of ore daily.

South Dakota

LAWRENCE COUNTY

Blue Belle—The Chicago owners have arranged for the commencement of work. A 200-ft. shaft will be sunk, considerable drift work will be done and a new high-grade orebody developed.

Gold Eagle—The new working tunnel is in 150 ft., and will be continued another

150 ft. A new shaft 200 ft. deep is to be started.

Tinton—The mill is treating 25 tons of ore daily, and as soon as some tests are completed this tonnage will be materially increased. The tin product is to be treated in the plant here and then shipped to Liverpool, England.

J. G. LaSarre—The Chicago owners expect to be able to ship regularly in a few weeks; the ore is now being put in shape, and appears to be sufficient.

Schleihardt—J. A. Blatt and others, of Lead, are making good progress in the development of this Nigger Hill gold property.

PENNINGTON COUNTY

Balkan—At the annual meeting the following officers were elected: President, M. Ramonovich; vice-president, John Shanosky; secretary, M. Milokovich, and treasurer, Harry Groth, all of South Chicago. The property at Rochford will be developed this year and a test mill is to be erected.

Golden Metal—Preparations are being made for a resumption. An electric-power plant is to be erected to cost \$50,000, and the 20-stamp mill will be refitted and modernized.

Golden Slipper—A new high-grade ore-body has been opened up and will be developed.

Klein & Burton—The tunnel is in more than 300 ft., and the vein is expected to be cut daily. The property is situated near Hill City.

Evinvale—New machinery is being placed in the hoist in preparation for the sinking of a new 200-ft. shaft. The property contains wolframite. J. Truax is the owner, and has charge of the work of development.

Wisconsin

ZINC-LEAD DISTRICT

Platteville—Good lead ore has been found at a depth of 40 ft. on the Billy Robinson farm, adjoining the Weigle mine on the west. The Empire and Acme companies will resume next week under the management of the Wisconsin Zinc Company; the mines and mills will be operated two shifts per day. The Old Homestead mill is completed and running, the first car of jack assaying close to 50 per cent. zinc. The Forest City will resume work next week. The new pumping plant at the Calemesis, comprising two 16-in. crossheads, is installed and shaft sinking has been resumed. The Washburn will start milling soon.

Cuba City—The Pittsburg and Board of Trade mills are both inclosed and will be finished about Aug. 10. The Erie and the Big Four are pumping and will resume shaft sinking and development work. The Beloit-Elmo has installed a larger pump-

ing outfit for shaft sinking. The Dall and Baxter mines are making big productions, but both are holding their jack for better prices; the Dall has 300 tons of roasted zinc ore and the Baxter has about the same amount of green concentrates. The Dall is making 10,000 lb. of lead per day which more than pays all expenses.

Benton—The Fox company will erect a roasting plant; satisfactory roast tests of their ore are being made at the Enterprise roaster at Platteville. The inclined shaft at the Ollie Bell, owned by the Mineral Point Zinc Company, has just been completed; a 100-ton mill was built on this property last fall, but was not put in operation, awaiting the completion of the incline shaft. Good sheet jack was struck in the Minnie shaft near the Empress. The Good Hope has resumed development work. The Dawson, under new management, is mining and milling again with a limited force. The Pittsburg-Benton, Frontier, Etna, Fox and Vandeventer are each making a big production of jack and considerable lead. The Wiseman, Wilkinson and Only Wonn are making lead exclusively.

Hazel Green—A big deposit of lead ore is being opened up on the Jeffries and Sutherland land, two miles north of Hazel Green. The ore was struck 5 ft. below the surface in a vein 3 ft. wide containing lumps weighing 500 and 600 lb.; two men alone took out 50,000 lb. in two weeks. The new No. 2 mill at the Kennedy will soon be ready for operation. The old mill is running again after a shutdown to overhaul machinery. The mine will be operated two shifts per day as soon as the new mill is completed. The Kennedy and the Mills are shipping their green concentrates, under contract, to the Mineral Point Zinc Company. The Illinois has resumed. The Big Dad is pumping out and will start work again soon.

Canada

BRITISH COLUMBIA—CROW'S NEST PASS

The coal miners in the Crow's Nest Pass district have suffered severely from forest fires of great extent in that region, which spread widely owing to the dry condition of the woods following a long drought. The mining towns of Fernie and Hosmer were destroyed, while at latest dates Coal Creek and Michel were threatened. So far as known 125 lives were lost, and a number of men are missing. The surface plants at the mines of the Crow's Nest Pass Coal Company at Fernie and Hosmer were totally destroyed, the fire descending upon those towns so rapidly that it was impossible to save anything; and it was there that most of the lives were lost. At latest advices, the fire had extended through a belt 70 miles long and from three to six miles wide; while the fire was still extending eastward. The loss to date is estimated at \$8,000,000. The hope of saving the

town and coal-mine buildings at Michel was slight.

