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The Situation in Copper

The last report of the Producers' Association was generally regarded as favorable and the market which was beginning to wobble has picked up again since its publication. The only criticism that is voiced pertains to the discrepancy between the production of the refiners and that of the smelters.

In 1910 the refinery production had attained a total of rising 125,000,000 lb. per month before the curtailment. Since December, 1911, most of the old producers have returned to their former maximums while the new producers have been contributing upward of 12,000,000 lb. per month. Consequently the actual production has been upward of 135,000,000 lb. per month. This figuring is confirmed by the individual monthly reports.

It appears therefore that we have learned how to add to our production without really doing so. On this theory the working of the law of supply and demand might be baffled, the price for copper might rise to 25c. per lb. stimulating new production, and yet the latter would be without effect. However, we do not think that any such thing will happen.

In the meanwhile the chief question of interest is, What has become of the increased production? The refiners to a man deny that they have accumulated any unusual quantity of crude copper.

We are inclined to think that the surplus unaccounted for is distributed in a variety of forms and places. What we call the smelters' statistics are in the main just that, but included in them is some production in the form of ore, e.g. the Alaska, Chino, and Ray products and also some foreign supplies. There may have been an increase in the stock of ore at the smelters. This has been necessarily the case at the new Hayden works.

Some of the refiners have been increasing their capacity and in putting new plant into operation some copper has gone into the electrolyte, where it is permanently locked up.

The foregoing are two undoubted, partial explanations. For the rest, the statements of the refiners are probably to be taken *cum grano salis*. No one may be carrying any large accumulation of crude copper, but several may have a little more on hand than ordinarily, while there may be an increased quantity in the vats and in the between-products of the works, and perhaps an increased quantity of crude copper at the smelters and in transit.

The increase in the production of refined copper is already overdue, but sooner or later it will appear. In the meanwhile valuable time has been gained. The question is, Can the gain be held? The rate of ultimate consumption will answer this. European consumption has certainly been well maintained and American has improved without doubt, but it is questionable whether the combined requirement from this market is equal to the production of the mines. Probably it is not. A great deal of the copper that we have exported has obviously been taken by speculative interests, who will aim to maintain the price until they have distributed what they are carrying and it is not unlikely that they will accomplish what they are planning. Pending that consummation the market is likely to exhibit such halting and irregularity as we have witnessed lately, with fitful spurts and slow relapses.

Proposed Arizona Legislation

We are informed that the Hall bill introduced in the Arizona legislature, which we commended last week, has been dismissed without discussion by the legislature, and that a very drastic bill, giving the mine inspector rather full judicial authority to punish by fine or imprisonment if he (the inspector) be not implicitly and summarily obeyed, has replaced the Hall bill and may possibly pass.

This bill, of course, departs from the fundamental conditions of the engineering committee. That committee proposed

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that the inspector should be a policeman, not a combination of policeman and judge, which ought not to be, as most sensible persons will agree. An inspector clothed with the police power of a state, as for example the inspectors of the health department in the city of New York, may have great power but when that is given the state assumes the responsibility to answer to citizens who may be improperly interfered with. Of course, even then the inspector is far from being a judge.

The Advance in Aluminum

A sharp advance in the price of aluminum abroad has followed the announcement that the large manufacturers of that metal in England, France, Switzerland, Germany and America have agreed upon the basis for a new convention, which is to put an end to the close competition and low prices which have been the rule since the old syndicate was dissolved two years ago. Although only a preliminary agreement has been made, there has been an advance in London of £10 per ton, and in Germany of 20 to 25 marks per 100 kg. A further increase in prices is expected. In this country the imports of aluminum for some time past have been very considerable—over 6,000,000 lb. for the first quarter of the present year—and the foreign market has governed prices here, the American producer meeting the prices at which imported ingots could be laid down in New York, duty paid.

It is claimed that there has been no profit, sometimes even a loss, at the prices which have recently prevailed. There is little doubt that in Europe they have been uncomfortably close to the cost of production. It is quite probable, however, that the advance in prices may not be carried much further. It would hardly be good policy to do so, since too high quotations might check the demand in certain directions, though in others—automobile construction, for instance—the metal has become almost essential. It seems quite probable at present that ingots may go up to at least 25c. here, in place of the level of 18@20c. which has prevailed for some time past.

The close of the meetings at Paris, in which the reconstitution of the syndicate was completed, was accompanied by as-

surances, made through the president of the Neuhausen company, that there was no intention of trying to force up prices to the high levels maintained by the old syndicate. The intention was to maintain prices which would enable the makers to secure a fair profit only and to recover from the losses resulting from the recent competition. Though the spokesman did not state it, there is a certain reason for this moderation. The basic patents which permitted a certain monopolization of the manufacture have nearly all expired, and there is nothing to prevent new companies from entering the business, should it promise high profits.

Extraction Determinations in Cyanide Mills

In most cyanide mills a sincere effort is made to keep a record of results obtained. Theoretically, it seems a simple matter to ascertain the percentage of extraction, for instance, since, unlike some metallurgical calculations, this one involves nothing more intricate than arithmetic. The difficulty, of course, lies in accurately determining the value of the factors on which the calculation is based, which in many cases is a real problem.

The metallurgical record should show the total ounces of gold coming to the mill in the ore, the quantity recovered in the form of amalgam, concentrate or bullion, and the amount lost in the tailings. For this information, tonnage determinations and assays are necessary and the methods employed are various.

Where automatic weighing and recording devices and automatic samplers are used these determinations are much simplified but such an arrangement is not feasible in all mills. The ingenuity of the individual operator, consequently, is called upon to work out a plan of his own. Sometimes the ore is brought to the mill in railroad cars and the weights furnished by the railroad company offer a convenient basis for figuring the tonnage treated. In other cases it is more convenient to calculate the tonnage from the number of sand and slime tanks filled; the volume of the tanks being known, and the specific gravity and moisture of the pulp, being determined for each charge.

Some operators make no attempt to determine the amount of the gold in the crude ore, relying upon assays of the tailings and the bullion returns for their

calculations. The disadvantage of this method is that it allows no means of checking the results. This is an important consideration, especially in mills using zinc shavings where there is always the temptation of crediting the boxes, after cleanup, with the gold not accounted for in other ways. The difficulty of obtaining the value and amount of used zinc put back in the boxes lends itself well to this procedure, and is one of the arguments in favor of zinc-dust precipitation.

The article by Mr. Nordberg, of which we begin the publication in this issue, was inspired by a paper published in the bulletin of the American Institute of Mining Engineers and starts off as a refutation of certain fallacies of that paper, but soon passes into a general summary of systems of hoisting. Being a contribution by a past master of this subject, an engineer who has built many of the greatest hoisting plants of this country, we think that his present expression of opinion is particularly noteworthy and will command the interest of all of our readers who have to do hoisting on a large scale.

The decision of Judge Lacombe of the U. S. Circuit Court, rendered on May 14, in the case of the Nipissing Mines Co., that the Government may not collect a tax on the net income of a mining company, but must allow for the depreciation in the value of the mine resulting from the withdrawal of ore, is a high legal indorsement of the theory that the dividends of a mining company are in part merely the reimbursement of principal.

An unusual feature of the Joplin ore market this week is that the base price of 60% zinc ore ranged from \$2 to \$4 per ton above that of lead ore. The base price of zinc was from \$54 to \$56, while lead ore sold at an average just over \$52. One cause is a short supply of zinc ore resulting from recent heavy rains.

The effect of the coal strike in Great Britain on the iron trade is shown by the fact that on March 31 there were only 55 blast furnaces in operation, the usual number being from 240 to 250. The average number in blast for the quarter was 215. The production of pig iron in March was cut down to about one-quarter of the usual quantity.

By the Way

The promoters of Highgrade, the rechristened Hoag district in the northeastern corner of California, appear to be much concerned because the state mineralogist has suggested that their advertisements be confined to facts.

A curious accident is reported from Pittsburg. Twenty-two men were carrying a bar of iron 29 ft. long at the Pittsburg Steel Co.'s Monessen plant on May 8 when a bolt of lightning struck the iron, twisted it into an "S" shape, knocked all the men unconscious, and internally injured two.

One of our daily contemporaries is fortunate in being gifted with second sight. Last Thursday it said confidently: "Copper prices on this side, however, will be advanced shortly. The next move will be to place the metal on the 16½c. basis, and from that level a gradual advance will take place."

The total number of shares in the Guggenheim Exploration Company is 207,933. At the last annual meeting 169,573 shares were voted, of which the Guggenheim-Whitney interests were supposed to control 92,698. Members of the Whitney family, however, owned only 44,663 shares and members of the Guggenheim family only 28,277 shares.

A shipment of a carload of pig iron was made from Heroult, Calif., to Salt Lake City on May 10. This iron is made from Pitt River ores in the electric furnace. It is notable as being the first California pig iron shipped out of the state; and also, we believe, as one of the first commercial shipments in this country of pig iron made in the electric furnace.

Bids have been asked for supplying 3,986,500 lb. of dynamite for use on the Panama Canal next year. This sounds like a large noise, but as a matter of fact indicates that the canal is approaching completion. Over 8,500,000 lb., or more than double the above amount, were bought for the canal work of the present year; in the eight years of digging, a total of 50,517,650 lb. of explosives have been used.

The sense of humor is not equally possessed. We have learned that some remarks in this column on May 4 have been misunderstood, so we make haste to explain. We have, upon several occasions, expressed our confidence in the statistics of the Copper Producers Association and our appreciation of their value, and we feel both just as much as ever. The sole point of our remarks was the futility of undertaking to forecast the monthly returns and our humor, if any there were, was directed at the prophets, not at the producers.

The Vieille Montagne company of Belgium in 1911 produced 108,568 metric

tons of spelter, 4402 tons of lead and 98,108 tons of sulphuric acid. The net profit of the year amounted to £424,644, of which £189,144 were carried to the amortization and reserve fund, £27,187 paid for the expenses of administration, and £207,000 were distributed in dividends. This ancient, honorable and successful mining and metallurgical company is one of those that has learned that an amortization fund is a necessity of conservative financing. It will be observed that the distribution of profits as dividends in 1912 was less than one-half of the net operating profit.

The following contribution to the literature of the apex law is printed, as received, by the *Colorado School of Mines Magazine*, May, 1912: Dear Sir' As i am a Mineral prospector & do prospect locations from surface showings called apex of a lead or vein i believe if i understand aright—that the apex of a ore body holds good even if the angel or pich goes down so as to vertically be on anothers ground & apexes on the prospectors ground the prospectors are the rightful owner of the ore. Well i see there has bin efforts made by some advocator for the vertical ownership, that would do the prospector & ruin already a many a locator that holds good developed apex shoings—i hope this will meet your approval to advocate the apex-right May always hold good as a prospector locator i remain as ever for the apex law to hold all dips & angels."

The punishment of the illegal wire pools managed by Edwin E. Jackson was the most successful accomplishment of the Department of Justice in the prosecution of such offenders. In the trial of the suit against the U. S. Steel Corporation, now in progress, Samuel J. Bailey, assistant to Edwin E. Jackson, told how the "horseshoe pool" worked, especially in the case of government contracts. Whenever such a contract was to be let, Jackson decided what company should receive it, and notified that company what its bid should be. Then he sent a circular letter to the other members of the pool informing them of his decision, and adding that if they cared to make a tender they should bid according to a schedule of prices for the various kinds and grades of shoes which he specified. Some of the companies sent in bids at the higher rates, and the government officials supposed they were really getting competition. Jackson allotted a fair share of government business to each member of the pool every year. All business was taken by the component firms on a percentage basis, and if in the annual reckoning one firm fell below its allotment, it received so much per keg from the association for the number of kegs it fell short, and *vice versa*.

Reports of enormously rich discoveries in Bolivia were circulated last year and as the result a number of American miners went to that country. The American Legation at La Paz cabled on May 2 to the State Department at Washington that "many of these miners were now returning from the Tipuani River bringing unfavorable reports of the quantity of gold found there." There is gold in Bolivia but it will doubtless require the same arduous and indefatigable effort to deposit it in the pockets of the miners that is required elsewhere. Apropos of Bolivia, an American engineer wrote under recent date "Send your friends to buy tin mines in Bolivia. It is the best mining country in the world for rich mines, opportunities, altitude, and pneumonia—though the Gringos are peculiarly exempt from the last. What the west coast of South America needs most is a through line of American ships, thus giving us more direct transportation and other advantages. The real gold strike of the West coast is the one made at Putú, Chile, of which the JOURNAL has already made mention. Last week Putú took out a pocket of 62% gold ore weighing 58 kilos? They are hard after another pocket now. It will be a magnified jewelry shop if it keeps up."

The divining-rod salesman should not find a fertile field in Utah where supernatural visions and revelations are at the miner's elbow if he but placed himself *en rapport*. A Salt Lake paper records the dream prospecting of a Brigham City woman, who had a vision 10 years ago that a gold mine would be found by driving a tunnel into a certain prominent outcropping in the mountain two miles southeast of that beautiful little peach village. At the time her husband, the local district attorney, merely laughed the matter off. But the dream was repeated time and again and finally the attorney himself had a similar nocturnal visitation. It was no longer to be scouted, and the two went to the spot and began with their own hands driving an adit into the hills. When two miners last September visited the place, they found the plucky woman holding the drill while her sturdy worse-half dealt the blows which might mean future affluence. A 6-ft. vein is reported and 50 claims located, extending from Box Elder Creek to Three Mile Creek Cañon. A 2,000,000-share company has been organized with the head dreamer as treasurer. We only trust that she will be equally successful in dreaming real dividends into the pockets of shareholders. The legend of the discovery of the Beck Tunnel by revelation is well known. But, revelators like baseball pitchers have their off days and Mountain Lake, for example, proved no better than other prospects in the Cottonwoods that were not so favorably introduced.

New Construction

Inspiration Consolidated Copper Co., Miami, Ariz., has authorized construction of a 7500-ton concentrator, work to start when a site has been selected. Henry Krumb is consulting engineer.

Tonopah-Belmont Development Co., Nevada, is erecting a 500-ton mill at Tonopah, estimated cost, \$435,000. Frederick Bradshaw, Tonopah, is general superintendent.

Northern Customs Concentrator, Cobalt, Ont., is adding 40 stamps and accessories at \$75,000 estimate cost.

Shattuck-Arizona Copper Co., Bisbee, Ariz., will erect a 400-ton smeltery, at Douglas. John Olson, Bisbee, is superintendent.

Timber Butte Milling Co., Montana, organized by Senator Clark, will erect a zinc-ore concentrator at Butte.

Calumet & Hecla will construct another regrinding plant, at Lake Linden, Mich. Equipment will include 64 conical tube mills. Work has started. James Mac Naughton, Calumet, is general manager.

Porcupine Gold Mines Co. is constructing a 100-ton mill on the property, at Porcupine, Ontario.

Anaconda Copper Mining Co. will reconstruct its Great Falls smeltery in Montana, at an estimated cost of \$2,500,000.

Osceola Consolidated Mining Co. will construct a steel rockhouse at No. 3 North Kearsarge shaft, in Michigan. Frank H. Haller, Osceola, Mich., is superintendent.

Munro Iron Mining Co. is erecting extensive mine buildings at the Rogers iron mine, in Michigan.

Granby Consolidated Mining, Smelting & Power Co. is erecting a 2000-ton smeltery at the Hidden Creek mine, in British Columbia. Estimated cost, \$1,000,000. Jay P. Graves, Phoenix, B. C., is general manager.

International Lead Refining Co. will erect a lead refinery at East Chicago, Indiana.

Boston & Corbin Copper & Silver Mining Co., Montana, will build a 200-ton concentrator at the mine. H. E. Emerson, Corbin, is manager.

Butte & Superior Copper Co. is completing a zinc concentrator of 200,000 tons yearly capacity, at Butte. R. M. Atwater, Jr., Butte, is manager.

Old Dominion Co., Arizona, has let a contract to the El Paso Foundry & Machine Co., for a separate flue and dust chamber for the converter plant. Plans are being drawn by G. Caetani to increase the dressing works to 1000 tons capacity. George Hegardt, Globe, is superintendent.

Arizona Copper Co., Arizona, is constructing a smeltery at Clifton. Grading has been done. Norman C. Carmichael, Clifton, is general manager.

Calumet & Arizona Mining Co., Arizona, is erecting a new smelting works at Douglas. Repath & McGregor are designing and supervising construction. John C. Greenway, Warren, Ariz., is general manager.

Nipissing Mines Co., Cobalt, is erecting a low-grade mill. Work is well under way.

Ferdinand Schlesinger, of Milwaukee, owner of the Newport iron mine in Michigan, has purchased 425 acres of dock property in Hammond, Ind., as a site for one or more manufacturing plants to utilize ore and coal, from companies with which he is associated.

The Highgrade District

FORT BIDWELL CORRESPONDENCE

The first real excitement in this district occurred about 50 years ago, when a man named Hoag brought in good specimens of free-gold bearing quartz. He was tortured and killed by the Indians and no further interest in the country was taken until August, 1905, when a young sheepherder, named Lorenzo, brought in a piece of rock from what is now known as Discovery Hill, and showed it to the Kafader brothers who conducted a blacksmith shop. Immediately the five Kafader boys went into the hills and the boy showed them where he had found the rock. The vein stood up through the country and running through it were about 2 in. of white quartz, showing free gold in hand specimens.

RANCHMEN DID EARLY MINING

This is what brought in the ranchmen, sheepmen and cowmen from the Surprise and Goose Lake Valley region. They knew nothing about mining, failed to follow the pay shoots which they uncovered on surface, and persisted in driving tunnels without any sense of direction. Much money has been spent by the ranchmen in this manner. There are few claims owned in the district in which there are less than four interests. About 500 locations have been made by prospectors and field men here.

The chief reason for this tunnel work is explained by the following incident: One of the above mentioned Kafader boys pointed out a place where he stated there is a vein that pans for over 300 ft., assaying about \$15, remarking, "But there was no tunnel site and we will not work in a shaft because it is dangerous to work way down in the ground with a chance of a rock falling down upon one and maiming or killing."