ONTARIO—COBALT DISTRICT

Ore Shipments—Shipments of ore for the week ending July 25 were as follows: Buffalo, 63,560 lb.; Coniagas, 82,590; Cobalt Central, 37,440; City of Cobalt, 123,650; Drummond, 109,720; LaRose, 298,130; McKinley-Darragh, 283,980; Nipissing, 176,480; O'Brien, 194,000; Right of Way, 57,180; Watt, 60,180; total, 1,486,910 pounds.

Cobalt Central—On the first level 800 ft. of drifting and crosscutting have been done, and 1000 ft. on the second level. Two drifts have been started at the third level. The concentrator is treating 60 tons daily. On the Bailey property adjacent, which is now under lease to the Cobalt Central company, 100 ft. of drifting has been done on the Big Pete vein at the 65-ft. level. The vein averages 9 in. in width and is reported to contain 5000 oz. silver to the ton. An equal amount of drifting has been done on this vein at the 100-ft. level, the character of the vein being about the same. In crosscutting at 65 ft., a new 6-in. vein was struck.

Columbus—This company, which lost its plant in the fire a few weeks ago, is arranging to install a compressor and will shortly resume underground work. Before closing down, the 160-ft. crosscut at the 150-ft. level struck the main vein, which was about 10 ft. wide at that depth. Drifting along this vein will be resumed.

La Rose—The company is exploring the high bluff, separating its property from the O'Brien and Chambers-Ferland, which turns out to contain a network of rich veins. A series of tunnels is being run, in one of which a vein 1½ in. wide was encountered carrying 1047 oz. silver to the ton; the wall rock for a foot on each side also contained silver.

Nipissing—A force of 325 men is employed, 125 doing surface prospecting. In all 30 miles of trenching have so far been done on the property. A fine new vein, struck on Little Silver ridge, has been opened up 300 ft., and averages 6000 oz. of silver to the ton. It is known as No. 96. A tunnel is being driven into the hill to cut it at depth. This vein is crossed at right angles on the top of the ridge by another newly discovered vein, No. 102. The tunnel, driven from Cobalt lake, is now in 1150 ft., and has been connected by a 40-ft. upraise, with the underground workings of vein No. 49 at a depth of 105 feet.

Progress—A small compressor plant will shortly replace that destroyed by the bush fire. The main shaft is down 100 ft., at which level the vein is of calcite, 14 in. wide.

ONTARIO—SOUTH LORRAINE TOWNSHIP

Haileybury Silver Company—The main

shaft is down 85 ft., the vein at this point being 10 in. wide of calcite and cobalt with silver showing. Machinery will be installed next winter.

Keeley Location—New camp buildings have been erected and development is being pushed by a force of 35 men. About 10 tons of silver ore has been sacked.

Mexico

MEXICO CITY

The campaign, which was being waged by the press of this city against the proposed mining legislation, has suddenly been stopped, whether "by request," or not, is not stated. Whether the lull is due to the fact that public opinion is now molded, or that there is no further necessity, is not apparent. President Diaz, in an interview with a prominent American is reported to have indicated that he would disapprove the anti-foreign clause of the pending law, which is now in his hands.

CHIHUAHUA

Veta Colorado—Construction on the mill at Parral is still delayed. Much of the tank steel is on the ground as well as other machinery, but construction is at a standstill.

San Rafael—Corrigan, McKinney & Co., former owners of the Concheño mine, have completed the purchase of this mine in the Terrazas district.

Parral Production—The production of the Parral camp for the week ending July 18 amounted to 5970 tons, of which about 3000 tons were shipped to smelters and the balance milled locally.

El Porvenir—Shipments of high-grade ore amounting to about 100 tons weekly are being sent out from this mine in the Parral camp. Nat. P. Wilson is the manager in charge.

American Smelting and Refining Company—A contract has been awarded the Trenton Iron Company for the installation of a two-mile aerial tram from this company's Vieja mine in the Santa Eulalia camp to the town of Santa Eulalia. Branch lines to the Velardeña and Santo Domingo mines are also planned. The smelter at Chihuahua is now receiving ores from the Santa Barbara and other camps in this State.

Hinds Consolidated—This company is marketing ore at the Chihuahua plant of the American Smelting and Refining Company. W. W. Elmer is the general manager of this company's Santa Barbara properties.

Dolores Mines Company—This company, recently shipped through the Banco Minero, Chihuahua, silver bullion of the value of 160,000 pesos. The new hydro-electric power plant is now in commission.

Bismark—The London Mining Company, operating this old mine, situated

near Guzman in the northern part of the State, is sending occasional shipments of high-grade ore to the El Paso smelter. R. H. Sutton, is the superintendent.

GUANAJUATO

Production—Shipments of ore and concentrates for the week ending July 25 amounted to \$135,000; bullion, \$149,000; total for the week, \$284,000.