LIVING CONDITIONS GOOD

Living conditions here are good. A room and good board can be obtained for \$1.50 per day. The small bank has \$316,000 on deposit, 50,000 cattle are

running through the hills together with large bands of sheep, and the ranchers are wealthy. Excellent flour costs \$2.50 per 100 lb. and a good cut of meat, 12c. per lb. The New Bidwell hotel furnished the rates quoted above. There are from 8 to 10 ft. of snow on the ground and more coming down. The Sunshine, the much discussed and advertised mine of the district, is situated on a small hill on the north slope of Discovery Hill, at an altitude of 7800 ft. A 22-ft. shaft has been sunk near what appears to be the apex of the hill and a 42-ft. shaft has been sunk at a point 20 ft. north of this. A tunnel driven into the hill at the east end of this claim, following the high-grade ore into hill for 150 ft., gives backs that are estimated to be not in excess of 75 ft. About midway between the portal and breast of the tunnel a stope was broken out, 30 ft. high and 32 ft. long.

FISSURE VEINS

The vein is a fissure and stands at about 79°; the walls appear to be basalt on the foot and porphyry on the hanging. The fissure is regular, unbroken and from 5½ to 6 ft. wide. The pay streak is from 5½ to 6 in. wide, that is, it will about average this throughout. It consists of mud, talc and broken pieces of oxidized quartz; the remaining part being a coarse-grained, white quartz, with oxidized spots that contain the gold. The free gold can be seen in picked specimens. A fair sample of this high-grade streak assayed \$491.60 per ton. Five feet of the vein, without this seam, assayed \$24.40 per ton. In the breast of the tunnel, at an estimated depth of 75 ft., the high-grade seam for 5½ in. assayed \$253 per ton and chipped samples from the remainder of the vein, 5 ft., ran \$9.30. The material in the fissure appears not unlike the brecciated mass found in the Victor mine at Cripple Creek.

The Fort Bidwell Consolidated's Sugar Pine and the Big Four mine are among the older properties that installed milling equipment last year. Winter conditions, however, arrived before any satisfactory tests were obtained. These mills will operate on a fairly low-grade ore, with occasional high-grade streaks.

From what can be seen of the large dikes that traverse the country, it appears that the main vein systems should run north and south. Most of the field men now in the district feel that with proper mining and prospecting there is a chance to make a camp here.

The U. S. Geological Survey has just issued a large map of North America, 28x38 in., in three colors. It is on a scale of 158 miles to 1 in., and may be obtained from the Director of the Geological Survey, Washington, D. C., at 20c. per copy.

Correspondence and Discussion

Views, Suggestions and Experiences of Readers

Sodium Sulphide as Cyaniding Precipitant

In the article "Cyaniding of Concentrate," in the JOURNAL of Apr. 27, 1912, E. M. Hamilton brings up the matter of precipitation and partial regeneration of silver-bearing cyanide solutions by means of sodium sulphide. The use of this substance for the purpose, though long neglected, seems to offer possibilities of convenience and economy in working; and it is to be hoped that the experiments of so accomplished a metallurgist will draw to the method the attention it seems to merit from cyanide operators engaged in the treatment of silver ores.

SILVER SULPHIDE INSTEAD OF BULLION AS SHIPPING PRODUCT

Some time in the latter part of 1909 and beginning of 1910, I instituted some experiments at La República mine, near Ocampo, Chihuahua, with the idea of ascertaining the practicability and economy of substituting sodium-sulphide precipitation for precipitation on filiform zinc, and shipment of the raw silver sulphides instead of melting to bullion. Conditions were peculiarly favorable for the substitution, from both metallurgical and economical standpoints. The predominant silver mineral of the República ores is argentite, occurring mainly as a replacement of blende and galena, and in such physical condition that it dissolves in cyanide solutions with great facility; in effecting solution, moreover, few other elements are taken into the solutions in appreciable quantity, the zinc minerals seeming to be almost inert. After taking out a high-grade concentrate on Wilfleys, the pulp delivered to the cyanide tanks was still of unusual value, varying from 30 to 50 oz. per ton; and the pregnant solutions entering the zinc boxes ranged from nine to 13 oz. per ton. Gold in the ores was negligible, amounting (to the best of my recollection) to less than one gram per 1000 oz. of precipitate. Skilled labor was dear, and hard to keep in such an isolated camp. Freights from the railroad on zinc, fluxes, crucibles, etc., were high (about \$45 per ton), and the consumption was excessive; and smelting the precipitate in an inefficient wood-burning reverberatory was laborious and costly.

The work and patents of the late William Orr, of Denver, had come to my notice some years before. Although these related broadly to the regeneration of cyanide solutions by the precipitation of a

certain percentage of the zinc acquired during passage through the extractor boxes, there seemed to be no reason why the method should not be operative with regard to the precipitation of silver from such solutions, the zinc, antimony, arsenic, etc., dissolved from the ore during treatment, being released at the same time. It was realized, of course, that if these elements were dissolved in important quantities, the purity of the silver sulphide would be seriously lowered.

At the time of my experiments, regeneration of the working solutions was of no particular advantage at República. Crushing was done in water, instead of in solution; no proper thickener had been provided above the Pachuca tanks, which were expected to perform, intermittently, the functions of settlers and agitators; the pulp settled slowly, and the tankage was limited; it was necessary, therefore, to leave so much water in the pulp that little return solution could be used in making up the charges for agitation; and the strength of the agitating solution was furnished principally by sodium cyanide added in the tanks, while at the same time a considerable quantity of precipitated solution was allowed to escape from the sumps. Our experiments were hence directed to ascertaining whether a high-grade shipping product could be obtained; and outside of one or two analyses to determine the cyanogen in the solution after agitation, little attention was paid to regeneration. With 125 to 130% sodium cyanide costing us about 25c. per lb., the importance of regeneration (if practicable) was not overlooked, but was left for the future, when the installation of thickening apparatus should enable us to cut off solution losses.

SULPHIDE PRECIPITATE ABOUT 80% SILVER

An old Hendryx tank, fitted with air agitation, was cleaned out, and tests were made of about five tons of our usual mill charge, using fresh solutions of the accustomed strength; portions of the pregnant solution, after extraction had reached its limit, were precipitated by means of sodium sulphide, and the precipitate was assayed. I have preserved no accurate notes as to the fineness of this precipitate, but to the best of my recollection it ran in the neighborhood of 80% fine in silver; the contaminants were not determined, but we ascertained that no copper had been brought down. On making a few calculations regarding precipitation costs, as compared with zinc, and also as to marketing such a pre-

cipitate (even under uncorrected assays, as is customary in Mexico), the economy was evident; and I felt encouraged to extend the tests to the entire plant for a short time, using our pregnant-solution tanks alternately, one filling while the other was being precipitated and pumped through the clean-up press. The precipitate was to be dried, screened, thoroughly mixed for sampling, and shipped in soldered kerosene cans to the refinery. I considered this a fair test of the metallurgical and commercial features of the problem; but in spite of its promise, the scheme incurred the disapproval of the consulting engineer of the company (himself a cyanide metallurgist of rather conservative type), and the experiments were dropped.

The chief objection to the new method seemed to be that some of the sodium sulphide might remain in the working solutions, with disastrous effect, or that the efficiency of the solutions might be affected, in some unknown way; and I argued in vain that this could be obviated (precisely as stated by Mr. Hamilton) by leaving a small quantity of silver unprecipitated—or, in case a tank should happen to receive an excess of precipitant, by running in pregnant solution until the silver was again in excess, or by using a lead salt at the sump, and thoroughly aerating before returning solutions to the plant.

ADVANTAGES OF SULPHIDE PRECIPITATION

Where solutions high in silver are handled, the sodium-sulphide precipitation seems advantageous; and if gold and copper are present, these may be removed by electrolysis when they have accumulated sufficiently in solution, as Mr. Hamilton remarks, and all loading of solutions with zinc avoided, unless dissolved from ores. In the latter case, of course, it would be precipitated with the silver. The cost of the precipitant, say 2 to 3c. per lb., as compared with 8 to 9c. for zinc, is low, and it requires no preparation for use; the weight of silver precipitated, per unit of sodium sulphide, should probably be over double the weight thrown down per unit of zinc in practice; the action is quick, and the precipitate available without loss of time; the cleanup, if the precipitate is pumped through a press, dried and screened in a mechanical sifter, should be easy and quick, and the plant solutions would be kept free from fouling and maintained at a high standard of free cyanide. Whether electrolysis of the precipitated

solution, for gold and copper, would render the cyanogen of the sulphocyanides available, is at least open to doubt; Clenfell denies such regeneration.

Whether to market the sulphides in their crude state, or to smelt them to bullion at the mine, would be a matter of calculation in each case. Sampling the dried, screened and thoroughly mixed sulphides is easy, and offers the advantage that a single sampling (or one sampling and a check) may represent an entire month's output. This would reduce materially the cost of sampling, assaying, umpiring and representation at the refinery, as compared with the operations necessary to effect settlement for the number of bars representing an equal output in the shape of bullion. The treatment charge on precipitates (in Mexico, at least) is generally less than on bars, but most refiners insist on uncorrected assays of precipitate, while bars are sold on corrected assay. Even so, the total refinery deductions will differ but little on the two classes of material; but certain European refineries, I understand, will accept precipitates and settle on corrected assays. As a matter of fact, the loss in treating precipitate is practically nil in some refineries, where it is simply added to cupel charges from time to time. When the cost of smelting to bullion is added to that of marketing the bars, it is quite likely that in most cases the figures will much exceed the total costs and deductions in connection with marketing crude sulphides of the fineness which can reasonably be expected from this method. A sample shipment or so, with a little investigation as to local and European markets available to the particular plant, will settle this point.

Information regarding the regenerative features of this method may be found in the patents taken out by Mr. Orr, Nos. 687,258 and 689,017, dated respectively Nov. 26 and Dec. 17, 1901; also in the discussion which he carried on with Andrew F. Crosse, in the *ENGINEERING AND MINING JOURNAL*, of May 30, June 13 and 20, Sept. 19 and Oct. 19, 1903. It is interesting to note, in this connection, that Mr. Orr claimed to have effected regeneration, in actual milling practice, at a cost of 3 to 5c. per lb. of cyanide, so regenerated, also, that a certain plant was run for over a month without the addition of fresh cyanide to the working solutions, after the installation of his method.

E. H. WEBSTER.

Los Angeles, Calif., May 8, 1912.

The Canon Diablo Crater

The Cañon Diablo crater, referred to in the *JOURNAL* of Apr. 13, 1912, p. 730, was investigated by G. K. Gilbert, of the U. S. Geological Survey, and the results published in the *Bulletin of the Geological*

Society of America. Mr. Gilbert concluded that the crater, which is in a sandstone formation, without volcanic rocks of any kind, was formed by impact of a body from space. Numerous fragments of meteoric iron were found in the vicinity and some of these contained minute diamonds. H. W. TURNER.

London, April 23, 1912.

Food Supplies for Miners

In the *JOURNAL* of Apr. 27, 1912, p. 837, are given some data on "Food Supplies for Miners," taken from the report of Arthur A. Cole to the Temiskaming & Northern Ontario Ry. From the data it would appear that the consumption of eggs per man per day was 2.03 lb. or about 1½ dozen! It might be well for the authorities in Cobalt to investigate this matter. Of course 2.03 eggs were meant.

The other data are interesting and agree closely with such facts in other camps. A close record over 18 months at a mine employing 21 men, showed that from 6 to 7 lb. of food supplies per man per day were used in the boarding house. By estimating quantities omitted in Mr. Cole's report and adding some others, such as sugar, etc., his figures will come up to the above.

When it is considered that the average man cannot eat more than 3½ lb. per day one realizes that the waste amounts to from 30 to 40%, and this is not the exception, but the rule. The average manager, as long as the boarding house pays, is content, and leaves the details to the steward or head cook. These men cannot be expected to worry much about the conservation of our natural resources.

U. R. HESSYL.

Montreal, Canada, Apr. 30, 1912.

Underground Labor

It would be interesting to know the comparative efficiency of the various races employed underground, as shown by actual records. General statistics appear from time to time setting forth the division of labor among the various races represented in one or more districts. While these are of considerable interest, the figures generally have given more of an idea as to wages earned and the social conditions existing. Figures applying more definitely to the actual operations in mining would be of more importance to mining men.

For instance, in the Lake Superior copper district, the underground labor is performed principally by the following races: English, Irish, Finnish, Italian, Austrian and Croatian; in addition, there are representatives of the smaller European countries as Servia, Bulgaria, Montenegro, etc., which could probably be classed under a general head. Now, of these races, it seems to be general

opinion that the English use their brains to the best advantage. The Cornishmen, on other counts, however, are meeting competition from the Finns. In machine-drill work, the latter will break a large quantity of ground in a given time, but in so doing use powder unsparingly. The Cornish miner may not break quite so much ground but he will use considerably less dynamite. Operators' records on this, covering various mining districts, would have a distinct bearing on the class of labor to be sought for certain work. Again, the Italians, Austrians and Croatians, particularly the last two, have been found to be efficient workmen under competent direction; this has resulted, in the district above referred to, in the employment of large numbers of these men in tramping, mucking, etc. The figures showing the distribution of these races in the different classes of underground work and the efficiency with which they perform this work would be of more value to mining, I believe, than the average run of statistics, dealing with foreign labor in American mines.

J. E. MINTURN.

Calumet, Mich., Apr. 29, 1912.

Research in Analytical Methods

Noting D. E. N. M.'s letter in the *JOURNAL* of May 4, 1912, asking whether inventors of chemical methods ever work on quantities of materials unknown to them until after the determination is ended, it would appear that Salas or some assistant did so (*Bull.*, A. I. M. E., March, 1912), in the work on the effect of tin on the Gay-Lussac silver method. However, I think with D. E. N. M. that this is unusual.

F. ZEIGFIELD.

Chicago, Ill., May 10, 1912.

The Camp of Highgrade

In the *JOURNAL* of Apr. 11, some comments of W. H. Storms' on the camp of Highgrade are quoted. N. E. Guyot, on his side, says: "No mining engineer or expert mining man of standing dare turn down the camp of Highgrade—he would write himself down an ass." Isn't that going some?

FRED SMITH.

New York, May 14, 1912.

Centrifugal Filter

In "Notes from Current Literature," in the *JOURNAL* of Apr. 20, 1912, is described a centrifugal filter, which is claimed to be of recent origin. This description fits exactly a centrifugal filter which was installed in a chlorination mill at Florence, Colo., by a Mr. Koneman, about 20 years ago.

J. L. WELLS.

Lordsburg, N. M., Apr. 25, 1912.

The Searles Lake Potash Deposit

By W. D. Hamman *

Recent press reports of the discovery of "millions of tons of potash" in California, aroused so much interest in the subject, that I hastened to visit the Searles Lake basin, to study the question of origin, extent and possible commercial potash industry on the Pacific Coast of the United States.

SITUATED IN SAN BERNARDINO COUNTY

Searles Lake is in the extreme north-west corner of San Bernardino County, lying contiguous to Kern and Inyo Counties. While this basin has been known to geographers for a score or more years, its position on the map has shifted within a radius of 100 miles on maps of the desert region. This was due to the fact that the land has never been surveyed by the U. S. Government. However, the owners of the claims covering the deposit, have made private surveys and plats of the entire lake area. This region may be truthfully designated as "the land that God forgot," and Uncle Sam, until recently, thought "was not." As designated on these plats, the basin is mainly in T 25 S, R 43 E and T 26 S, R 44 E, Mount Diablo base line and meridian.

It is about 30 miles northeasterly from Searles station, on the Nevada & California R.R. (Southern Pacific), and about 40 miles from the terminus of the Santa Fé Branch line, at Johannesburg, from which point a stage runs to Ballarat and Skidoo every other day, passing along the west side of the Searles basin. The extension of one or both these railroads involves no serious engineering problems. The only question is whether the importance of the minerals in the deposit would justify the necessary expenditure, and I believe that a branch line will be constructed by the railroad companies, or the syndicate may provide its own transportation facilities.

The Searles Lake basin is about five miles wide in the center in an east-west line, and about 12 miles in length in a north-south extension, tapering to a point at the southeast extremity. The area will probably average 9 by $3\frac{1}{2}$ miles, embracing from 20,000 to 25,000 acres.

The depth of the deposit is shown by a well on the original Searles tract, 790 ft. in depth, still in mineral. The outer edges of the deposit are shallow and possibly of small value. I saw one well near the northern limits, the casing of which was being pulled up, showing the presence of organic matter, the escaping marsh gas (methane) and sulphureted hydrogen being extremely offensive to the smell. This abandoned well is in a portion of the tract that, from surface crusts of salt and soda, looked as promising as any other portion of the lake. This con-

The Searles Lake basin in San Bernardino County, California, occupies an area averaging 9 miles long by $3\frac{1}{2}$ miles wide. The deposit, which is owned by a syndicate, was known to contain borax, salt and other sodium minerals. Potash is found as a solution in this basin and may lead to the profitable exploitation of all the minerals hitherto hindered by expensive transportation.

*President, Way's Pocket Smelter Co., South Pasadena, Calif.

vinced me that nothing but the sinking of a well could determine the value of the mineral below.

HISTORY OF SEARLES DEPOSITS

This deposit was originally located by John W. Searles about 30 years ago, at a time when hostile Indians were said to infest the region. The remains of the crude borax plant used by Mr. Searles are still visible. On the western edge of the basin can be seen the dismantled and abandoned Pacific Coast Borax Co.'s plant.

In the early days borax commanded a price of 40 to 50c. per lb., and this permitted a profitable business, even with the crude and costly methods of the elder Searles. The San Bernardino Borax Co. was organized by Searles, which continued in a modest way to manufacture borax, until it was absorbed by the Pacific Coast Borax Co., of which "Borax" Smith and Dennis Searles are the dominant characters. This company found the expense of freighting to Mojave, about 80 miles distant, too great to be profitable.

The discovery of a pure bed of colemanite near Death Valley caused the Pacific Coast Borax Co. to discontinue the manufacture of borax at Searles. The California Trona Co. was organized to take over the property for the manufacture of soda; a plant was erected and about 25 tons of soda were made, which is still at the works. The California Trona Co. had issued bonds on the property, which were sold in England. Soon financial difficulties overtook them and the English bondholders brought suit to foreclose the mortgage. S. W. Austin was appointed by the U. S. Circuit Court as receiver, pending determination of the suit, in order to hold the property intact and keep up the required annual labor. Meantime, the English syndicate bought up all the stock of the California Trona Co., so that it has now acquired the prop-

erty by actual purchase, which will doubtless soon terminate the receivership.

The owners of the property claim to have expended \$25,000 annually on the entire property, which has, no doubt, been sufficient to meet all the requirements of the law relating to assessment work. According to the plat shown me, wells were drilled on each quarter-section of the tract, aside from the expenditure for roads, buildings and equipment. It was impossible to verify these statements, but a number of wells were visible throughout the property, and I have no doubt statements were truthfully made. At present three camps are maintained on the property, one at the east and one at the south, but the main camp is at the soda works at the north end of the lake.

BASIN COVERED BY CRUST OF SALT

The surface of the basin is covered by a crust mainly composed of salt mixed with small quantities of soda and borax. Near the edge of the deposit this crust is a mere shell, but in the center of the deposit the salt has crystallized into the mineral halite, which is 20 to 25 ft. thick. This salt, with present transportation facilities, is valueless, and will, perhaps, never be important except as a byproduct. Near the east side of the deposit is a big reef of carbonate of soda on the surface. This outcrops for about three miles and is several hundred yards in width. It is said to be $2\frac{1}{2}$ ft. thick and 70% pure.

After the halite is penetrated in the body of the lake, at from 23 to 25 ft. depth, a stratum is found of well defined crystals, known as hanksite. This is a mineral compound composed of sodium carbonate and sulphate. These crystals, as brought up by the pumps, are more or less broken up, but I was able to get several well defined specimens of ideal symmetry whose physical properties are identical with the standard description of the mineral hanksite. These crystals are about an inch in length, hexagonal form, with short unit prisms at each end, like quartz. They are translucent and yellowish in color. Some borax crystals are found along with the hanksite crystals, and this stratum is said to average about 40 ft. in thickness.

Beneath the hanksite stratum is found the trona, a hydrous carbonate of soda in crystals of ideal symmetry. I was able to get several of the trona crystals, which I consider true mineralogical specimens. The trona crystals are said to be found in bodies from 10 to 20 ft. in thickness in the center of the lake. Trona is the mineral from which soda ash is made, and is considered more valuable than the hanksite, the sulphate being more readily

soluble in surface waters than the carbonate or trona crystals. The mineral thenardite is also found in the bed of the lake, in perfect crystal form.

POTASH IN SOLUTION

The potash content of the deposit is not in beds, no potash crystals having yet been obtained. The potash solutions are found permeating and lying underneath the strata of soda crystals. The potash being so readily soluble will not separate and form crystals like sodium and boron salts. The Searles Lake potash, in a dissolved form, aside from its economic value, is new to science. The possibility of such a condition has not heretofore been discovered within the bounds of reason, and this fact makes the discovery of double importance.

Another curious scientific fact was brought to my attention by the managing director for the owners of the property, and that is the tendency of certain crystals to separate or congregate in families or groups within the deposit. It is related that in some wells a solid body of one class of crystals will be found, while in others the several crystal minerals are mingled together within the deposits.

As before stated, the potash solutions permeate the entire deposit, but are more abundant beneath the crystal beds. The explanation for this is that the soluble potash percolates through the crystal bodies like water through sand and gravel to reach a solid bed. Sodium sulphates are more soluble in water than the carbonates, and this fact seems to account for the hanksite and trona in distinct beds.

There are places in the deposits corresponding to air holes in an ice field, so that it is dangerous to travel over the lake. However, an automobile can go anywhere on the bed of the deposit, with perfect ease and safety. The broad tires furnish sufficient surface to withstand the weight of the car.

The heat on the lake in the summer sometimes reaches 140°, and all work must be done in the night. The laborers work with heavy rubber boots on, but the heat of the mineral solutions is such that it fairly cooks the workmen's feet, and they cannot stand it for any great length of time.

LARGE HOLDINGS NECESSARY FOR PROFIT

Some people find fault with the mineral laws that permit corporations to hold so much land. While this criticism may be justifiable in some instances, it does not seem proper as regards the Searles Lake deposits, as this is no "poor man's proposition," and cannot be worked, except by a corporation with unlimited capital. Divide the area into a hundred, or even a dozen holdings, and it would be difficult to secure required capital to

finance the venture, let alone construct necessary pipe lines and railroads to bring the commodities to market.

The action of President Taft in ordering the potash lands withdrawn from entry was, no doubt, proper, had the land been open for location, but it seems that he was without knowledge as to the prior appropriation of the entire Searles Lake deposit and the rights vested, which it seems may not now be disturbed.

The governmental experts' report of four to ten million tons of potash available in Searles Lake, may or may not be correct. Certain it is that the earlier press reports were entirely misleading, as they indicated solid beds of potash, which is absolutely erroneous. The impression also conveyed in dispatches from Washington indicated that Messrs. Cole and Free made the discovery, which, as previously noted, is apparently erroneous. It being quite generally known that the U. S. Government had experts in the field seeking potash, many persons, including myself, were misled into believing that the mineral was open to location. This caused a "rush" to locate claims. After days of hardships and privations, prospectors were brought to a painful realization that "somebody had falsified." Whether it was intentional or not does not change the fact.

TRANSPORTATION THE PROBLEM

Whether the undertaking is an assured commercial success depends almost entirely upon facilities for transporting the several commodities to market. With a wagon haul of 30 miles to railroad and high rate of freight thence to market, success would be doubtful. It must be understood that to recover the potash requires that the other commodities, such as borax, salt and soda must, at the same time, be extracted. Salt and borax are too cheap commodities to be worth the cost of extraction, except as byproducts. Soda, the most abundant and valuable constituent in the deposit, if required to be freighted by wagon to railroad, would not seem to be a profitable business. With a railroad direct to the works, and a reasonable freight rate to market, soda manufacture would doubtless be profitable, and the salt and borax might carry the expense of production. The new element potash in this deposit makes a certainty of what before was a doubtful commercial proposition.

It is now thought practicable to pipe the solutions to tidewater, and there convert the valuable elements in solution into commercial products, which would, no doubt, be wonderfully profitable. A railroad would insure success, with proper connections and equitable freight rates. And since the owners are prepared to build a railroad of their own if necessary, it appears, on the whole, certain that an-

other prospective California industry will soon be a reality.

The managing director of the English syndicate, puts it in this way, "with proper transportation facilities, the potash can be extracted, giving the salt, borax and soda as byproducts, free. Or these latter products can be extracted at cost, leaving the potash as a byproduct. In either case, the cheaper commodities must move to market on rates effective on such products, in other parts of the country."

PROBABLE METHODS OF EXTRACTING POTASH

The usual method of extracting potash from a solid or crystalline compound, involves mechanical crushing of solids and subsequent dissolving of the several constituents, depending upon their relative solubility. Potash, being the most soluble of all the salts, is readily separated from its more refractory associations. The sodium chloride being next in the scale of solubility, then the sulphates, and lastly the carbonates.

The Searles Lake potash is already in solution, therefore no mechanical crushing is necessary. Its isolation from sodium, also partly held in solution, does not seem to offer any great difficulty. If it is decided to extract the potash on the ground, nature has provided all the heat necessary to evaporate the solution to its dry salts, the whole basin being one great "chemical bathhouse" for three-fourths of the year.

The element sodium is reduced to the metallic state by electrolysis, and inasmuch as cheap electricity is available in the upper Owen's Valley, power lines conveying the current passing within 25 miles of the basin, it seems probable that electricity will supply a most economical and effective agent in the manufacture of potash from the mineral solutions in the basin of Searles Lake.

The Pacific Coast states need potash fertilizers, perhaps more than any other section of the United States, especially as intensive farming is becoming an accomplished fact, and therefore this section would always be the chief market for the Searles Lake potash output. However, assuming suitable transportation by rail, or by vessel through the Panama Canal, such a product might be laid down in the Mississippi Valley, and perhaps even in New England, so as to displace the German imports of potash.

California is the only state which makes a commercial production of borax annually. The output for 1910, according to recent press bulletin of the U. S. Geological Survey, was 42,357 short tons, valued at \$1,201,842. Less than 4 tons was imported. About one-half of the borax consumed is used in the enameling industry for making kitchen and sanitary ware.

Anaconda Copper Mining Co.

During the year ended Dec. 31, 1911, there were 3,844,070 tons of ore and 4603 tons of precipitates produced from the mines of the Anaconda Copper Mining Co. The reduction works treated a total of 3,154,036 dry tons of ore and cupriferous material at Anaconda, and 1,101,778 tons at Great Falls. Of this 3,756,235 tons were company ore, 499,077 tons were purchased ore, and 501 tons were precipitates from the old works. There were 191,573,783 lb. fine copper, 8,510,122 oz. fine silver, and 40,546 oz. of fine gold produced at Anaconda, and 67,833,313 lb. of fine copper, 1,221,439 oz. silver, and 8404 oz. of gold produced at Great Falls.

MINING OPERATIONS

Production was somewhat curtailed during the year on account of the low price of copper, but development was kept at normal, and advantage taken of the low production to do a great amount of repair work. There were 30.7 miles of development work performed, so that more ore was developed than was extracted. Sinking aggregated 3711 ft. The hoisting engines at the Mountain View, High Ore, Diamond and West Gray Rock shafts were equipped with new cylinders for the use of compressed air, and operated satisfactorily, and cylinders for the Leonard, Pennsylvania, West Steward and Original mines have been received and will be put in place as soon as possible. Twelve air-operated auxiliary hoists have been ordered also to take the place of the engines at the auxiliary shafts. Power, as far as possible, is being furnished by the Great Falls Power Co., and the use of steam abandoned. In 1910, the Parrot and Little Mina shafts were put out of commission, and in 1911 the East Gray Rock and Gagnon were added to this list. Gagnon ore will be hoisted through the Original shaft, and the East Gray Rock ore through the West Gray Rock. The Butte & Boston and Parrot operating departments have also been abolished. Fourteen electric motors for underground haulage were installed during the year.

A fire in the stopes, northeast from the High Ore shaft, was discovered on Jan. 14, and was not extinguished until Apr. 1, 1911. The Never Sweat shaft was out of commission from Sept. 13 until the end of the year, because of gas from the fire district, but cement bulkheads on several levels, and a fire wall from the 1800- to the 1400-ft. level, it is thought will do away with future trouble. No damage was done to the shaft.

Three electrically driven quintuplex vertical-cylinder pumps were installed on both the 1200- and 2200-ft. levels of the

High Ore shaft, each pump having a capacity of 600 gal. per min., and power lines taken down an auxiliary shaft. The pumps will soon be started, and the steam pumps kept in reserve. The St. Lawrence, Diamond, Anaconda and Poulin water will be pumped through the High Ore shaft.

Skips are being found more economical than cages for hoisting, and the High Ore shaft has been equipped with skips and pockets on the 1600-, 1800-, 2200-, 2400- and 2800-ft. levels.

CONCENTRATION

Experiments were carried on during the year with a large centrifugal concentrating unit, which concentrated successfully, but could not be run continuously. A new machine will be constructed, and tried out in 1912. Experiments running back several years for the purpose of increasing the saving in concentration have been successful, and one full section of the Great Falls concen-

ANACONDA BALANCE SHEET AS OF DEC. 31, 1911.

Assets.	
Mines, water rights and lands.....	\$67,652,350
Building, machinery and equipment.....	15,938,493
Timber lands.....	6,011,238
Investments.....	5,426,398
Insurance and prepaid expenses.....	242,564
Materials and supplies.....	2,537,218
Merchandise for sale.....	1,919,179
Metals on hand.....	14,343,155
Accounts receivable and cash.....	4,072,194
	\$118,142,789
Liabilities.	
Capital stock.....	108,312,500
Accounts payable.....	4,751,688
Unclaimed dividends.....	7,264
Dividend No. 45.....	2,166,250
Surplus.....	2,905,087
	\$118,142,789

trator has been operating on this system. One unit of the Washoe plant is being changed to this method, and as soon as work is complete, corresponding changes will be made on the other sections. It is stated that capacity is increased as well.

SUBSIDIARY OPERATIONS

In regard to subsidiary companies, the Belt, Mont., coal mines shipped 101,258 tons of coal to other departments, sold 9361 tons, and consumed 20,878 tons. The Diamondville, Wyo., mines shipped 310,355 tons, sold 197,495, and used 47,206 tons at the mines. The Washoe mines shipped 97,300 tons, sold 9791 and used 6429 tons at the mines. The three collieries produced a total of 800,073 tons. The sawmills at Hamilton, Hope, Bonner and St. Regis cut 89,782,204 ft. of lumber, of which 6,246,467 were used at the mills, 72,713,827 ft. were sold commercially, and 10,821,910 ft. went into stock.

The Butte, Anaconda & Pacific Ry. will electrify its system, and will probably extend from Anaconda to the Georgetown district. Among the mines tributary to this extension will be the Southern Cross Mine, for the purchase of which negotia-

tions have been concluded by the Anaconda company.

Deliveries of copper, silver and gold for the year amounted to \$38,918,637, profits were \$8,043,719, and dividends \$8,608,750. However, extraordinary repairs during the year amounted to \$583,462, or more than this deficit. All this was charged to operating, but notwithstanding this, and the curtailment of production, the costs per pound of copper were lower than in previous years, while not all the economies of consolidation have been reached.

American Iron and Steel Institute

The general meeting of the American Iron & Steel Institute was to be held in New York, May 17. The program, as issued by Secretary James T. McCleary, provides for three business sessions. The morning meeting was to open with the presidential address by Judge E. H. Gary, to be followed by two papers: "Contract Obligations," by E. A. S. Clarke, president Lackawanna Steel Co., New York. Discussion by Willis L. King, vice-president Jones & Laughlin Steel Co., Pittsburg; James A. Farrell, president United States Steel Corporation, New York, and others. "Competition: Its Uses and Abuses," by Joseph G. Butler, Jr., vice-president Brier Hill Steel Co., Youngstown, Ohio. Discussion by John A. Topping, chairman Republic Iron & Steel Co., New York; Charles M. Schwab, president Bethlehem Steel Corporation, New York, and others.

At the afternoon session four papers were provided for, as follows: "Some Experiences in India," by Julian Kennedy, Pittsburg. "Electric Furnaces," by William R. Walker, United States Steel Corporation, New York. Discussion by Theodore W. Robinson, vice-president Illinois Steel Co., Chicago; Eugene B. Clark, American Sintering Co., Chicago; S. T. Wellman, Wellman-Seaver-Morgan Co., Cleveland. "Corrosion of Steel and Its Prevention," by Dr. A. S. Cushman, Institute of Industrial Research, Washington. Discussion by Louis J. Campbell, Youngstown Sheet & Tube Co., Youngstown, Ohio. "Metals and Alloys," by Dr. John S. Unger, Carnegie Steel Co., Pittsburg. Discussion by George B. Waterhouse, Lackawanna Steel Co., Buffalo.

The evening session, taking the form of a banquet at the Waldorf-Astoria, provided time also for a paper on "Mining Operations on the Mesabi Range," by William J. Olcott, president of the Oliver Iron Mining Co., Duluth; also for a discussion on welfare and safety work, including papers on: "Enforcement of Health Laws," by Dr. Thomas Darlington, New York; "Something Doing in Colorado," by Dr. Richard W. Corwin,

Denver, Colo.; "Rendering Labor Safe," by Raynal C. Bolling, New York.

The important discussions provided for were on "Contract Obligations" and on "Competition." No provision appeared in the program for any discussion on labor conditions.

The second day, May 18, was to be devoted to excursions to various points of interest in and about New York.

U. S. Assay Offices

WASHINGTON CORRESPONDENCE

Strong protests against the abolition of the present unnecessary assay offices of the United States were made in Congress during the last week, in connection with the provision carried by the legislative, executive and judicial appropriation bill for consolidating the assay and mint service and doing away with the establishments no longer needed. The debate showed general opposition throughout the West to the change, and further vigorous discussion will be had when the measure comes up in the Senate.

Among the protests filed with the House during the debate was one from the Montana Mining Association. The arguments advanced against the abolishment of the assay office at Helena are essentially as follows: The U. S. Assay office at Helena for the last five years has treated an average of \$1,986,887 of bullion. If this assay office were abolished, bullion would have to be shipped to Eastern points or disposed of to pawnbrokers or custom smelters at higher charges. This, it is claimed, would work a hardship to the small operator, who depends upon immediate returns from each cleanup to meet payrolls and to purchase supplies; small properties, now running on a close margin of profit, might thus be compelled to shut down. Resolutions on similar lines were also transmitted by other mining organizations.

The Southern bankers' views were expressed by the New Orleans banks, and may be summed up as follows: The gold assayed at the U. S. assay office at New Orleans was \$950,000 in 1910 and \$1,650,000 in 1911, and is steadily increasing, due to large shipments to this port from Central America. The appropriation for the fiscal year ending June 30, 1912, for this office, is only \$21,300, of which less than \$18,000 will probably be expended. If the department in Washington would permit the operation of the refinery in the New Orleans mint, which could be done at small cost, the expense of transporting bullion to the New York assay office would be saved.

As the policy of the government has been to foster and aid the Central American republics, some of which are of growing importance as gold producers, the cutting off of the small appropriation and

closing of the assay office in New Orleans might be considered as discrimination and interfere with relations which have been established after considerable effort and a large expenditure of money on the part of the banks. The San Francisco bankers took a like view.

Copper Range Consolidated

The total copper production controlled by the Copper Range Consolidated Co. in 1911 amounted to 29,310,579 lb., a decrease of 3,546,113 lb. from 1910. The average cost of production was 9.47c. per lb., and the average yield of copper per ton of rock was 20.87 lb., as compared with 23.32 lb. in 1910, and 21.73 lb. in 1909. The Copper Range Consolidated Co. owns 99,659 shares of the Baltic company; 99,699 of the Copper Range Co.; 99,355 of the Tri-Mountain; and 92,470 of the Atlantic (acquired in 1911 and 1912); and about 39% of the Copper Range R.R. Through the Atlantic company it controls the Atlantic & Superior R.R.; through the Copper Range Co., one-half of the Champion Copper Co., and 61% of the Copper Range R.R.; and through various subsidiaries, 68% of the Michigan Smelting Company.

The Baltic Mining Co. in 1911 produced 15,370,449 lb. of copper, at 9.09c. per lb., and sold it at 12.54c. per lb. The total net profits were \$530,215, from which \$500,000 dividends were paid. There were 696,795 tons of rock stamped, at a total cost, including taxes, of \$1.80 per ton. This rock yielded 25,254,160 lb. of mineral, and 15,370,449 lb. of copper, or 22.06 lb. of copper per ton of rock.