Mineral Belt Railway—A conference was recently held between the officers of the Mexican Milling and Transportation Company and the contractors for its mineral belt railroad; as a result the work is to be pushed to completion at once. At present about 400 men are employed.

Guanajuato Consolidated—This company is reported to be considering the purchase of a slime filter. At present the slime from the 80-stamp mill is treated by decantation, entailing a slight loss in dissolved metal, and in cyanide.

OAXACA

Oaxaca Smelting and Refining Company—The Oaxaca smelting plant of this company has been bought in at public auction by H. D. Milde, former auditor of the company, for the bondholders at \$275,546. There were no other bidders.

Magdalena Smeltery—This plant, which for a time seemed in successful operation by Lloyd R. Hamer and associates, but which is now in the hands of a receiver, has completed the short run made to clean up the ores on hand, and is once more closed down indefinitely.

Oaxaca Iron and Coal Company—This company has denounced about 1500 acres of iron lands near Tlaxiaco, and has a number of experts in various parts of Oaxaca in search of coal and oil.

SONORA

Aguaje—This mine worked by the antiguos for the high-grade silver ore and from which they were driven by the water, is now handled by Eastman and McMillan; good ore is being taken out.

Nacozari Consolidated Copper Company—Ore carrying upward of 1000 oz. silver to the ton has been struck in the workings, but to tap this ledge will necessitate the driving of the main tunnel about 100 ft. farther.

Valdeza Mining Company—This company has installed a small plant on the property near Valdez Pass out of Cos. The ore is free milling gold carrying about \$20 per ton. The plant consists of a crusher, a battery of two Nissen stamps and plates, and the estimated capacity is about 15 tons per 24 hours.

Oso Negro—Messrs. Camp, Ish and associates have started shipments of ore from the property. This ore averages about \$100 per ton, principally in silver.

Las Chispas—At these mines of the Pedrazzini Gold and Silver Mining Company, the mill is resuming operations after

a 40-day shutdown due to lack of water.

Tigra—Two Huntington mills and four Wilfley tables are being added to the concentrator at the mine giving a capacity of about 150 tons daily. Shipments now average about six tons of concentrates and four tons of crude ore per day. Work in the mine is practically confined to development, all ore being the result of such operations.

Moctezuma—At the works at Nacozari the north half of the new concentrator has been in operation for about 30 days. About 750 tons of ore are being treated per 24 hours. This ore averages about 3¾ per cent. copper, and a net saving of about 82 per cent. has been made thus far. The concentrates carry about 12 per cent. copper.

Creston de Oro—At the new plant of the Dawson Mining Company about 20 tons of ore carrying \$12 in gold and 25 oz. silver per ton is being treated daily. The plant consists of a crusher, Lane slow-speed mill, amalgamating plates and a Wilfley table and a saving of about 80 per cent. is made, equally divided between bullion and concentrates.

VERA CRUZ

Burning Oilfield—The big gusher in Tampico district is said to be flowing 70,000 bbl. per day and is still burning. An immense drag is being built to use in an attempt to smother the flame. The hole is said to have increased in size from 6 in. to 12 feet.

Africa

WEST AFRICA

Gold output for June was 23,360 oz., being 867 oz. less than in May. For the six months ended June 30 the total was 146,585 oz. bullion in 1907, and 149,619 oz. in 1908; an increase of 3034 oz. The bullion reported this year was equal to \$2,905,619, or 149,572 oz. fine gold.

New Zealand

The Mines Department reports the exports of gold for the four months ended April 30 at 144,087 oz. bullion in 1907, and 162,382 oz. in 1908; an increase of 18,295 oz. The bullion reported this year was equal to \$3,104,096, or 150,174 oz. fine gold.

South America

BRAZIL

Exports of minerals for the full year are officially reported as below, in metric tons:

	1906.	1908.	Changes.
Manganese ore.....	121,331	236,778	I. 115,447
Monazite sand.....	4,352	4,437	I. 85
Mica.....	6,123	4,501	D. 1,622

Exports of gold bullion were 4548 oz. in 1906, and 3779 oz. in 1907; a decrease of 769 oz. This does not give the full amount of gold shipped, however; only that in the form of bullion.

Metal, Mineral, Coal and Stock Markets

Current Prices, Market Conditions and Commercial Statistics of the Metals, Minerals and Mining Stocks

QUOTATIONS FROM IMPORTANT CENTERS

Coal Trade Review

New York, Aug. 5—The coal trade in the West is quiet for the most part. Here and there a little improvement is reported, but there has been no general forward movement. In some of the large centers there has been a tendency to supply too much coal, with a consequent effect on prices. In the East the bituminous market is dull; though a slight improvement may be reported at a few points, it has been only temporary and local. The anthracite market has been steadier, but this has been due to curtailment of production and smaller supplies in the markets. There is plenty of coal stored to supply any demand that may arise unexpectedly.