The Trimountain Mining Co., in the year ended Dec. 31, 1911, stamped 347,885 tons of rock, from which was produced 10,705,685 lb. of mineral, or 6,120,417 lb. of fine copper (17.59 lb. of copper per ton of rock). Costs were 11.55c. per lb. of copper, or \$1.8585 per ton of rock, including taxes. The net profit for the year was \$60,371, and no dividends were paid.

The Champion Copper Co. in 1911 stamped 734,392 tons of rock, at a total cost of \$1.8645 per ton, including \$0.1213 taxes. This rock produced 26,137,007 lb. of mineral (35.59 lb. per ton of rock), from which was produced 15,639,426 lb. of copper (21.296 lb. per ton of rock), at a cost of \$0.0963 per lb. of copper. Dividends of \$500,000 were paid, of which \$454,589 came from net profits, the remainder from surplus. The Champion Copper Co. is owned half by the Copper Range Co. and half by the St. Mary's Mineral Land Company.

Control of the Atlantic Mining Co. was taken over by the Copper Range Consolidated Co., on a basis of one share of Copper Range for 10 shares of Atlantic stock. Since the Copper Range Co. assumed charge, no mining work has been

done, but the railroad (Atlantic & Superior) and the mill are busy handling Superior rock.

Nipissing Mines Company

The report of the Nipissing Mines Co., Cobalt, Ont., for the year ended Dec. 31, 1911, gives the production as 5,197,042 oz. of silver, the total cost being 13.95c. per oz., the lowest cost so far obtained. The profit was 40.3c. per oz., or a total of \$2,095,241, representing 74.29% of the value of the ore produced. The ore reserves are given as follows: Developed and partly developed, 3454 tons containing 6,127,000 oz.; mill rock on dumps, 80,000 tons, with 1,757,000 oz. Dividends to the amount of \$1,843,297 were paid.

The mill for treating the high-grade mine ore was started Feb. 1, 1911. The process, devised by Charles Butters and G. H. Clevenger, consists essentially of amalgamation in cyanide solution in a tube mill, where more than 97% of the silver is recovered as amalgam. A further extraction is obtained by regular cyanide treatment of the residue. The cost of mill and refinery was \$57,122. The first year's operation gave a substantial profit compared with shipping to the smelter.

A 200-ton mill is now under construction for the treatment of low-grade ore. The ore from sorting and jigging will go to the high-grade mill, while the rest will be treated in the new mill. It is proposed to crush in cyanide solution in a 40-stamp battery and all-slime the ore in four 6x20-ft. tube mills. The slime will be amalgamated, if found necessary, agitated in cyanide solution and then sent to a Butters filter. Merrill zinc-dust presses will be employed.

Japanese Iron and Coal

Statistics of Japanese iron and coal for 1910 are reported by Consul General Sammons of Yokohama, as follows:

Coal, 15,681,321 metric tons; pig and cast iron, 187,793; iron and steel by "Kera" direct process, 474; wrought iron, 19; bessemer and open hearth ingots and castings, 167,886 metric tons. Wrought and Kera-process iron show a gradual diminution for the last five years.

Russia's Oil Production

A correspondent of the London *Mining Journal* gives the statistics of Russia's oil production in 1910 and 1911 in metric tons, as follows:

Districts	1910	1911
Baku	8,120,000	7,870,000
Grozny	1,194,000	1,212,000
Cheleken	152,000	174,000
Maikop	22,600	129,000
Fergana	33,000	50,000
Total	9,521,600	9,435,000

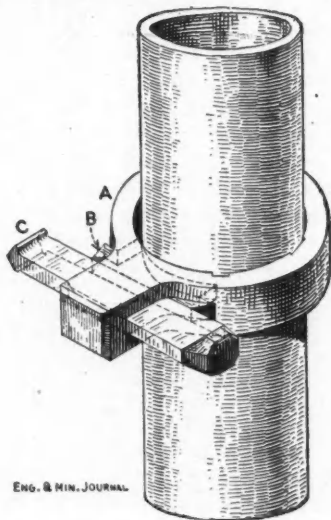
Details of Practical Mining

Accounts of Useful Ways of Doing Many Things in the Day's Work

Improved Drill Post Collar

BY ALBERT MENDELSON*

An improved post collar now being used in some of the copper mines of Lake Superior, is illustrated by the accompanying drawing. It does away entirely with the two bolts of the collar at present in general use, and can be loosened or tightened by a single blow of the miner's wrench. It consists of a cast-steel band *A* of diameter slightly greater than that of the post. A tool-steel gib *B* fits into a slot in the band, and directly over the gib a wedge-shaped key *C* of the same material is driven. The inner face of the gib is shaped to an arc of the same radius as the post and when the wedge is struck on its wide end the gib is forced tightly against the post.



ENG. & MIN. JOURNAL

DRILL-POST COLLAR WITHOUT BOLTS

An advantage of this collar over the one at present in general use is that time and work are saved, because there are no bolts to tighten and loosen. This time may not amount to much on a two-man machine, but with the introduction of the one-man "butterfly" drill and the attention to details necessary in running it, any device that will save two or three minutes per hole drilled is of importance. At present the miner using a one-man machine has to adjust nine bolts; the elimination of two is, therefore, no small item. Another advantage, and one which is of importance on one-man machines, is the fact that this improved collar can be rapidly loosened and tightened, and if

*With Superior Copper Co., Houghton, Mich.

necessary with one hand. In raising the machine on the post, if the post is wet or the machine too far in on the arm, the arm will not catch on the post. This means that the machine and arm must be held in the elevated position while the collar is loosened, slid up the post under the arm and tightened. In any case, speed is desirable under these conditions, and with a one-man machine it is imperative.

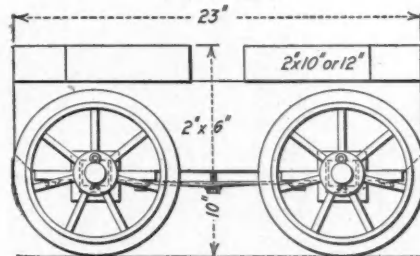
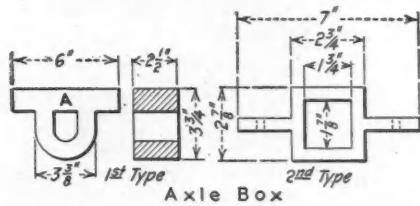
Incidentally, it might be mentioned that these collars were used with the two one-man machines with which four men recently drove 285 ft. of 6x7-ft. drift in one month; exceptional drifting for the copper country.

Joplin Bucket Cars

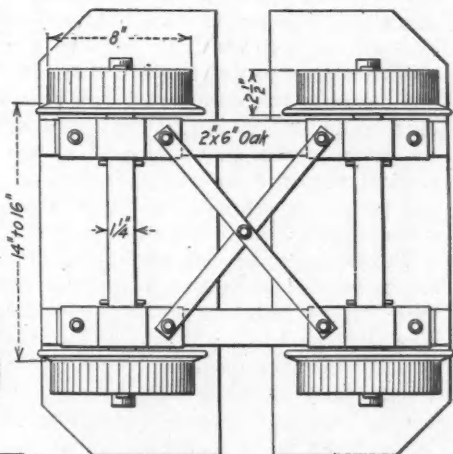
With a few notable exceptions, the hoisting in the lead and zinc mines of

that has been evolved, these tubs can be hoisted on an average of a bucket in 35 sec. without great exertion on the part of the men. Indeed, more than 1000 tubs have been hoisted in one shift of 7½ hours by a single engine, and the hoistman dumps the tubs himself.

At some of the mines, cars have been used underground, but it is questionable whether they are cheaper in the long run than a tub system. The only advantage of the car over the tub is that it is more difficult for the shovelers to build "windies" in them. In the vernacular of the district, tubs loaded with boulders in such a way as to leave the maximum free space between them, are called "windies." When the distance is to be trammed is much over 250 or 300 ft., and bids fair to continue so for some time to come, the practice is to use mules.



Side View of Tub Truck



Bottom View of Tub Truck

BUCKET CARS USED IN THE JOPLIN DISTRICT

Southwestern Missouri is done in buckets, or "cans" and "tubs," as they are called in the district. This permits the use of narrow-gage track, so that sharp curves can be laid around the pillars and through the "drifts," as the openings between the pillars are called. Because, as a rule, the tubs hold only about 800 lb., 1250 lb. being the maximum capacity, a light track can be used that is cheap to install and quickly and readily changed. In fact, in many of the mines the track, made of 8-lb. rails, is lifted up bodily, ties and all; the ties are usually 2-in. planks. This system is flexible, and admirably adapted to the conditions prevailing in the district. The hoisting system is excellent, and because of the simplicity of the hooking and tramping routine

A tail-rope system of hauling the tubs is used at two of the mines in the district, it being considered cheaper than mules when the distance is over 800 ft., while at one of the mines a light-weight, gasoline-driven locomotive is to be used to haul the tubs.

Many excellent features are embodied in the construction of the tub cars. For instance, the wheels are mounted loosely upon the axles, and the axles are loosely attached to the truck by sleeve bearings, so as to admit of lateral as well as up and down movement of the wheels in respect to the truck. This is an important feature, because of the lightness and temporary nature of much of the track that is used in these mines. By the use of the sleeve attachment, the four wheels

of the car stay on the rails, no matter how rough the track is. It is impossible for the truck to run on three wheels at rough places in the track which, with trucks of the ordinary type of axle, is a common cause of derailment.

The looseness of the attachment and the open bearing make the use of oil impossible, so cocoa butter is used to lubricate the axle and the sleeve bearings. This material, used for greasing cars, gave rise to the term "cocies," which is applied to the shovelers; the shoveler boss being called a "cocey herder," names which to the visitor are extremely puzzling until he hears the explanation of their derivation.

There are two types of bearings used on these tub cars, and likewise there are two types of axles. Some of the cheaper trucks are equipped with round axles and sleeves of the first type shown in the accompanying drawings, but the round axles, which are from $1\frac{1}{4}$ to $1\frac{1}{2}$ in. in diameter, turned down slightly at the ends, frequently break just at the points where the holes are drilled to receive the pins that limit the side motion of the axle in the sleeves. At one mine, instead of using two pins, a piece of old pipe is put over the round axle to form the shouldered that limit the side play, and this pipe is fastened to the axle by a rivet through the axle halfway between the sleeves where the bending strain is least, and the axles are consequently less weakened by the boring. But probably 90% of the axles in the district are of square section, turned down for 3 in. at each end to receive the wheels. These axles seldom break.

The truck proper consists of two 2x6-in. pieces of oak fastened together by two crossed iron straps on the under side at the bearings, while the deck of the truck consists of two 2-in. planks, 10 to 12 in. wide, nailed to the two 2x6-in. pieces. The gage ranges from 14 to 16 in., but the latter is coming to be regarded as the standard.

A Borehole Surveying Instrument*

BY JOHN I. HOFFMAN†

The instrument now exclusively used on the Rand for surveying diamond-drill or other boreholes was invented by Mr. Oehman, and improved by A. Payne-Galloway; it is illustrated in Fig. 1. The instrument is an electric-light photographic apparatus and consists of a gun-metal tube in two parts *A* and *A* connected by a coupling *O*. In the lower part of the gun-metal tube are placed a magnetic needle *B*, and a plumb-bob *C*, each independent of the other and each swung over

*Excerpt from a paper entitled "Recent Practice in Diamond Drilling and Borehole Surveying," Bull. 91, I. M. M.
†Mining engineer, 216 Moorgate Station Chambers, London, England.

a gimbal *D*. Above both the needle and plumb-bob is fixed a small electric lamp *E*, and all these parts are held in position and pressed against an insulated brass rod *F*, in the center of the coupling by a spiral spring *G*, attached to the bottom screw plug *H*. In the side of the tube are small screws, placed in a straight line parallel to the side, the ends projecting inside the tube about $\frac{1}{8}$ in. The cylindrical cases carrying the lamps

and bottom. To the top end piece a ball-bearing swivel is attached, in order that the instrument may be lowered on a wire if necessary.

The cases *P*, which carry the marine-compass attachments for the magnetic needle and the plumb-bob, are made of vulcanite for insulating purposes, the compass attachments being made of brass, the outer ring of which is held in position by two brass screws, on which the ring swings. On the face of each gimbal is a fixed pin point and around the edge is a recess ring which holds a disk of sensitized photographic paper in its place, the pin point holding it in position.

The plumb-bob is made of gold, attached to a fine silk thread hung from the center of a thin disk of plate glass *Q*, which fits into a recess in the top of the vulcanite case. Both the magnetic needle and the plumb-bob swing immediately above and almost touching the sensitized papers.

The watch is equipped with an extra wheel *R*, to which is attached a copper projection *S*, which, at a certain set time, makes connection with a copper spring *T*, attached to the frame of the watch, and completes an electric circuit, lighting the lamps above the plumb-bob and the needle and photographing a sharp shadow of each on the sensitized papers. When the two photographs are developed, the dip and direction can be read by making the pin pricks coincide. In Fig. 2 are shown two photographs taken from a borehole, where the dip was 25° and the direction N. 20° E. magnetic.

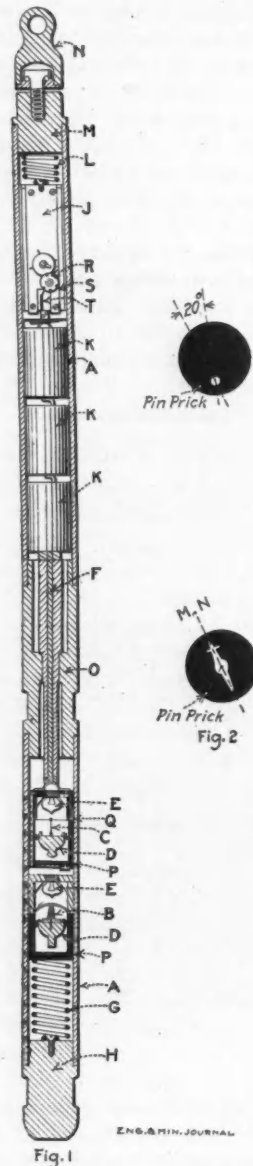


Fig. 1
BOREHOLE SURVEYING DEVICE AND PHOTOGRAPHIC RECORDS

and those carrying the needle and plumb-bob have a slot down the side, the projecting screws acting as guides for the slotted cases to slide in and keep them in position.

The top part of the tube contains dry batteries *K* and a clock *J*, with a spiral spring *L* attached to it. The spring presses against the top end piece *M* of the tube, so that when the two parts of the tube are screwed together, all parts within are held rigidly together and contact assured by the spiral springs at top

Fast Hoisting in Michigan

At the Empire iron mine of Oglebay, Norton & Co., at Palmer, Mich., the skips were recently used to assist in unwatering the mine, and some fast hoisting records were made. During the 10-hour day shift of May 1, the number of skips of water dumped was 1305, and on the 10-hour night shift 1339 skips. The average distance hoisted was 80 ft., the skips hoist in balance and the capacity of each is 45 cu. ft. A double-drum, geared or second-motion hoist is used.

When the unwatering was started, the method consisted of pumping the water out through a 3-in. pipe by compressed air conducted into the submerged end of the water line through a 1-in. pipe. It is believed that by this method, unwatering was done at the rate of about 150 gal. per min. Shortly afterward the skips were used and 1200 skips were hoisted per 10 hours, or 2 per min., or at the rate of 675 gal. per minute.

The speed of hoisting had to be reduced at the surface because it was necessary for the lander to unfasten the catches that kept the skips from overturning in the water. If automatic devices for doing this had been on hand, less time would have been lost.

An Ore Wharf in Chile

BY ALFRED GRADENWITZ*

The wharf shown in the accompanying half-tone was built on the shore of the Bay of Michillas, Chile, for loading vessels with ore from the mines of the Compañía de Minas de Cobre, Michillas. At the end of the wharf is a large bin from which the ore is discharged through chutes to the vessels. Above the bin there is a rotary crane of 30 ft. radius and of two tons capacity, which is used for unloading timber, food stuffs and other supplies for the mine.

The ore is brought to the wharf from the Carolina mine over a Bleichert cable-

an excess of about 50 hp., which, at present, is absorbed by the braking mechanism, but which will, in the future, be used to drive crushers, or compressors and electric generators.

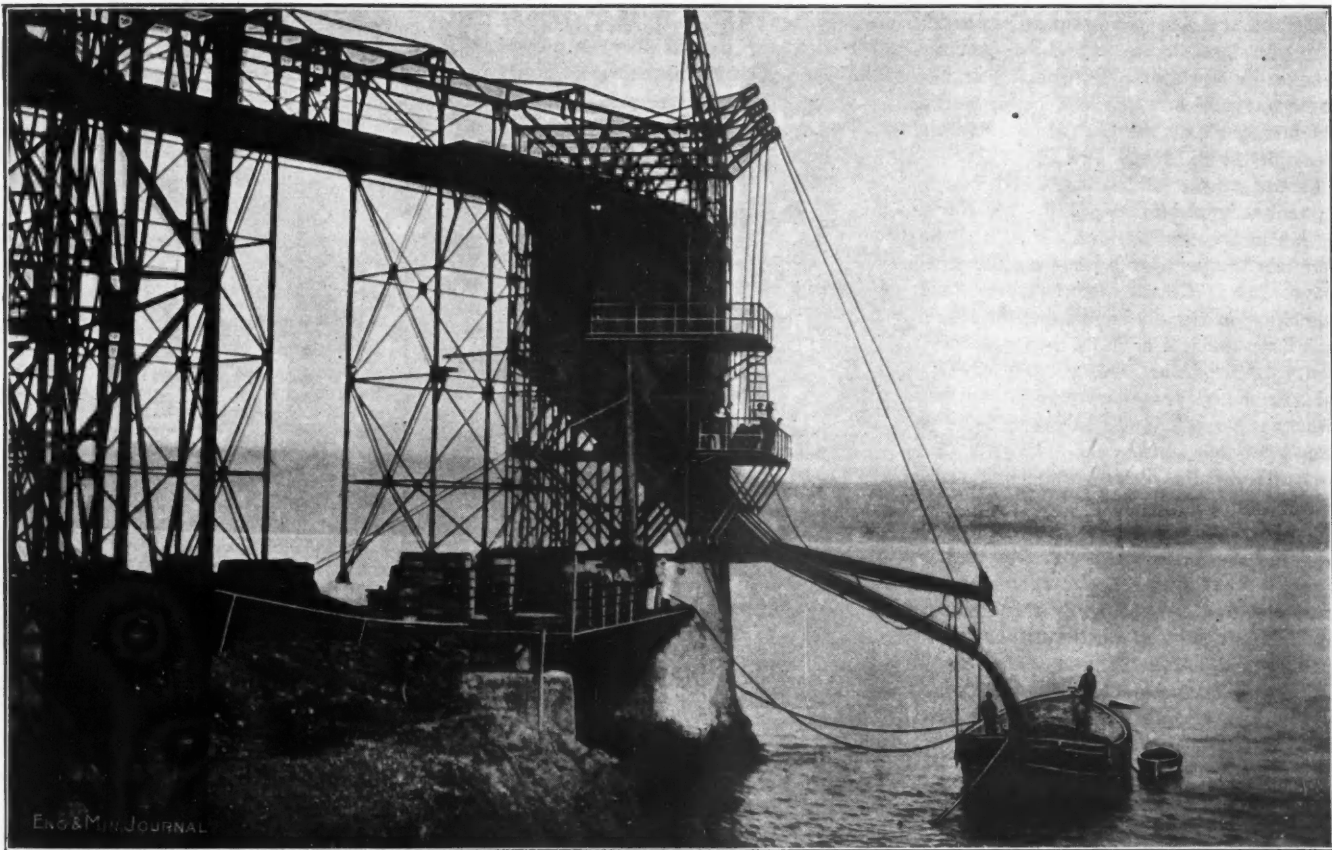
Tempering Drill Steel—II

BY CLARENCE C. SEMPLE

The common method of tempering drills is that known as "drawing the temper." The bit, otherwise finished except for the tempering, is placed in the forge and the end heated slightly above the critical temperature or to about a full cherry red. The bit must also at the

heat from the upper part to the end of the bit, the thicker the oxidized scale becomes, so that the color of the inner metal shows through in gradually darkening shades ranging through yellows, browns, purples and finally blues.

This return flow of heat softens or tempers the steel hardened by quenching and the degree of softening depends upon the temperature to which the returning heat is allowed to raise the end of the steel. In this way the hardness of the finished bit is controlled. The temperature to which the chilled end is allowed to rise is checked by plunging the entire heated portion of the steel into the quenching trough. This second quench-



ORE WHARF ON THE SHORE OF MICHILLAS BAY, CHILE

way, 3.2 miles in length. The greatest elevation passed over is 3020 ft. higher than the wharf. The cableway is supported by 50 towers; the capacity is 20 tons per hour, 80 buckets of 33 kg. capacity being used, which travel at a speed of 8.4 ft. per second.

Upon arrival at the angle station at the wharf, the buckets leave the traction cable and are moved by hand over a suspended rail to the bin, where they are dumped. The bucket is then moved around the circuit to the return cableway, where it is automatically coupled to the return traction cable. An "Automat" coupling device is used, which holds the buckets safely even on the steepest grades. The descending loads develop

*Regensburgerstrasse 3, Berlin, Germany.

same time, be heated, though not to so high a temperature as at the end for from four to six inches back from the point. The end only of the bit is then plunged into the quenching trough while the steel is moved rapidly up and down until the end of the bit is black. This hardens the end of the bit. As soon as the end of the bit is black it is removed from the bath and the end polished. The heat in the upper, unquenched part of the bit immediately begins to flow toward the chilled end, softening the hardened steel in doing so. This flow of heat is accompanied by a surface oxidation which, at the low temperature of the first return of heat, takes place as a thin scale through which the heat of the inner steel shows as a straw or lemon color. As the temperature rises with the flow of the

ing is done below the critical temperature and therefore has no hardening effect, its purpose being solely to check the return of heat to the end of the bit, which would otherwise soften the steel to more than the desired degree.

Razor blades are quenched at a light straw—when the return of heat has not been sufficient to greatly reduce the hardness of the steel. Such steel is brittle. Drills and picks should be tempered when the browns or first blues appear about a quarter of an inch above the edge of the bit. It is this final quenching color that the smith must determine by experience; if the drill is quenched at straw heat, the edge may be too brittle for drilling in hard ground and if quenched at too intense a blue may be so soft as to rapidly lose gage in anything but soft

ground. Therefore if trouble arises from points cracking the quenching color is too bright; if the bits lose gage too rapidly the color is too dark. The happy medium must be determined from experience. However, the file test is preferable to the color indications. In that method the smith draws a small smooth file over the point of the bit as the heat returns and plunges the steel when the file just takes hold, but does not cut. The proper "feel" must be learned by experience. Once acquired the smith knows exactly the "feel" at which the steel should be plunged to stand up to the work required of it. The file should be reserved for only such testing.

If, in quenching, the drill is held stationary, that is not moved up and down or back and forth in the trough, a sudden change in hardness will occur at the water line and stresses will be produced which may cause the end of the steel to break off at the water line.

As the degree of hardness obtained is dependent upon the rapidity of cooling, the hardening and softening may also be done in one operation by heating the steel above its critical temperature and quenching in some slow-conducting liquid such as cylinder oil. It is then only necessary to bring the steel up to a cherry-red heat at the point and place it upright with the heated end submerged in a trough of oil until cold. Exactly the same intermediate hardening and embrittling effect will be produced as if it had first been hardened in water then tempered the desired amount. One maker of drill steel has even recommended hardening and tempering by this method then reheating the bit to the critical temperature and hardening and tempering a second time by the method of drawing the temper. It is questionable if the advantages obtained would warrant this extra labor.

In the Transvaal and at certain large mine-drill shops in the United States the hardening and tempering are done in one operation, usually without reheating the drill after it has received its forging heat. The drills are sharpened in machine sharpeners so quickly that the steel is above the critical temperature at the end of the sharpening operation. The sharpened steel is then stood upright on a tray covered with water at 60° to 70° F. to depth of about one inch. The hardening takes place only where the bit is immersed in water and the heat in the upper part flows downward toward the cooling point and from the interior of the steel. This flow of heat prevents hardening of the upper and interior part of the bit to the same degree as the surface in immediate contact with the water. The formation of steam causes the surface of the water to play up and down enough to avoid cracking off of the point at the water line. It is to be noted that in this method the plunging is done on a de-

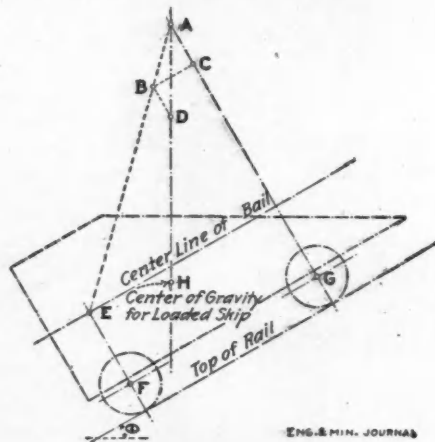
scending heat. In some shops the sharpened drills are quickly reheated just at the points by an oil blast, the parts of the bits just back of the points being kept cool by an air blast. The reheated bits are then dropped into a trough of water where they are allowed to cool. In such methods success depends much upon the composition of the steel. The cooling takes place more rapidly on the outside than in the interior, so that there is a gradual reduction in hardness from the surface inward. It would seem that such methods of cooling might cause stresses in the metal, but it appears that satisfactory bits are obtained.

Various alloys are added to steels which influence their hardness, some adding both toughness with hardness, and the proportion of carbon has an important influence upon this property.

Graphic Solution of Skip Loads

By F. W. COLLINS*

The pull on the bail of a skip used in an incline shaft and the load on the



GRAPHIC DETERMINATION OF PULL ON A SKIP BAIL

wheels can be determined graphically by the method illustrated in the accompanying sketch.

In the sketch θ is the angle of inclination of the shaft; AH , a vertical line drawn through the center of gravity of the skip; AG is the center line of the front wheel drawn normal to the rail; EF , the center line of the rear wheel drawn normal to the rail; E is the point of intersection of EF with the center line of the bail; A is the point of intersection of AH with AG , the center line of the front wheel.

After completing this construction lay off on AH the distance AD , the weight of the skip and load, to any convenient scale, and draw BD , parallel to AG , and BC , parallel to the center line of the bail; then BD will be the load on the front wheels, BC the pull on the bail, and AC

*Mining engineer, Hurley, N. M.

the load on the back wheels. The bail need not be parallel to the rails and may be hinged at any point.

Temperature Correction Chart for Tapes

By H. J. RAHILLY*

The accompanying chart will often prove useful to an engineer when he is called upon to give accurate measurements, as in the setting of anchor bolts in concrete piers in cold or hot weather. The chart is made for a steel tape standard at 62° F., at a 16-lb. pull. The coefficient of linear expansion is taken as 0.0000065 ft. per Fahrenheit degree.

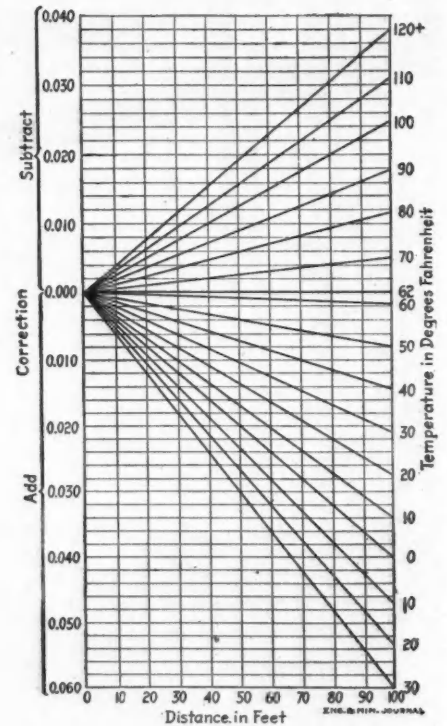


CHART FOR TAPE TEMPERATURE CORRECTIONS

The table requires little explanation. If, for instance, the temperature is 90° and the distance actually measured 70 ft., by following the 00-90 line out until it intersects the 70-ft. ordinate and then following the abscissa through this point across to the left, a reading of 0.013 ft. is obtained. This amount will be the increase in the length of the tape in 70 ft. at the temperature of 90° F., and should be subtracted from the tape reading. When the temperature is below 62° F. the correction should be added instead of being subtracted.

In driving the Laramie tunnel in Colorado the rock in the face was broken down on steel plates $\frac{3}{8}$ in. thick, $3\frac{1}{2}$ ft. wide and $7\frac{1}{2}$ ft. long. No. 5, D-handle shovels were used in loading the rock into the cars.

*Mining engineer, Douglas, Ariz.

Details of Metallurgical Practice

Records of Experience in Ore Dressing, Cyaniding and Smelting

Argonaut Amalgamation Tables

The type of amalgamation table used in the mill of the Argonaut Mining Co., on the Mother Lode in California, is shown in the accompanying illustration. The mill was built in 1897 and the mortars were set too low. The tables are portable, are built in three sections, and can be blocked to any desired grade. It is the intention of the manager to remove the lower sluice plates, which catch only enough gold to maintain themselves in good condition without being cleaned up at all, and to use two splash plates. Experiments are now be-

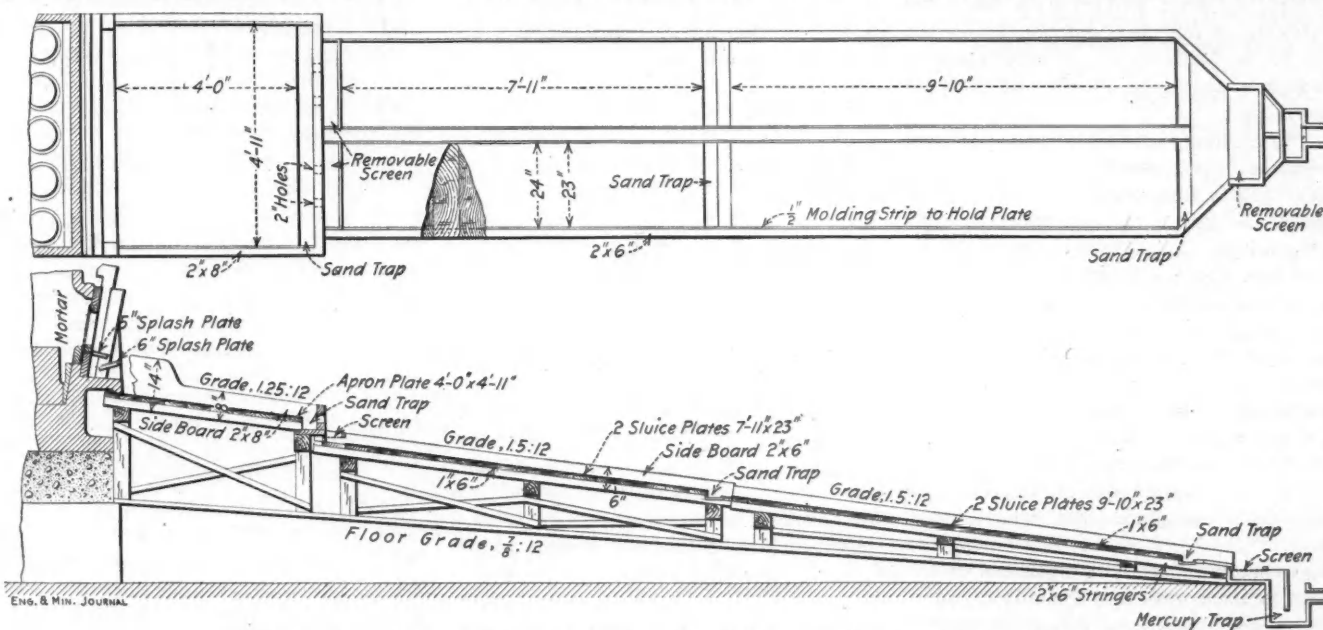
The plates are dressed once each day and only the loose amalgam is brushed off. The brushing is done with whisk brooms, no scrapers of any kind being used. A thick coat of pasty amalgam is maintained on the plates.

Joplin Jigging Practice

BY CLAUDE T. RICE

The most interesting characteristics of Joplin milling practice are: The low cost, in certain mills being less than 20c. per ton, including supplies, power and maintenance; the excellence of the jigging practice; the poor quality of the table work; and the low recovery of the metal-

larly amenable to concentration by jigs, and why such excellent results are obtained by the use of these concentrators. The jigging practice consists of first concentrating roughly on "roughing" jigs, the hutch products going to the "cleaning" jigs; in treating such low-grade ore it is impossible to make a satisfactory recovery and clean the concentrates until they have been enriched in the proportion of about 5:1. Some of the products from both roughing and cleaning jigs are treated in the sand jigs. Sizing and classifying are not essential to good jigging, as is proved by the results obtained at Joplin mills, in which the feed to the jigs consists of particles of ore ranging



AMALGAMATION TABLES IN THE ARGONAUT MILL, JACKSON, AMADOR COUNTY, CALIF.

ing made with these extra splash plates and the results so far obtained seem to indicate success.

There are 40 stamps in the mill, each weighing 1050 lb. and crushing five tons of ore per day through 16-mesh, brass wire-cloth screens; 40 to 45% of the pulp discharged will pass a 200-mesh screen. The batteries are run with "wash" not "splash" discharge, as then the screen is not crowded, and the pulp in the mortar is thoroughly churned with the mercury that is added at the battery. This churning is conducive to good inside amalgamation, an inside chuck block being used, and while it causes a high loss of mercury better results are obtained in amalgamating inside the battery and outside and the plates have to be dressed less frequently.

lic constituents of the ore, rarely exceeding 65% and usually being close to 60%, which may be in part due to the ore being low grade.

The Joplin orebodies are replacements of cherty limestone by sphalerite, galena and secondary silica. These minerals are so associated that they are readily separable from the gangue and from each other after the ore has been crushed to relatively coarse pieces. The ore is quite free from iron-sulphide minerals, but marcasite is a constituent of the shale overlying the limestone in which the ore is found, and as some of the shale is broken down with the ore, there is a small amount of marcasite in the ore milled. However, the concentrates rarely contain more than 4% iron.

It is thus seen that the ore is particu-

larly amenable to concentration by jigs, and where a high recovery is made of all free minerals larger than 1 1/2 mm. in diameter. To successfully jig such an unclassified feed, it is necessary to use multiple-compartment jigs and different plunger strokes in each compartment. There is a large difference in the strokes in the different compartments of the same jig.

Usually there is one roughing and one cleaning jig in a mill, although in certain mills there are two roughing and one cleaning jig, while in a few others, two roughing and two cleaning jigs are used. In a few mills, where the jigging practice has been brought to high efficiency, sand jigs are used in addition to those above mentioned, but lately the tendency has been to concentrate both coarse and fine

sands on tables. In certain mills, the chats—particles of ore composed of gangue and metallic minerals in about equal proportions—that pass a 3-mm. screen are fed to the sand jigs, while in certain other mills the coarser sand from the main settling vats is fed to the sand jigs.

The roughing jigs are 5- or 6-compartment machines, although some 4- and a few 7-compartment jigs are in operation. The 7-compartment jigs are used in mills wherein the ore treated contains much lead or the jig feed is rich. The grate area of each compartment or cell ranges from 30x42 in. to 36x48 in. The jig shafts make 90 to 110 r.p.m.; the stroke ranges from $\frac{5}{8}$ to 1 in. In a 6-cell jig the extreme difference of stroke in the different compartments is $\frac{1}{2}$ in. The bed of material on the grates is usually 5 in. thick; in some instances the thickness is 4 in., in others 6 in. The roughing jigs are operated with the hutch gates partly open, which tends to increase the strength of the suction stroke. There is a drop of about $3\frac{1}{2}$ in. from one compartment to the next, and the grates are set at an inclination such that the discharge is about one inch lower than the upper end.

The cleaning jigs are 6- or 7-compartment machines; usually there is one more cell in the cleaning than in the roughing jigs. The grate area of each compartment ranges from 24x36 in. to 36x48 in., 30x42-in. grates being the most common size. The bed of material is 4 to 5 in. thick; the shafts make 135 to 160 r.p.m., and the stroke ranges from $\frac{1}{4}$ to $\frac{5}{8}$ in. The drop from one compartment to the next ranges from $1\frac{5}{8}$ to $1\frac{3}{4}$ in. The grates are set at an inclination, as in the roughing jigs.

The sand jigs are 4- or 5-compartment machines; the grate area ranges from 20x30 in. to 30x42 in., 24x36 in. being the most common size. The thickness of the beds is usually 5 in.; the shafts make 150 to 190 r.p.m., and the stroke ranges from $\frac{1}{8}$ to $\frac{3}{8}$ in., $\frac{1}{2}$ in. being the stroke usually preferred. The drop between cells is one inch.