COAL TRAFFIC NOTES

Tonnage originating on Pennsylvania railroad lines east of Pittsburg and Erie, year to July 25, in short tons:

	1907.	1908.	Changes.
Anthracite.....	3,218,472	2,925,951	D. 292,521
Bituminous.....	21,627,815	18,165,406	D. 3,462,439
Coke.....	7,994,094	3,799,751	D. 4,194,333
Total.....	32,840,411	24,890,808	D. 7,949,593

The total decrease this year to date was 24.2 per cent.

Receipts of coal at Lake ports for the five months ended May 31 were as follows, in tons, according to the Department of Commerce and Labor:

	1907.	1908.	Changes.
Anthracite.....	861,676	433,258	D. 428,418
Bituminous.....	2,993,519	624,842	D. 2,368,677
Total.....	3,855,195	1,058,100	D. 2,797,095

The total decrease in this period was 72.6 per cent. The receipts of bituminous coal at the upper Lake ports Duluth, Superior and Ashland fell off from 1,233,125 tons in the first five months of 1907 to 96,162 tons in the same period of 1908, a loss of 92.2 per cent.

New York

ANTHRACITE

Aug. 5—Prepared sizes are not moving rapidly except in a few cases. The movement to upper Lake ports has been fairly good, but aside from this not much business has been done. Small steam sizes seem to be in fair demand or rather the production is so curtailed that the supply is being taken readily. Circular prices, which are being cut for prepared sizes, are as follows: Broken, \$4.65, egg stove and chestnut, \$4.90; pea, \$3.25@3.50; buckwheat No. 1 \$2.35@2.50; buckwheat No. 2 or rice, \$1.60@2; barley, \$1.35@1.50; all f.o.b. New York harbor.

BITUMINOUS

It is constantly reported that conditions in the soft-coal trade are better, but these reports are not backed up by specific cases. Throughout New England factories start up and run for about a week only, to shut down on account of lack of orders. This gives the impression, probably, that conditions are better, whereas the improvement is only temporary. In New York harbor the trade continues at a standstill and good grades of steam coal are offered at \$2.45@2.50 with no takers. Fair grades have been offered as low as \$2.25, but no interest has been shown in them.

Transportation from mines to tide has not improved. No change is reported in the Coastwise vessel trade and there are still many vessels seeking business. The rates from Philadelphia are as follows: Boston, Salem and Portland, 55c.; Lynn, 60@65c.; Newburyport, Gardiner and Bangor, 70@75c.; Portsmouth, 55@60c.; Saco, 90@\$1.; Bath, 65@75c.; to the Sound, 45@50 cents.

Birmingham

Birmingham, Aug. 3—Coal production in Alabama is improving slowly, as imported labor is being placed in the mines. At Wylam, for instance, in the western part of Jefferson county, the production is about 25 cars a day against 105 cars during normal conditions. At Brookside, Blossburg and other places in this county, the production is picking up slowly. The operators assert that there will be no giving in to the unions. There have been few shut-downs because of the strike. The furnace companies, in addition to sending out labor agents, are employing a force of deputies to guard their property and protect the men who are working. The military is on duty in the district and the Governor of the State is near to see that there is no violation of the law.

Coke supplies are falling off; the furnace companies have made arrangements to bring in all the coal and coke they can use from Tennessee and West Virginia.

Chicago

Aug. 3—The harvesting trade continues to give a semblance of activity to the coal market, steam and domestic business continuing very light. Demand is exceptionally good from the West and Northwest, and is increasing. In consequence lump coals are finding improved sale.

Illinois and Indiana lump bring \$1.75@

2.35, run-of-mine sells for \$1.60@1.75, and screenings are in relatively heavy supply at \$1.40@1.50.

Hocking is in light but fairly steady demand at \$2.90@3.15, the latter being standard circular price. Smokeless is not so plentiful as regards run-of-mine, with lump hard to get and bringing premiums. Run-of-mine smokeless holds steady at \$3.30. Youghiogheny is quiet at \$3.15 for steam and \$3.25 for ¾-in. gas. Anthracite is hardly at all in demand.

Indianapolis

Aug. 3—For the first time in several weeks Crown Hill mine No. 2 in the Clinton field hoisted coal on July 29, giving employment to 300 miners. During the recent strike the company put in electric haulage and this is now in operation. The mine has the record of the second largest output in the Clinton field. The Deering Coal Company, which is undergoing reorganization, has temporarily shut down its Old Oak Hill mine, but to offset this mine No. 7, where work had been stopped for two weeks for repairs, renewed operation. Work in the entire Clinton field has been fair, but miners are looking forward to a material betterment.