Although the practice of setting the grates at an inclination results in unequal working of the current, because of the thick beds there is still enough thickness of zinc-ore particles at the head of the grate to clean the product going into the hutch. The beds of both roughing and cleaning jigs are supported by wooden or cast-iron grates, which are placed so that the direction of the slots is at right angles to the flow of pulp. The slots in the grates of the roughing jigs are $\frac{1}{8}$ in. wide, in the grates of the cleaning jigs $\frac{1}{12}$ in. wide, and in the sand jigs $\frac{1}{12}$ to $\frac{1}{16}$ in. wide. The feed to the roughing jigs contains an excessive amount of water.

In the best practice, both roughing and cleaning jigs make clean tailings, which

are washed free from slime before being sent to the tailing pile. The reason for this practice is that because of the great quantity of water used, the fine particles of galena and sphalerite are carried through the jig by the rush of water, and have no chance to settle upon the beds. This washing is done by a crude settling-box, which is built at the end of the roughing jig, or, in some instances, a hydraulic classifier is used that is a part of the cleaning jig. The fine material that overflows is allowed to settle in a vat; the coarser portion is treated in sand jigs while the fine material is fed to tables.

Hutch products are drawn off through gates that are kept partly open, so that there is a uniform flow of the products from the jig compartments. The chats are drawn continuously through special gates from the bedded material on the grates. The lead in the ore is readily recovered, as the galena is freed from the gangue after coarse crushing; therefore no real lead middling is made. In certain mills a dirty lead concentrate is drawn from the first compartment and is set aside until enough has been accumulated to enable cleaning to be done with a thick bed of material on the jig grates. An obstacle to the recovery of more lead than is made at present is that the galena is crushed to fine flakes in the rolls. Spring rolls are used, operated with a choke feed, and the faces of the rolls can come in contact. This is why the quantity of sand made in Joplin mills is large, in spite of the fact that all crushing is done by rolls after reduction to $1\frac{1}{2}$ in. in Blake crushers.

The hutch product from the last compartment and the bed product from the last two compartments are fed to sand jigs in those mills in which sand jigs are used. The chats are drawn from a depth of 3 in. below the surface of the bed in the other compartments, and after being crushed in the chat rolls, are returned to the roughing jigs. Clean concentrates can be obtained from the roughing jigs only when the feed contains much galena, or when rich in sphalerite. In general, the Joplin ore is too poor to permit clean bed or hutch products being made by the roughing jigs. A small quantity of lead concentrate is sometimes obtained from the bed and from the hutch of the first compartment; it is fed to the cleaning jigs. In some instances all the bed products or coarse concentrates from the roughing jig are fed to the sand jig. A marcasite product is sometimes drawn from the grates; the marcasite being less friable than the sphalerite, which is therefore finer and goes through the grates.

The enriched products from the roughing jigs that are not otherwise treated as has been mentioned, flow to a pyramidal box, where the excess water is re-

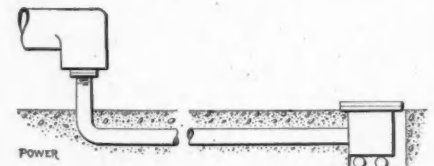
moved, and they are then elevated to the cleaning jigs. If the pulp is rich, clean lead concentrate is obtained from the hutch and bed of the first compartment; otherwise a dirty lead concentrate is obtained, which is set aside until the accumulation is large enough to permit cleaning. However, throughout the district, little lead is recovered by the jigs. With the exception of the last two grates and the last hutch, zinc concentrates are obtained from the other compartments. In a few instances, a marcasite-pyrite-blende middling product is obtained, but usually the marcasite goes into the zinc concentrate. The chats from the last two grates and from the last hutch of both roughing and cleaning jigs go to a chat trommel, the oversize from which goes to chat rolls, the product from which is returned to the trommel. The undersize goes to the sand jigs.

The tailing from the sand jig goes to the main settling vats; middlings are drawn from the last two grates and the last hutch, and, after regrinding, go to tables. The other compartments make clean concentrates.

The capacity of a 36x48-in., 6-compartment roughing jig is 250 tons per 10-hr. shift. The capacity of a 30x42-in., 7-compartment cleaning jig is 75 to 100 tons. From 1500 to 2500 gal. of water is used per ton of ore treated. A large proportion of concentrates passing 2-mm. openings is recovered by the jigs. This product comes from the cleaning as well as from the sand jigs, because much blende that will pass 1-mm. openings is drawn into the hutches by the strong suction.

Movable Muffler for Gas Engine Exhaust

In many mills, situated in districts remote from coal fields, gas and oil engines have been found to be satisfactory prime movers. Where such engines are used it is customary to muffle the exhaust, and



GAS-ENGINE MUFFLER ON ROLLERS

occasionally some difficulty is experienced in preventing leaks in the exhaust pipe. When an exhaust pipe leaks, the disagreeable fumes may escape into the engine room.

This leakage, according to *Power*, results from the inflexibility of the exhaust pipe, so that when expansion takes place, the resulting strain upon a rigid pipe may cause slight opening at the joints. In one instance the trouble was remedied by supporting the muffler upon rollers, as shown in the accompanying sketch.

Notes from Current Literature

Concerning Mining, Metallurgy and Industrial Chemistry

Water Analysis after Homestake Fire

The Homestake mine waters, as compared with surface waters, show a larger percentage of lime and magnesia, and a much larger percentage of sulphates and chlorides (*Econ. Geol.*, Dec. 1911). The chlorides are partly the effect of percolation containing drainage, partly of the excreta of 1500 men and 50 horses working underground. During the fire in 1907 it was necessary to flood the mine to a point above the 300-ft. level, and in spite of the vastly increased influx of water, the percentage of sulphates and of total solids at least quadrupled. This was partly due to the heating of the ore, but still more to the opportunity for leaching freely through over 1,500,000 tons of pyritic ore, and a still larger quantity of broken rock used as filling. In unwatering the mine over 2,500,000 tons of water were raised, carrying 2788 tons of SO_2 , or the total sulphur in over 2000 tons of pyrite. This water also carried over 1000 tons of alkali. The complete analysis, in parts per 1,000,000 was: SO_2 , 1115; CaO , 442; KNaO , 427; MgO , 328; FeO , 28; Cl , 8; Fe_2O_3 , tr.; Au , 0.0017. The 1,500,000 tons of broken ore must have contained about 120 tons of soda from the explosives used, some came from the excreta referred to, less than one-tenth from the incoming water, showing that most of it was leached.

Vertical vs. Incline Shafts

The question of relative economy of vertical and incline shafts was discussed by John M. Nicol (*Informes y Memorias Inst. Mex. Min. y Met.*, Vol. II, No. 6). In shafts for prospecting, the incline shaft offers the following advantages: (1) The vein can be followed, however much it changes, and no long crosscuts are needed to reach the ore for extraction purposes. (2) If the shaft is sunk on rich ore, the ore extracted will pay or partly pay expenses, giving a maximum of exploration work at a minimum of expenditure. (3) The vein is, often softer than the country rock, so sinking is cheaper.

The disadvantages are: (1) The veins usually carry more water than the walls, and all the water of a region has to be drained with sinking pumps. (2) This is intensified by the cutting of sinking-pump valves by the quartz grit from the vein, while the cutting is usually less in sinking in slate or porphyry. (3) If

the vein varies greatly in dip, there is difficulty in maintaining favorable track and hoisting conditions, and the shaft may become economically useless. (4) If a large amount of good ore is found on either side of the shaft, when sinking on the vein, it may require either extremely expensive timbering, or else allowing large pillars of ore to stand until the mine is worked out.

The advantages enumerated by Mr. Nicol for vertical shafts are: (1) The maximum depth is reached in a minimum time. (2) They can be driven more rapidly and timbered more easily than an incline shaft. (3) The pumping question is less difficult, as pumps can be suspended more readily. (4) Ore extraction can be done more economically. As to the last, however, it is now usually considered that self-dumping skips are an improvement on putting cars on a cage, and hoisting the cars, so that the last claim need not be seriously considered.

Treatment of Low-Grade Oxide Copper Ores

A recent patent (U. S. pat. No. 1,019,708) for the treatment of low-grade oxidized copper ores, or mill tailings, is that of J. W. Bennie of the Shannon Copper Co. This presupposes making a roast heap of copper or iron pyrites, which after ignition is covered with the fines to be treated. The idea is to convert the oxides, hydrates and carbonates into sulphites and sulphates. This conversion is assisted by iron sulphates or sodium chloride, so the pile is occasionally sprinkled with one of these substances in solution. It is attempted to make the roasting as complete as possible, and after it is entirely over, the pile is either leached *in situ*, or removed to tanks or reservoirs for leaching. The copper is precipitated from the leach, and the mother liquor furnishes the ferrous and ferric salts to assist in leaching the next lot of ore.

Manganese in the Caucasus

The manganese mines of the Caucasus are among the richest in the world, says *Daily Consular and Trade Reports*, May 7, 1912, 442,465 tons of ore being exported through Poti, and 129,233 tons through Batoum in 1911. About 15 to 20% is washed. The richest deposits are about 126 miles from these ports, at Tchiatouri, Kotals government. Ore re-

serves here are estimated at 1,070,000,000 tons, the ore lying in a horizontal bed between limestone below and sandstone above, and also in oolites. The area covered by rich deposits is about 44 square miles.

The mines have usually been worked in a crude way by the Georgian peasants, taken one to three miles in ox carts or by packhorses, at a cost of 55 to 85c. per ton, taken by narrow-gauge railway 25 miles from Tchiatouri to Sharopan, and thence by the Trans-Caucasian R.R. to Batoum or Poti, 107 miles.

The washing plants have recently greatly polluted the Kvirili River, and it appears that a vigorous anti-débris campaign is being waged, which is to be met by impounding the washery water until the slimes settle.

Chromax Bronze

According to C. Vickers, in the *Foundry*, for March, chrome-nickel bronze is being manufactured in this country by the Naulty Smelting & Refining Co., Philadelphia, the product being known as chromax bronze. The proportions of the metal in the mixture are said to be as follows: Copper, 66.66%; zinc, 12.13%; nickel, 15.15%; chromium, 3.03%, and aluminum, 3.03%. The tensile strength of the alloy is said to be 79,000 lb. per sq.in., and there is reason to believe that this figure is not too high. The color of the alloy is white, and it takes a fine, silvery polish. The fracture is fine and dense, especially after being remelted. One test bar made from the first melt of new metal had a tensile strength of 66,670 lb. per sq.in., although after being broken it was found that the bar was unsound to the extent of one-third of its area. Chrome-nickel bronze, owing to its high melting point, has a denser structure and greater compressive strength than manganese bronze. It can be rolled into sheets and wire.

Utilization of Lead Furnace Fume

Lead-furnace fume from baghouses is ordinarily burned giving a whitish cinder of approximately the following composition, in the case of a fairly pure lead ore: PbSO_4 , 55%; PbO , 44; ZnO , 1; Fe_2O_3 , tr. This is ordinarily resmelted, attempts to use it as a pigment having proved fruitless, owing to its variable color. L. S. Hughes has attempted to convert this material into a pigment in

the wet way (*Journ. Ind. and Eng. Chem.*, Apr., 1912). The first step was to convert the lead sulphate to hydrate, which was done by grinding in a ball mill with soda-lye solution. As this solution must be concentrated, the resultant sodium-sulphate solution was supersaturated, so that a strongly cemented mass resulted, which had to be broken out of the mill.

This was avoided by using a mill through which water could be run without stopping the mill. In this way the hydrate was washed out and then settled in tanks. The resultant lead hydrate was then found available in many ways: It could be converted into a basic salt with acetic or nitric acid, and precipitated with alkaline chromates; converted into oxide by heating; or the fresh hydrate mixed with arsenic acid for the production of lead arsenate.

Ancient Hard-Copper Tools

The copper-cutting instruments of the Tarascans, found in the Balsas River ruins in Guerrero, says the *Engineer*, Apr. 26, 1912, are so hard that they would turn the edge of a modern knife, and it has been claimed that these people, along with the Aztecs and Toltecs, possessed the secret of tempering copper. On the other hand, copper knives and axes, found at Atcopotzalco, are so soft that they can be cut with an ordinary pocket knife. Analysis showed that in all three localities the copper implements were of the same composition as the copper ores found therein. The blades from Guerrero, which are hard and apparently tempered, were made from the natural ore carrying nickel and cobalt, thus making the smelted alloy approach steel in hardness. Thus, the natural product gave an alloy of great hardness when heated and sharpened, while the other ores of practically pure copper, when smelted, resulted in implements which were soft and inferior in cutting value. Therefore, many archaeologists of Mexico deny that these people possessed the secret of tempering copper, the sharp cutting copper implements being the result of Nature's handiwork.

Cyanides from Aluminum Nitride

The production of cyanides and cyanamides from aluminum or silicon nitride, or silicon carbide-nitride is described by Carl Bosch and Alwin Mitasch (U. S. pat. 1,022,351). A mixture of any of the above compounds is heated with soot, coal, pitch, or even a hydrocarbon such as acetylene, and an oxide, carbonate, or sulphate of an alkali or alkaline-earth metal. The reaction should be carried out at as low a temperature as possible, to avoid loss of nitrogen, and

for this reason it is desirable to use mixtures of nitrides rather than pure compounds, as the mixtures will ordinarily melt at a lower temperature than will either constituent.

Tin in the Gay-Lussac Silver Determination

The end point in the Gay-Lussac silver titration is usually clouded when the bullion contains tin. This was investigated with a view to finding a prevention or remedy, by L. E. Salas (*Bull. A. I. M. E.*, Mar. 1912). His results seem to indicate that the presence of tin has no effect on the volatilization or absorption losses in cupellation; that the addition of reagents such as barium sulphate, or albumen to carry down the interfering metastannic acid is of no avail; that a centrifuge will not settle it out; and that the necessity of making many additions of the decinormal salt solution aggravates the trouble. The effects of tin are minimized by the following procedure. For 1.0 gram of silver bullion containing 5% of tin, place 2 gram of tartaric acid and 3 or 4 c.c. of distilled water on the silver sample in the assay bottle. Heat until the tartaric acid dissolves. Cool thoroughly. Add 10 c.c. of 1:1 HNO₃, and keep cool while the silver dissolves. It is unnecessary to boil off the nitrous fumes after the silver dissolves, and the assay must not be boiled for any other reason. The amount of bullion taken must be such as to leave an excess of silver in solution after 100 c.c. of NaCl have been added.

Heat Balance of the Blast Furnace

In George Ralli's "Consumption de Combustible" the following figures are given as the apparent requirement per kilogram of charge in the furnaces at Mansfeld: As heat in the exhaust gases, 90 cal.; radiation, 12 cal.; driving off water, 18; slag, 450; matte, 22; jacket water, 35; decomposing carbonates, 32; total, 659 cal. At this plant the actual theoretical number of calories given by the coke is 1680; the furnace carrying 23% of coke.

In contrast to this, a similar calculation for the Elisseina (Bulgaria) matting furnaces shows a need for 700 cal., and a theoretical input of 730 calories.

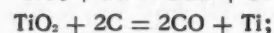
Waterproof Concrete Work

The following conclusions were drawn by the Bureau of Standards after testing the effect of waterproofing compounds on concrete (No. 3, *Technologic Papers*, Bureau of Standards). Portland-cement mortar and concrete can be made practically water-tight or impermeable to any hydrostatic head up to 40 ft. without the

use of any waterproofing materials, by care in selecting good materials and in proportioning them. The consistency of the mixture should be wet enough so that it can be puddled, the particles flowing into position without tamping. The mixture should be well spaded against the forms when placed, so as to avoid the formation of pockets on the surface. The ordinary materials used for waterproofing seem to be without any effect; probably one uses greater care when the waterproofing compound is used, which accounts for the improved results. In certain cases a bituminous coating may be of advantage; this is the only form of waterproofing recommended.

Making Titanium Alloys

Among the recent patents are a number given to A. J. Rossi for the production of titanium alloys. Probably the most interesting is the production of silico-titanium (U. S. pat. No. 1,019,526). Pure silica (white sand) and rutile are mixed with carbon in such proportions as to give the following reactions:



and heated in an electric furnace. By adding a metal or its oxide, and carbon to reduce it, a ternary alloy may be produced, of which the most promising would appear to be ferrosilicotitanium.

Sulphate Leaching Process

The Williams and Bradley patent (U. S. pat. 1,006,330) claims that the chief objection to leaching ores with sulphuric-acid solutions is the gelatinization of the silica of the ores. To overcome this, they use a solution containing about 0.3 to 0.5% of sulphuric acid, but considerable copper or zinc sulphate, or both. By this means, gelatinization is avoided, while a solution strong enough to electrolyze is obtained because of the zinc or copper, or both, already in the solution. Regeneration by electrolysis is carried on until the solution has about its original composition, and it is then used again.

The Air Lift Pump

Experiments by Davis and Weidner, at the University of Wisconsin (*Bull. No. 450, U. of W.*), indicate that with the air-lift pump, the maximum efficiency is attained at 63% submergence. With the same percentage of submergence, the efficiency increased as the lift was increased. Experiments were made up to 24 ft. Theory indicates, however, to a point's being reached above the limits of the experiment beyond which efficiency would decrease.

Electricity and Chemical Action

By Harry C. Jones *

The reciprocal transformations of intrinsic and electrical energy constitute the subject matter of electrochemistry. That intrinsic energy can be transformed into electrical is exemplified in the primary cell. The Daniell cell is a machine for converting a part of the intrinsic energy of zinc into electrical energy.

CONVERSION OF ELECTRICAL INTO INTRINSIC ENERGY

That electrical energy can be converted into intrinsic is shown in every act of electrolysis of, say a fused salt. When an electric current is passed through fused sodium chloride, some of the electrical energy disappears, and a part of that which disappears is converted into intrinsic energy of sodium and of chlorine. The intrinsic energy of the sodium and of the chlorine is raised to the level at which it exists in these substances in the elementary condition. The elements sodium and chlorine are re-formed, the one at the cathode and the other at the anode, each with its original quantity and intensity or potential of intrinsic energy.

It should be said in advance that the developments in the field of electrochemistry during the last 25 years have been nothing less than marvelous. Indeed, a quarter of a century ago, the whole subject of electrochemistry was literally in its infancy. During this time entirely new electrochemical methods have been discovered and devised for separating the metals, not only from one another, but from their ores. The art of electro-metallurgy has come into such prominence that many of the most valuable metals are now obtained almost exclusively by the electrical method. A new branch of quantitative analysis has grown up around the electric methods of effecting these separations.

Much of the remainder of these papers will be devoted to a discussion of the principles which underlie these recent and epoch-making developments.

ELECTROLYSIS OF THE ELEMENTARY GASES

The elementary gases, oxygen, hydrogen, chlorine, etc., have been known for a long time to contain two atoms in their molecules. One atom of an elementary gas was, however, looked upon as just like any other atom of that element.

Sir J. J. Thomson showed that this was not the case. He introduced hydrogen into a glass tube into whose ends platinum electrodes were sealed, and sparked the gas. Across the center of the tube a loosely fitting septum of alum-

Primary batteries convert intrinsic into electrical energy. Explanation of the primary and secondary cell. Electrolysis of the elementary gases possible. Chemical action impossible without electrolytic dissociation. Chemical action at a distance.

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inum was placed. After sparking the gas for some time, its spectrum was taken on the two sides of the aluminum septum. On one side the green line of hydrogen came out strong and the red line weak; while on the other side of the septum the red line came out strong and the green line weak.

This shows that the molecular hydrogen had been broken down into a positively charged atom and a negatively charged atom of hydrogen. One of these gives the strong green line and the other the strong red line.

Similar results were obtained with chlorine, so that it now seems fairly certain that in diatomic molecules of the elements in general we have a positive atom and a negative atom, and these two atoms have, of course, somewhat different properties.

Thomson went farther and showed that when the compound methane, CH_4 , is electrolyzed, the carbon went toward one pole and the hydrogen towards the other. The hydrogen in methane can be readily replaced, one at a time, by chlorine, giving monochloromethane, CH_3Cl ; dichloromethane, CH_2Cl_2 ; trichloromethane, CHCl_3 ; and finally tetrachloromethane, CCl_4 .

AN ION NOT ALWAYS CHARGED WITH THE SAME SIGN

When these compounds were electrolyzed, the chlorine went not to the positive pole, as it would have done if it were negatively charged, but to the negative pole—to the same pole that the positive hydrogen which it replaced went; showing that the chlorine which replaced the positive hydrogen was positive, and not negative, as it had hitherto been supposed that chlorine always is. The bearing of this experiment on one of the most important reactions known to chemists ought to be obvious. The hydrogen in methane is replaced or substituted by chlorine—positive hydrogen by positive chlorine. Now substitution is one of the most important and

general of chemical reactions. When zinc is treated with sulphuric acid the hydrogen of the acid is replaced by the zinc. In what does this act really consist? A transference of the positive electrical charge from the hydrogen ion which has it but holds it loosely, to the zinc which takes it and holds it more firmly than the hydrogen.

Since the substituting atom or group, from Thomson's work, always has the same charge as the thing substituted in the molecule, it follows that this most important chemical reaction is purely an electrical act, a transference of the electrical charge from the constituent of the molecule which holds it weakly, to something which holds it more firmly and therefore takes it. The constituent which has lost the charge leaves the molecule, since there is nothing to retain it in the molecule, while the atom or group which has taken the charge is consequently drawn into the molecule.

Probably all substitution in chemistry, organic or inorganic, is then purely an electrical act.

CONDUCTIVITY OF ELECTROLYTES A MEASURE OF DISSOCIATION

We have discussed the theory of electrolytic dissociation, and the way in which molecules of acids, bases and salts break down into ions. Further, it has been pointed out that the presence of ions is necessary for chemical action, and that chemical action is a maximum where there are a maximum number of ions present.

It is obviously a matter of fundamental importance to determine in any case the magnitude of the dissociation of any solution of any concentration of any given electrolyte. A simple method, and one that is fairly accurate, was worked out by the distinguished physicist, Kohlrausch, and every one must be familiar with the essential features of this method.

If a solution of any given substance is not dissociated at all, it means that it does not conduct the current, and, conversely, if a solution does not conduct the current it means that it is not dissociated.

We have maximum conductivity when we have maximum ionization. This statement must be clearly understood or it will lead to confusion. In order to produce complete dissociation we must have the solution very dilute. The above statement does not mean that a very dilute solution of an acid, base, or salt conducts the current better than a more concentrated solution, but it does mean that when the conductivity

of a dilute solution is divided by the concentration expressed decimally, the resulting conductivity is greater than that of a more concentrated solution.

This holds up to a certain dilution, beyond which the conductivity does not further increase, no matter how much the dilution is increased. When this maximum, constant value is reached, it means that the dissociation of the solution is complete.

When the actual conductivity is divided by the concentration expressed decimally, the result is known as the molecular conductivity.

To obtain the dissociation of any solution of any electrolyte, it is only necessary to divide the molecular conductivity of the dilution in question, by the maximum, constant value of the molecular conductivity for the substance under investigation.

Space will not permit of a discussion of the details of the method—such as the units used, the concentrations employed, the apparatus required and the results obtained. For these details see "Elements of Physical Chemistry," fourth edition, pp. 377 to 419.

SULPHURIC BY NO MEANS THE STRONGEST ACID

A few results will, however, be mentioned. Hydrochloric, hydrobromic and nitric are among the strongest acids. Sulphuric acid at ordinary dilutions is only a little more than half as strong as those acids just mentioned. This may be a surprising result, since sulphuric acid has generally been regarded as one of the very strongest acids. The reasons for this are obvious after a moment's reflection. Sulphuric acid has a comparatively high boiling point. It is, therefore, not appreciably volatile at ordinary temperatures. Further, sulphuric acid has great power to combine with water.

Sulphuric acid, having a high boiling point, displaces acids with lower boiling points from their salts, e. g. hydrochloric acid from chlorides; and for this reason was regarded as a stronger acid than hydrochloric. This fact shows absolutely nothing as to the relative strengths of the two acids in question; the action is simply a result of their relative boiling points. Boric acid, one of the weakest acids known, will displace sulphuric acid from sulphates at a sufficiently elevated temperature, simply because it has a still higher boiling point.

The fact that sulphuric acid has great power to combine with water, has also led to a misunderstanding as to its strength. In the presence of organic matter it causes hydrogen and oxygen to combine and form water, with which it then combines—in a word it produces bad burns upon the body.

DISSOCIATION THE MEASURE OF AN ACID'S STRENGTH

The conductivity method as a measure of dissociation is the best general method for determining the relative strengths of acids and bases. An acid is a compound, which, in the presence of a dissociating solvent yields hydrogen ions. The strength of an acid simply means the number of hydrogen ions present in a given volume of its solution, at a given concentration. To measure the strength of an acid, we must therefore simply measure the concentration of the hydrogen ions, and this is just what we do when we measure dissociation.

Potassium and sodium and the other alkali hydroxides are among the strongest bases; with the hydroxides of calcium, strontium and barium next in order. The strength of a base simply means the number of hydroxyl ions present in a given volume of a solution of a given concentration of the base. To determine the strengths of bases it is simply necessary to measure their dissociation, the strength being proportional to the dissociation.

The conductivity method of measuring dissociation is applicable to all electrolytes, acids, bases and salts. Among the acids we find all degrees of strength represented—from the strongest like hydrochloric, to the weak organic acids, such as carbonic, hydrocyanic, etc. Similarly, we have all degrees of strength represented among the bases.

The salts in aqueous solution are, in general, strongly dissociated compounds. The exceptions are the halogen salts of mercury, cadmium and to some extent zinc.

The above definition of acids and bases applies to solutions of these substances, which is the condition under which they act chemically. When fused these substances conduct and are, therefore, somewhat dissociated.

NO SUBSTANCE IS ACID OR BASE UNTIL DISSOCIATED

The above definition would, of necessity, lead to the conclusion that pure, homogeneous substances are neither acids nor bases, but become such only when dissolved in dissociating solvents. We have already had examples illustrating this point. Pure, dry liquid hydrochloric acid, as we have seen, has no trace of acid properties; it will not act upon metals and will not decompose carbonates. It will not even turn blue litmus red. Similarly, pure, dry sulphuric acid will not color blue litmus red.

Further, when an acid like hydrochloric is dissolved in a nondissociating solvent like chloroform or benzene, it has no acid properties, as we have seen. These facts alone suffice to show the

justification for the above definition of acid and base, and there are a large number of others which could be cited were it desirable, and did space permit.

RELATIVE DISSOCIATING POWERS OF DIFFERENT SOLVENTS

We have dealt thus far chiefly with water as a solvent, and have already referred to it as having the greatest dissociating power of any of the common solvents. We have, moreover, discussed the relation between the dissociating power of solvents and certain physical properties, as their dielectric constants and their own association, and have pointed out that these physical properties stand in about the same relations as the dissociating powers of these solvents.

It, however, seems desirable to go a little more fully into the dissociating powers of solvents, on account of the importance of this property both for pure science and for the industries. We have seen that chemical reactions depend primarily upon ions. The dissociating powers of the solvents in which the electrolytes are dissolved is what gives us the ions. Consequently, the dissociating power of a solvent is what determines primarily the chemical behavior of substances dissolved in it.

Water, as has already been pointed out, is not only the best solvent known, but has a greater power to break molecules down into ions than any other common solvent. Its great solvent power and its great dissociating power make it the most important solvent, many times over, in all chemistry. Indeed, water is by far the most remarkable compound in all chemistry. It is formed by the union of the hydrogen ion with the hydroxyl ion. The hydrogen ion is the one that gives all acidity, and the hydroxyl the one that gives all basicity. These are not only the most important ions in all chemistry, but they are the ions that have the greatest velocities in solution.

Water, with respect to its properties is, in general, an extreme substance. Take any given property. With respect to this it stands either at the top or at the bottom of the list of solvents, and usually at the top.

Again, take its property of expanding before freezing. If water contracted down to its freezing point, as most liquids do, the whole face of nature would be changed in one cold winter, at least in northern latitudes.

Concentrated nitric acid has considerable dissociating power, but can hardly be used as a general solvent, and the case of liquid ammonia has already been referred to. Sulphuric acid, concentrated, has also been shown to have a marked power of breaking molecules down into ions.

Among the common organic solvents methyl alcohol has the greatest dissociating power—in general—from one-half to one-third that of water.

Ethyl alcohol comes next with about one-fourth the dissociating power of water. The higher isomeric alcohols have less dissociating power than the lower or simpler members of the series, and this is a general fact in any homologous series of compounds. The simpler members, or those containing the smallest number of carbon atoms, have greater power to form ions from molecules, than the more complex members.

Acetone, which is a good solvent, has about one-fifth the dissociating power of water. It should be stated in connection with acetone, that in addition to its power to break molecules down into ions, it also has a marked power of forming molecular complexes from simple molecules dissolved in it. It has a great associating or polymerizing property, and this accounts for the abnormal results that are so often obtained in acetone solutions.

Formic acid, while not a common solvent, has high dissociating power. Indeed, it dissociates to about three-fourths the extent of water.

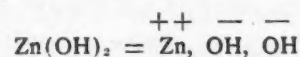
The remaining organic solvents have much less dissociating power than those mentioned above, and this accounts for the comparative chemical inactivity of solutions in these substances as solvents. The hydrocarbons and esters have about the least dissociation power of any known solvents, and solutions in these substances show little chemical activity.

The dissociating power of the different solvents shows why it is that we often have to be almost as careful about the solvent we use to get a certain result, as about the substance that we dissolve in the solvent.

AMPHOTERIC ELECTROLYTES

We have spoken thus far of liquid solvents breaking molecules of acids, bases and salts down into an equivalent number of positively charged cations, and negatively charged anions. This would leave the impression that the kinds of ions into which an electrolyte would dissociate, are fixed and determined by the nature of the electrolyte alone, and are independent of the surrounding conditions. This is not always true, and one exception, at least, must be discussed.

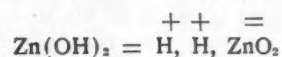
Take a compound like zinc hydroxide. In the presence of an acid it dissociates into zinc and hydroxyl ions, and as follows:



It dissociates, under these conditions, just like any other base, and when treated with an acid the hydrogen ions of the acid combine with the hydroxyl

ions of the base, and when the solution is evaporated a salt is formed. It should be stated that a salt is not formed when a dilute solution of an acid reacts with a dilute solution of a base, unless the salt is insoluble in the solvent in question. This will be seen to be the case when we recall that a dilute solution of almost any salt is completely dissociated into its ions. We get the salt only when we evaporate the solution, and drive off water which breaks the molecules down into charged parts or ions.

When zinc hydroxide is treated with a strong base, say sodium hydroxide, it no longer dissociates as a base, but as an acid, and in the following sense:



The hydrogen ions from the zinc hydroxide combine with the hydroxyl ions from the sodium hydroxide, and form water and sodium zincate.

There are a number of well known substances which behave like zinc hydroxide, dissociating as a base in the presence of an acid, and as an acid in the presence of a base. Such substances are termed amphoteric electrolytes. Aluminum hydroxide is another example in general chemistry, and there are many examples among the compounds of carbon.

The above discussion of amphoteric electrolytes brings out a principle which is fundamental and apparently general. Zinc hydroxide in the presence of an acid yields hydroxyl ions, while when a base is added to it, i.e. when hydroxyl ions are added to it, it no longer dissociates into hydroxyl ions. This kind of dissociation is suppressed, and the zinc hydroxide dissociates in an entirely different way giving no hydroxyl ions, but only hydrogen ions. The dissociation into hydroxyl ions is entirely suppressed by the addition of a large number of hydroxyl ions from the dissociated sodium hydroxide. The general principle illustrated by the manner of dissociation of the zinc hydroxide is that *the presence of a common ion drives back the dissociation which yields that ion.*

If hydrochloric acid is added to a solution of sodium chloride, the dissociation of the latter is driven back, and driven back according to a well known law; the amount depending on the amount of hydrochloric acid added. This driving back of the dissociation is due to the presence of the common ion—chlorine. Indeed, the best method of purifying sodium chloride is based upon this principle. Prepare a saturated solution of sodium chloride and conduct in a stream of hydrochloric acid gas. The dissociation of the salt is driven back, i.e. more molecules are formed—but the solution is already saturated with respect to molecules of sodium chloride,

and as more molecules are formed they are precipitated. A repetition of the above method of precipitating sodium chloride will give the fairly pure salt from a complex admixture with other things.

The above principle of the presence of a common ion driving back the dissociation which yields that ion, is almost as important for the industries as for pure science, as a little thought on this problem, in the light of the above facts, will show.

THE ACTION OF PRIMARY CELLS

The primary cell was discovered by Volta, more than a century ago, but it is only comparatively recently that we have come, even in part, to understand its action. So true is this that it is only for a few decades that we have known what are the chief sources of the electromotive force in such cells. Take as a type of the primary cell the Daniell battery, which consists of one electrode of copper immersed in a solution of copper sulphate, and the other electrode of zinc surrounded by a solution of zinc sulphate. The copper is the positive pole and copper separates from the solution upon the copper electrode. The zinc electrode dissolves, zinc passing into solution as zinc sulphate, or zinc ions pass into the solution.

There are three possible sources of electromotive force in such a system. At the surface of contact of the zinc with the zinc salt; at the surface of contact of the copper with the copper salt, and at the surface of contact of the two electrolytes with one another. Which is the chief source of the electromotive force of the cell?

The solution of the problem of the primary cell we owe largely to W. Nernst, now of the University of Berlin, utilizing the gas laws as applied to the osmotic pressure of solutions by Van't Hoff, and the theory of electrolytic dissociation of Arrhenius.

Given a metal, say zinc, surrounded by one of its own salts, say zinc sulphate. At the surface of the metal there exists a tension, known as solution tension, which tends to drive atoms off of the bar of metal into solution as ions. The metal atoms become ions by taking a positive charge of electricity from the remaining metal bar, which, consequently, becomes charged negatively.

OSMOTIC PRESSURE OPPOSES SOLUTION TENSION

Opposing the action of solution tension which drives atoms of the metal into solution, is the osmotic pressure of the metal ions in solution, which acts so as to drive metal ions out of the solution onto the bar. If these cations were driven onto the bar of metal, they would

give up their charge to the bar, and the electrode would become charged positively.

What happens in any case depends upon which of these opposing forces is the greater. In the case of zinc the solution tension of the metal is always greater than the osmotic pressure of the zinc ions in any possible solution of any zinc salt. Consequently, a bar of zinc is always negatively charged whenever it is dipped into any solution of a zinc salt.

With copper exactly the reverse is true. The osmotic pressure of the copper ions in a solution of almost any concentration of a copper salt is greater than the solution tension of copper which is infinitesimal. Consequently, when a copper bar is plunged into a solution of copper salt, the bar becomes charged positively relative to the solution.

When the copper and zinc are connected metallically, and the copper and zinc salts by means of a siphon, we have a Daniell cell, and we can now see just how this works. Zinc, having a high solution tension passes into solution, and copper having such a low solution tension separates from the solution of the copper salt onto the bar. Copper, receiving the copper ions, is therefore the positive pole, and zinc, losing positive ions to the solution, is therefore the negative pole. The current flows on the outside from the copper to the zinc, and on the inside from the zinc to the copper.

E. M. F. OF PRIMARY CELLS CAN BE CALCULATED

Nernst has worked out a method for calculating the electromotive force of such cells. The method involves essentially the solution tensions of the metals used as electrodes, and the osmotic pressures of the cations of the electrolytes.

This method of dealing with the primary cell involves the existence of the force which has been called solution tension of the metals. It should be stated that the existence of this force has been demonstrated beyond reasonable question by experiments that have no direct connection with the primary cell as such.

The method worked out by Nernst for calculating the electromotive force of primary cells of the Daniell and several other types, cannot be more than mentioned in the narrow scope of these papers. Those interested will find it discussed in detail in my "Elements of Physical Chemistry," fourth edition, pp. 442-492.

Suffice it to say that the electromotive force calculated for such cells agrees with the results of direct measurements, otherwise the method would not be discussed here. The result is that the chief source of the electromotive force in pri-

mary cells is at the surfaces of contact of the electrodes with the electrolytes. There is a small difference of potential, or electromotive force at the surface of contact of the two electrolytes with one another, and another small difference of potential where the two metal electrodes come together directly or indirectly; but these are both so small that, under ordinary conditions, they are comparatively speaking, almost negligible.