Pittsburg

Aug. 4—There is but little change in the coal trade. Prices remain on the basis of \$1.15 for mine-run coal at mine. Production is at the rate of 60 per cent., although the mines are running to about 75 per cent. of capacity. Operations are not more than five days a week at most of them. The river mines are running to capacity and stocks are being rapidly accumulated. The rise in the rivers was disappointing, as the water was within a foot of a navigating stage when it subsided and the loaded coal was left in the harbor. There is about 10,000,000 bushels loaded and ready to go out.

Connellsville Coke—The demand for coke is increasing and prices are firmer, but there has been no advance. Furnace coke remains \$1.65@1.75, and foundry \$2.10@2.25 on contract. For prompt shipment these prices may be shaded. The Courier, in its report for the week, gives the production in both fields as follows: Connellsville, 121,349 tons; Lower Connellsville, 67,450; total, 188,799 tons. The shipments were 7155 cars, distributed as follows: To Pittsburg, 2987; to points west of Connellsville, 3709 cars; to points east of Connellsville, 459 cars.

Foreign Coal Trade

United States Coal Exports—Exports of coal and coke from the United States six months ended June 30, long tons:

	1907.	1908.	Changes.
Anthracite.....	1,213,354	1,353,060	I. 139,706
Bituminous.....	4,454,888	3,916,830	D. 508,058
Total coal.....	5,668,242	5,299,890	D. 368,352
Coke.....	434,846	323,706	D. 111,140

Exports do not include coal furnished to steamships in foreign trade. Canada took this year 3,992,801 tons of coal, or 75.3 per cent. of the total. The coke went chiefly to Mexico and Canada.

United States Coal Imports—Imports of coal and coke into the United States, six months ended June 30, long tons:

	1907.	1908.	Changes.
Anthracite.....	13	15,023	I. 15,010
Bituminous.....	951,433	815,467	D. 135,966
Total coal.....	951,446	830,490	D. 120,956
Coke.....	72,873	59,533	D. 13,340

Canada furnished this year 532,625 tons of coal and nearly all the coke; Australia, 240,998 tons of coal. The greater part of the imports are on the Pacific Coast.

Iron Trade Review

New York, Aug. 5—A moderate inquiry for pig iron is reported, with some sales, but prices are not firm, and furnaces are still inclined to make concessions for good orders. Southern producers claim that they are holding prices at \$12, Birmingham, for No. 2 foundry, but there is little doubt that iron can be had for 25 or 50c. less.

In finished material the market remains quiet. A few small structural orders have been placed, but on larger contracts negotiations are slow. The only rail orders reported are 7000 tons for the Boston & Maine, and 14,000 tons for the Baltimore & Ohio. Other new business is still light.

United States Steel Corporation—The statement for the quarter ended June 30 is condensed as follows, the net earnings being the balances remaining after paying working expenses, repairs and maintenance, and charges of subsidiary companies:

	1907.	1908.
April.....	\$14,600,838	\$ 6,761,680
May.....	16,056,832	6,021,279
June.....	14,846,035	7,482,797
Total net for quarter.....	\$45,503,705	\$20,265,756
Sinking fund, depreciation and reserve	\$ 3,911,766	
Charges on U. S. Steel Corp. bonds.....	7,311,963	
Total charges.....	\$11,223,729	
Surplus for quarter.....	\$ 9,042,027	

Appropriations made were \$6,304,919 for dividend of 1¼ per cent. on preferred stock, and \$2,541,513 for dividend of 0½ per cent. on common stock; a total of \$8,846,432, leaving a balance of \$195,595. For the first quarter in 1908 the earnings were \$18,229,005, and the surplus was \$7865. The unfilled orders on hand June 30, 1908, were 3,313,876 tons, against

3,765,343 tons at the close of the previous quarter.

Baltimore

Aug. 4—Exports from Baltimore for the week included 40,023 lb. spelter to Antwerp, and 1,122,351 lb. tin scrap to Rotterdam. There were 6111 tons steel rails sent to Mexico. Imports of iron ore were 5450 tons from Cuba.

Birmingham

Aug. 3—Alabama producers of iron announce that there has been no reduction caused by the strike of the coal miners and that all orders are being promptly filled. There is some business still being transacted and the market is considered firm. Prices are a little firmer, \$12 per ton for No. 2 foundry, being the average. There is a large quantity of iron being consumed in the district by the cast-iron pipe plants and other industries.

The Tennessee Company announces that the four furnaces in blast at Ensley broke a day's record during the past week, producing more than 1500 tons of iron. The other two furnaces at Ensley are undergoing repairs. Some time was lost at the big steel plant at Ensley during the past week, the fuel running light. Steel is being shipped out as quickly as manufactured.

Chicago

Aug. 3—Sales of pig iron continue light, as to both individual orders and aggregate amount. There is a renewal of inquiries for the future, and a few sales run into the first quarter of next year. In general, however, the demand is for only iron to supply needs of the next three months. The size of lots does not run over 100 tons as a rule, larger orders coming only from the exceptional smelter who feels his selling contracts secure. Foundries are running still as closely to the wind as possible.

Southern iron varies considerably, sales being made at \$11.50@12 Birmingham (\$15.85@16.35 Chicago), and perhaps lower than \$11.50. Northern holds at \$17 @17.50, with the demand fairly steady, though light. Lake Superior charcoal brings \$20@20.50, with small sales. These prices are for the last half, early-delivery iron bringing less.

The sale of iron and steel products is very light in nearly all lines, structural materials showing a little activity. Coke is quiet at \$4.90 for the best Connellsville.

Philadelphia

Aug. 5—Large sales for early delivery have been made within a few days of pig iron for cast-iron pipe, of bridge material and rails. These transactions have exerted a favorable influence on the pig-iron market, but not on prices. Orders for 1000 or 500 tons are taking the place of

orders for 100 or 200 tons. The sold-up condition of most Southern furnaces is serving to strengthen Eastern pig. Basic pig has sold more freely. No. 2 foundry averages \$16; forge about the same.

Steel Billets—Some long-standing negotiations for billets were terminated today in orders for the delivery of material. Billets continue weak in price.

Structural Material—Quite a little lump of new business has shown up during the past few days. Considerable building is to be pushed to completion before cold weather. The material is now being ordered.

Pittsburg

Aug. 4—Outside of a decided slump in pig-iron prices the iron and steel markets are in good shape. More mills were started this week, and the general outlook is better. There is a healthier inquiry for all material. The large interests are booking many orders, but all are for small tonnage, indicating that buyers are only covering for immediate requirements. In structural material some important contracts are in sight. The largest so far placed calls for 13,000 tons of steel for the new Oliver building. It will be filled by the American Bridge Company. The Republic Iron and Steel Company is still taking small orders which warrant the operation of all of its plants in the North. The Carnegie Steel Company is running its most important works, outside of the Edgar Thomson rail mill, to capacity. Another furnace was put in operation this week, indicating that more than 60 per cent. of its finishing mills are running. The only discouraging feature is the shutting down of over 80 of the hot mills of the American Sheet and Tin Plate Company. The only explanation given is that the hot mills have been breaking records of production and got ahead of the finishing mills. The tinplate output despite the closing of the hot mills shows no decline.

Pig Iron—There is an alarming drop in the prices of the best grades of pig iron, and the only explanation is in the fact that there is a surplus of stock and furnaces are willing to shade prices to get rid of these stocks. One of the most important deals was the sale of 300 tons of bessemer iron at \$15.50. Valley. The Page Woven Wire Fence Company came into the market for 400 tons of bessemer for ingot molds, and got the iron at \$15.45. Another sale was made at \$15.40 at furnace, and it is believed this price can be duplicated for delivery in the third quarter. Foundry iron also has been shaded, and there is no difficulty in doing \$14.40 at furnace. The Standard Sanitary Manufacturing Company came into the market this week for 8000 tons of foundry iron for September and October delivery; 3500 tons of Southern for its Louisville plant, 4000 tons of Valley and 500 tons of Virginia iron for its New Brighton and

Allegheny works. Malleable bessemer and basic iron remain firm at \$15, and gray forge at \$14, Valley furnace.

Steel—The steel market continues firm, and no shading of the price of \$25, Pittsburg, for bessemer and open-hearth billets is reported. Some good sales were made during the week at the regular prices. Plates remain at 1.60c. and merchant-steel bars at 1.40c.

Sheets—The sheet mills are running to about the same capacity as last week, and prices remain firm. Black sheets are still quoted at 2.50c., and galvanized at 3.55c., for No. 28 gage.

Ferro-manganese—Prices are firm at \$46@47, Pittsburg.

The silver market has fluctuated between 24 3/16 and 24 3/8d. in London, without any special feature. The market still depends on the Indian demand.

Messrs. Pixley & Abell report silver shipments from London to the East for the year to July 23:

	1907.	1908.	Changes.
India.....	£7,087,574	£4,467,193	D. £2,620,381
China.....	.....	516,400	1. 516,400
Straits.....	544,012	90,510	D. 453,502
Total.....	£7,631,586	£5,074,103	D. £2,557,483

Receipts for the week were £218,000 from New York and £5000 from Mexico; total, £223,000. Exports were £2500 to Egypt and £149,000 to India; £151,500 in all.

Metal Market

**Gold and Silver Exports and Imports
NEW YORK, Aug. 5.
At all U. S. Ports in June and year.**

Metal.	Exports.	Imports.	Excess.
Gold:			
June 1908..	\$ 8,626,718	\$ 3,409,885	Exp. \$ 5,216,833
" 1907..	23,872,140	2,165,342	" 21,706,798
Year 1908..	53,607,975	26,368,198	" 27,139,777
" 1907..	36,300,732	21,468,647	" 14,832,085
Silver:			
June 1908..	4,437,360	3,366,182	Exp. 1,071,178
" 1907..	5,360,599	3,476,546	" 1,884,053
Year 1908..	25,514,545	21,054,332	" 4,460,213
" 1907..	29,219,209	22,395,611	" 6,823,598

Exports of specie from New York, week ending Aug. 1: Gold, \$200, to Mexico; silver, \$981,123, to London and Paris. Imports: Gold, \$156,264, from Central and South America; silver, \$333,866, from Mexico and Central America.

Specie holdings of the leading banks of the world Aug. 1, are reported, as below, in dollars:

	Gold.	Silver.	Total.
Ass'd New York.....	.....	.....	\$321,313,400
England.....	\$185,601,945	.....	185,601,945
France.....	638,402,753	\$181,439,395	819,842,150
Germany.....	204,075,000	84,575,000	288,650,000
Spain.....	78,340,000	134,945,000	213,285,000
Netherlands.....	38,518,000	21,230,500	59,748,000
Belgium.....	20,223,335	10,111,665	30,335,000
Italy.....	183,555,000	22,000,000	205,555,000
Russia.....	580,170,000	39,725,000	619,895,000
Aust.-Hungary.....	235,080,000	67,315,000	302,395,000
Sweden.....	20,145,000	.....	20,145,000
Norway.....	8,400,000	.....	8,400,000
Switzerland.....	19,775,000	.....	19,775,000

The New York banks do not separate gold and silver. The foreign statements are from the *Commercial and Financial Chronicle* of New York.

Silver Market

SILVER AND STERLING EXCHANGE.

July-August.	Sterling Exchange.	Silver.		August.	Sterling Exchange.	Silver.	
		New York, Cents.	London, Pence.			New York, Cents.	London, Pence.
30	4.8690	52 3/4	24 5/8	3	4.8685	52 3/4	.....
31	4.8695	52 1/2	24 5/8	4	4.8670	52 3/4	24 3/4
1	4.8690	52 1/2	24 5/8	5	4.8645	52 3/4	24 1/4

New York quotations are for fine silver, per ounce Troy. London prices are for sterling silver, 0.925 fine.

Copper, Tin, Lead and Zinc

DAILY PRICES OF METALS.

July-August.	Copper.			Tin.	Lead.	Spelter.	
	Lake, Cts. per lb.	Electrolytic, Cts. per lb.	London, £ per ton.	Cts. per lb.	Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.
30	13 1/8 @ 13 1/8	13 @ 13 1/8	59 3/4	30 3/8 @ 4.47	4.65 @ 4.70	4.65 @ 4.55	4.50 @ 4.55
31	13 1/8 @ 13 1/8	13 @ 13 1/8	59 3/8	30 3/8 @ 4.47	4.65 @ 4.70	4.65 @ 4.55	4.50 @ 4.55
1	13 1/8 @ 13 1/8	13 @ 13 1/8	.....	30 3/8 @ 4.52	4.70 @ 4.70	4.65 @ 4.55	4.50 @ 4.55
3	13 1/8 @ 13 1/8	13 @ 13 1/8	.....	30 3/8 @ 4.52	4.75 @ 4.75	4.65 @ 4.60	4.55 @ 4.60
4	13 1/8 @ 13 1/8	13 @ 13 1/8	60 1/8	30 3/8 @ 4.52	4.70 @ 4.75	4.65 @ 4.60	4.55 @ 4.60
5	13 1/8 @ 13 1/8	13 @ 13 1/8	61 3/8	31 @ 4.57	4.72 @ 4.77	4.60 @ 4.65	4.65 @ 4.65

London quotations are per long ton (2240 lb.) standard copper, which is now the equivalent of the former g.m.b's. The New York quotations for electrolytic copper are for cakes, ingots or wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The price of cathodes is 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary Western brands; special brands command a premium.

Copper—The advances noted recently have continued without a check on any hand. Demand has been active, and the capacity of sellers was severely taxed during the week. Business has been done on a larger scale than at any time since the exciting days of last October. The orders for copper came from all sources, and are evidence of a rapid return to a normal level in the business of the large consuming interests. The market has reflected the heavy transactions by a steady advance in prices, and the close is firm at 13 3/8 @ 13 3/8c. for Lake; 13 1/4 @ 13 1/4c. for electrolytic in ingots, cakes and wirebars. Business in casting copper during the week has been done on an average of 12 3/8 @ 12 7/8, the close being 13 1/8 cents.

The London standard market was quick to take notice of the improvement reported from this side, and a heavy speculation ensued, which advanced the prices rapidly, notwithstanding the Monday holiday, and brought the market at the close to £61 7s. 6d. for spot, £62 5s. for three months.

Refined and manufactured sorts we quote: English tough, £63@64; best selected, £63@64; strong sheets, £75@76.

Exports of copper from Baltimore for the week, as reported by our special correspondent, were 1478 long tons.

Manufactured Copper—Sheets, cold-rolled, 17 1/2c.; hot-rolled, 16 1/2c. Wire, 15c. base.

Tin—Notwithstanding the fact that the domestic market did not give any encouragement to the London market so far as buying orders were concerned, the latter kept remarkably steady and closes at £137 12s. 6d. for spot and £138 17s. 6d. for three months.

The domestic market moved within narrow limits and transactions were confined to spot stock only, which is small and well concentrated. Spot tin is, therefore, practically independent of London quotations, and is selling at a considerable premium. Business at the close has been done at around 31 cents.

Lead—There has been a great deal of activity throughout the week, owing to buying on part of both consumers and speculators in anticipation of higher prices. This materialized today in a rapid advance; the close is firm at 4.57 1/2 @ 4.60c. New York.

The London market has been strong and advancing throughout the week, and closes at £13 10s. for Spanish lead and £13 11s. 3d. for English lead.

Spelter—It is reported from the West that the bulk of the stocks which have been a menace to the market for so long have been liquidated, and that it was due to this liquidation, which went on so gradually as to pass unobserved, that the depression in this metal was of such long duration. The advance which took place during the past week is, therefore, quite logical, and as the output of spelter is still away below normal a further advance is looked for. The close is strong and advancing at 4.72 1/2 @ 4.77 1/2c. New York, and 4.60 @ 4.65c. St. Louis.

Spelter has been neglected in the London market, and closes for good ordinaries at £19, and £19 5s. for specials.

Zinc Sheets—Base price is 7c., f.o.b. La Salle-Peru, Ill., less 8 per cent.

Other Metals

Antimony—Buyers are entirely indifferent to the market, and prices are nominal. Quotations are unchanged at 8 1/2c. for Cookson's, 8 3/4c. for Hallett's and 8 @ 8 1/4c. for ordinary brands.

Aluminum—Ingots, American No. 1, in large quantities, 33c. per lb. Rods and wire, 38c. base; sheets, 40c. base.

Cadmium—In 100-lb. lots, \$1.25 per lb., at Cleveland, Ohio.

\$25; La Salle, \$15.50; Mass, \$7.75; Michigan, \$14.25, and Wyandot, \$2.62½. Adventure is known to have this lode, and the Mass mining people are believed to be negotiating for the purchase of adjoining property. Allouez is up \$3.75 to \$38.25, and Centennial \$2.50 to \$30.75. Copper Range rose \$3.25 to \$80.50. Franklin, \$3 to \$14.50. Persistent buying of Butte Coalition has put the stock up \$3.25 to \$30, and North Butte, \$5.12½ to \$86.37½, although the latter has reacted moderately.

The Curb has also shown improvement in prices. Since T. W. Lawson has taken hold of this market business has been good. Lake Copper and Miami have been the mining features. These and Utah Apex are likely to be listed on the Exchange shortly. Many of the Curb representatives of Exchange houses have gone into business for themselves under the late ruling of the Stock Exchange.

San Francisco

The mining stock exchanges of this city are following up cases where operators have been swindling the public in various ways. Some men were arrested this week who, it was found, had been removing the cancellation stamp from returned mining stock certificates, and then reissuing the certificates as new stock. The matter was brought to the attention of the Grand Jury and investigation followed, resulting in the arrest of some of the operators. Similar cases are to be pressed with a view to punishing the gang of operators who have been following this and similar practices.

STOCK QUOTATIONS

Table with columns for NEW YORK, BOSTON, Name of Comp., Cig., and dates Aug. 4. Lists various mining stocks and their prices.

*Ex. Div. †Ex. Rights.

‡Last quotation.

N. Y. INDUSTRIAL, ST. LOUIS Aug. 1, LONDON Aug. 5. Tables listing various industrial stocks and their prices.

NEVADA STOCKS. Aug. 5. Furnished by Weir Bros. & Co., New York. Table listing Nevada mining stocks and their prices.

Table with columns for Name of Comp., Cig., and prices. Lists stocks from COLO. SPRINGS, GOLDFELD, and other locations.

Assessments

Table listing various companies and their assessment details, including delinquency, sale, and amount.

Monthly Average Prices of Metals SILVER

Table showing monthly average prices of silver in New York and London from 1907 to 1908.

New York, cents per fine ounce; London, pence per standard ounce.

COPPER

Table showing monthly average prices of copper in New York (Electrolytic and Lake) and London from 1907 to 1908.

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling per long ton, standard copper.

TIN AT NEW YORK

Table showing monthly average prices of tin in New York and London from 1907 to 1908.

Prices are in cents per pound.

LEAD

Table showing monthly average prices of lead in New York and London from 1907 to 1908.

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

SPELTER

Table showing monthly average prices of spelter in New York, St. Louis, and London from 1907 to 1908.

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