SOURCE OF ENERGY IN THE PRIMARY CELL

The question that still remains, is what is the source of the electrical energy that is produced say in a Daniell cell? We start with zinc, copper, zinc sulphate and copper sulphate. After the battery has acted for a time we have less zinc and more copper than at the beginning. The source of the electrical energy that appears is the intrinsic energy of the zinc that has disappeared, over and above the intrinsic energy of the copper that has been formed during the action of the cell.

Certain forms of primary cells are simply machines for converting heat into electricity—they cool themselves as they act, but unfortunately no such cell thus far discovered, has the power to convert any large amount of heat directly into electricity. If it did, it would be a matter of tremendous technical importance. To convert large amounts of heat directly into electricity would be almost as important as to convert large amounts of intrinsic energy directly into electricity, since there is no difficulty in converting intrinsic energy directly into heat in any amount desired. The solution of the problem of converting heat directly, quantitatively and in large quantity into electricity remains for the future, and its solution will be nothing less than epoch-making for the industries.

The Daniell cell can convert only a relatively small amount of intrinsic energy into electricity and this not very economically.

THE SECONDARY CELL OR STORAGE BATTERY

There have been several forms of storage batteries devised. The best known of these is the ordinary lead cell. While some of the details of its action are not fully understood, yet the general principles which it illustrates are perfectly clear.

Such a cell consists of one plate of lead dioxide, the other of lead and the electrolyte sulphuric acid of a certain definite concentration (sp. gr. 1.2). When an electric current is passed into and through such a cell, lead dioxide is deposited upon the plate where the current enters and lead upon the other plate.

Lead dioxide represents lead in the quadrivalent condition—each lead ion has four charges upon it, while lead in the form of sulphate has only two charges upon it. The action of the charging current, is then, to raise the valence of the lead from two to four—to raise the intrinsic energy of the lead.

When the accumulator discharges, exactly the reverse takes place. The lead dioxide and also some of the lead pass into solution in the sulphuric acid as lead sulphate.

The charging current, then, raises the intrinsic energy of the lead from the bivalent to the tetravalent condition; while in discharging the intrinsic energy of the lead is lowered from the tetravalent to the bivalent condition. In charging a storage battery we are converting electrical energy into intrinsic. In discharging we are converting intrinsic energy into electrical.

CHEMICAL ACTION AT A DISTANCE

The idea has long prevailed that in order to have chemical action we must have mechanical contact. We shall now see that this idea is erroneous, and not only shall we learn that we can have chemical action between two things that do not touch, but from what has already been said in reference to the solution tension of metals we can easily understand what takes place.

Take a bar of pure zinc and dip it into dilute sulphuric acid. If the zinc is sufficiently pure it will dissolve very slowly, and hydrogen will escape very slowly from the solution of the acid.

Wrap a piece of platinum wire around the bar of pure zinc and to the other end of the wire attach a piece of platinum foil. Let the bar of zinc pass through a cork which fits into the top of a glass tube three or four inches long. Close the bottom of the glass tube with a piece of vegetable parchment. Fill the glass tube now containing the bar of zinc with a solution of some soluble sulphate—say ammonium sulphate—and plunge it into a large beaker also filled with a strong solution of ammonium sulphate.

The platinum wire connected with the bar of zinc above the glass tube is led down into the beaker, and the platinum foil attached to the end of the platinum wire allowed to rest on the bottom of the beaker. If sulphuric acid is now added by means of a pipette, to the platinum foil, hydrogen will escape rapidly not from the zinc but from the platinum, and zinc will dissolve.

PROOF THAT ACTION TAKES PLACE AT A DISTANCE

The zinc thus really dissolves in sulphuric acid which does not touch it, but which is contained in another vessel. The

object of the vegetable parchment over the bottom of the glass tube is to keep the sulphuric acid in the beaker away from the zinc, at least for a time. That the sulphuric acid in the outer vessel does not at first touch the zinc, although hydrogen is given off at once from the platinum foil, can be very readily proved by introducing some blue litmus paper into the neutral solution of sulphate around the bar of zinc. The zinc not only dissolves in sulphuric acid which does not touch it, but dissolves much more rapidly than if the acid were added directly to the metal.

What is the explanation of these rather remarkable results? In the first place why does not pure zinc dissolve in acids when, as we have seen, zinc has a very high solution tension? The enormous solution tension of zinc is the very cause of zinc not dissolving in acids. The solution tension drives zinc ions into the solution with an enormous force. But in order that a metal should dissolve in an acid, the hydrogen cations of the acid must give up their charge to something and escape. If the metal has a very high solution tension tending to push its own ions into solution, the hydrogen ions of the acid cannot get up to it; and if the hydrogen cannot come up to and touch the zinc, they cannot discharge, since there is nothing to which they can give up their charge. Consequently, the zinc ions cannot enter the solution in any appreciable quantity; it being a fundamental condition of equilibrium in solution that there cannot be present in it any appreciable excess of cations or of anions.

MECHANICS OF ACTION AT A DISTANCE

Platinum is a metal with small solution tension. The hydrogen ions can easily come up to and give up their charges to the platinum. They do so and escape from the solution as hydrogen gas. The charge is conducted along the platinum wire to the zinc. The zinc atoms take up the charge and pass into solution as ions, pairing themselves against the SO₄ ions which were initially paired off against the hydrogen ions of the acid—the hydrogen ions in question having lost their charge escape as hydrogen gas.

Pure zinc, then, does not dissolve in acids not because it has not a powerful solution tension, but because the hydrogen ions of the acid cannot come up to it and give up their charge and escape. We render zinc "impure" and make it dissolve by bringing it in contact with some metal with a low solution tension, such as platinum, copper and the like, and for the reason pointed out above.

Another experiment illustrating even more strikingly "chemical action at a distance," is the following. Place a solution of ferrous chloride in one beaker

and a solution of potassium chloride in another beaker and connect the two beakers with a siphon filled with the neutral potassium chloride. Dip a platinum electrode into each beaker and connect the two electrodes externally through a galvanometer. Under these conditions nothing will happen.

IRON OXIDIZED BY DISTANT CHLORINE

Now conduct a current of chlorine gas into the neutral solution of potassium chloride, and the ferrous chloride in the other beaker will be gradually oxidized to ferric chloride. The ferrous chloride in one vessel is thus oxidized by chlorine which is in an entirely different vessel, and which may be separated from the ferrous salt by a very considerable distance. This is an ideal demonstration of chemical action taking place between two substances that are some distances apart.

What is the explanation of the above experiment? The chlorine coming in contact with the platinum electrode takes up negative charges or electrons as they are called, from it. This electrode, having lost negative charges, is charged positively, and a current flows from this electrode over to the other electrode which is surrounded by the ferrous salt. The ferrous ions are ions of iron that have each two positive charges upon them. The iron ion, however, can carry three positive charges, as in the ferric condition. The bivalent ferrous ion takes a positive charge from the electrode immersed in it, passing over into the ferric ion, which carries three electrical charges. The iron is thus oxidized from the ferrous to the ferric condition, i.e. its valence is raised by chlorine which never comes near it.

This experiment is of great importance in connection with the whole subject of chemical valence. The valence of the iron is raised from the condition of two to three, and how? By adding an electrical charge to it, by adding one unit of electricity to it, and by doing nothing else. This alone would show the connection between valence and the electrical charges carried by the ions. This same fact is, however, emphasized over and over again in the treatment of valence from the only standpoint that is worth calling scientific, viz. Faraday's Law. It would lead us much too far to discuss this subject here. For the application of this conception to general chemistry, see my "Principles of Inorganic Chemistry" and "Elements of Inorganic Chemistry," published by the Macmillans, New York,

Vanadium has been found in growing vegetation in minute amounts. This is thought by some to account for its presence in certain coal beds in Argentine, Peru and Colorado.

Rail Production in 1911

The American Iron & Steel Association reports that the production of all kinds of rails in the United States in 1911 amounted to 2,822,790 tons, against 3,636,031 tons in 1910, a decrease of 813,241 tons or 22.3%. Rails rolled from purchased blooms, crop ends and seconds, and rerolled and renewed steel rails are included. Included in the total for 1911 are 205,409 tons of girder and high T steel rails for electric and street railways. In the following table the production of all kinds of rails is in gross tons.

	1910	1911	Changes
Bessemer steel.....	1,884,442	1,138,633	D. 745,809
Open-hearth.....	1,751,359	1,676,923	D. 74,436
Miscellaneous.....	.....	7,000	I. 7,000
Iron.....	230	234	I. 4
Total.....	3,636,031	2,822,790	D. 813,241

Included in the miscellaneous rails rolled in 1911 are 462 tons of rails rolled from electric steel, and 6538 tons of rerolled steel rails which the makers were unable to classify as bessemer or open-hearth rails. Of the total production of steel rails in 1911, 2,708,795 tons were rolled from ingots made by the makers and 113,761 tons were rolled from purchased ingots or blooms, crop ends, seconds or renewed or rerolled rails.

Rail production for six years has been:

1906.....	3,977,887	1909.....	3,023,845
1907.....	3,633,654	1910.....	3,636,031
1908.....	1,921,015	1911.....	2,822,790

The production in 1906 was the largest ever reported. The proportion of bessemer rails to the total fell from 51.8% in 1910 to 40.3 in 1911, while that of openhearth rails increased from 48.2 to 59.4%. The rapid increase in openhearth rails is shown by the following figures of yearly production: 1908, 571,791 tons; 1909, 1,256,074; 1910, 1,751,359; 1911, 1,676,923 tons. Rails from electric steel were reported in 1911 for the first time. Of the bessemer-steel rails last year, 1,053,420 tons were rolled by makers of domestic ingots and 85,213 tons by companies which did not operate bessemer converters. Included in the total by makers of ingots are 19,379 tons of rerolled rails. Almost all of the openhearth rails in 1911 were rolled from basic steel, and all were rolled by producers of ingots.

The following table gives the production of all kind of rails—including street rails—in 1911, classified according to the weight per yard:

	Under 45 Lb.	45 to 85 Lb.	Over 85 Lb.
Bessemer.....	111,231	606,300	421,102
Open-hearth.....	100,755	461,387	1,114,781
Miscellaneous.....	6,538	9	453
Iron.....	234	.....	.....
Total.....	218,758	1,067,696	1,536,336
Per cent. of total....	7.8	37.8	54.4

Considerably more than half the rails rolled were of 85 lb. to the yard or over. It will be seen also that the greater part of the openhearth steel was used for the heavier rails.

The Lehigh Coal & Navigation Electric Plant

Reference has been heretofore made to the great power plant which the Lehigh Coal & Navigation Co. proposes to establish near its mines for the purpose of converting the coal into electric power for transmission to other points. The preliminary investigations of the commercial and engineering feasibility of the plan were carried on over the past three years by the late William A. Lathrop, president of the company and Lewis B. Stillwell, of New York, consulting engineer. The execution was committed to a subsidiary company, known as the Lehigh Navigation Electric Co., organized last year, with office in Philadelphia.

That company has now closed a contract with the General Electric Company, Schenectady, N. Y., for three 10,000-kw., 11,000-volt, 3-phase 25-cycle, complete horizontal turbo-generating units with two 300-kw. turbo-exciter sets and one 300-kw. motor-generator exciter set, to be installed in its new main generating station. This contract provides for an initial expenditure of \$3,000,000; definite plans are made for an eventual investment of \$10,000,000, with an assured supply capacity of 20,000 kw. from the first installation of the three 10,000-kw. turbo-generators and a gradual enlargement to 100,000 kw. ultimate capacity. This is the largest electric power project undertaken since the establishment of the Niagara Falls plant.

The main plant will be at Hauto, in Carbon County, Penn., about 10 miles west of Mauch Chunk. This place was chosen because it was at the entrance to the tunnel which leads to the largest body of coal owned by the Lehigh Coal & Navigation Co. Another consideration was the abundant water supply. An existing reservoir is being increased to a storage capacity of 1,000,000,000 gal. and an area of about 400 acres by the construction of a higher dam. The water-supply needs of the ultimate plant will be some 300,000,000 gal. per day, most of which will be carried back into the reservoirs after condensation. To run the plant up to the contemplated maximum installation of 100,000 kw. capacity, it is estimated that 1,000,000 tons of coal will be needed yearly. This coal will be used practically as it comes from the mines, saving the expense of preparing it for market, and also utilizing the culm, which is now a waste product.

From Hauto the distribution of current for heat, light and power by means of high voltage transmission lines, reaching out through all eastern Pennsylvania and New Jersey, will penetrate a territory with 2,500,000 population. Among the first power consumers in the district, it is planned to supply the slate and cement industries in Lehigh and Northampton counties, all of which are in a territory

from 20 to 40 miles distant from the Hauto plant. Substations will probably be established at once at Coplay and Pen Argyl for stepping down and distributing the current to users. Within a radius of 50 to 75 miles from the main station there are some 20 large cement mills. The transmission lines will be strung largely along the Lehigh Canal and on the right of way of the Lehigh & New England R.R., which the company controls.

With the assistance of these companies a complete power census of the industries has been taken, and within the district which will be reached by the distribution system of the first section of the Hauto plant, over 100,000 hp. is being used now. The Lehigh Navigation Electric Co. has made up a schedule of prices, running from 0.8c. up to about 2.5c. per kilowatt-hour, according to the amount of power contracted for and the steady continuance of consumption, which will deliver its current quite materially under the cost at which the industries are able to produce steam power.

Under the laws of Pennsylvania the right of an electric-power company operating with steam to distribute energy is confined to a single township; accordingly, charters have been obtained in Lehigh, Schuylkill, Carbon, Northampton, Bucks and Montgomery counties for about 60 electric companies, one for each township into which the transmission lines may be carried. These companies will all be under the management of the parent company.

With the exception of the 8000-kw. plant of the Harwood Electric Company, which supplies current for lighting and electric-railway operation around Hazleton, using coal direct from its own mines, no attempt has been made heretofore in this country to generate electric current in the coal regions for public service. The Lehigh Navigation Electric Co. expects to have the first installation at the Hauto plant in operation before the end of the year. As the capacity of the plant is gradually increased, energy will be carried to Allentown and Easton, Penn., Trenton, N. J., and undoubtedly finally into Philadelphia. That city is within 80 miles, and New York is only 105 miles distant.

The Lena Labor Trouble

The explanations given to the Russian Duma by the Minister of the Interior and the Ministry of Commerce and Industry regarding the recent shooting down of strikers at the Lena Goldfields have been attacked sharply in the St. Petersburg press, the criticisms of which have been summarized by the *Evening Post*. The *Novoe Vremya*, the *Retch*, and the *Bourse Gazette* dwell on the discrepancies of the respective statements. While M. Makaroff contended that the labor

movement bore a political character, and that the troops were compelled to fire in self-defense, M. Timasheff demonstrated the essentially economic nature of the men's grievances. M. Timasheff declared that the company systematically violated the law regarding the conditions of labor, notably by applying the truck system. The Ministry of Commerce and Industry had repeatedly censured the management. These violations of the law were the starting point of the labor troubles. The pledges given by the company to observe the law and the promises of certain concessions encouraged the hope of a peaceful settlement of the strike when the police authorities suddenly arrested the men's delegates on the plea that they were Socialists. The shooting followed. M. Makaroff tried to justify the shooting of 163 workmen because political convicts of Socialist proclivities were to be among the leaders of the strike, although he was unable to prove that they were responsible for a single illegal act.

Cobalt's Production

SPECIAL CORRESPONDENCE

An interesting paper on the future production of Cobalt, was presented by Prof. G. R. Mickle, at the last meeting of the Cobalt branch of the Canadian Mining Institute. Mr. Mickle is provincial mine assessor, and as such, has access to information which is available to but few.

Up to July, 1911, there were 111 known producing veins, and of these 86, or over 80%, were in the Huronian formation. Of the remainder, 12 are in the diabase and 13 in the Keewatin. In 1907, there were 53 known producing veins in the Huronian, seven in the diabase and six in the Keewatin. Of the veins in the Huronian, 90% do not carry silver into the Keewatin. Of the total output of the camp, 97% of the silver is produced at a profit. Mr. Mickle stated that 56% of the known producing veins have been exhausted. The production to date has been 115.8 million oz., so that the total production will be 206.4 million oz. of silver. There are estimated to be 8,000,000 oz. in the dumps.

Mr. Mickle's paper will undoubtedly create a good deal of discussion as the future of Cobalt has been a live question for some time past. The production for last year was approximately 35 million oz., but in view of the decreased ore reserves, a gradual decline in the yearly production will undoubtedly take place.

Owing to the great borax deposits in the province of Antofagasta, Chile, the government is said (*Chem. Trade Journ.*, Feb. 17, 1912) to be considering an export duty.

Mine Hoisting Systems Compared—I

The conclusions drawn by A. K. Pauly in the paper he read before the American Institute of Mining Engineers, entitled "Electric Motors versus Compressed Air Engines for Driving Deep Mine Hoists,"¹ are based upon assumed conditions that do not frequently exist in actual practice and, particularly, not in metal mines. In isolated cases where such conditions exist neither the system of air hoist as described, nor the electric hoist is adaptable, as I shall endeavor to show later in this article.

It is stated, by Mr. Pauly, that many compressed-air engines are at present being replaced by electric motors. This statement is misleading because there are no engines in operation that are designed for the economical use of compressed air with the exception of those applied by the Nordberg Manufacturing Co. to the hoists of the Anaconda Copper Mining Co., at Butte, Mont. The machinery operated by compressed air so far has been old steam engines that naturally are uneconomical.

WHY 90 LB. PRESSURE IS USED AT BUTTE

The statement to the effect that the practical limit of air pressure that can be carried on a compressed-air system operating hoisting engines is 90 lb. gage, is not correct, nor can this conclusion be drawn from what is said about the temperature change during the expansion of the air and the properties of the cylinder lubricant. The fact of the matter is that 90 lb. is the pressure used at Butte simply because this pressure is carried on the rock-drill system. By this arrangement it will be possible to connect the rock-drill and hoist systems together and concentrate all the air power in one plant. If there were any limitations of the air pressure due to the temperature drops during expansion and rise during compression, then such a pressure limit would not be a fixed pressure, but a certain multiple of the atmospheric pressure. If it be assumed, for instance, that 90 lb. would be the practical pressure limit at Butte where the atmospheric pressure is about 12 lb. absolute, then 106 lb. gage would be the corresponding pressure limit where the atmospheric pressure is 14 lb. absolute and, at sea level, the corresponding pressure limit would be 110 lb. gage.

The arrangement of reheaters described in Mr. Pauly's article is entirely impracticable for use on a hoisting plant. A reheater for that purpose must be based on entirely different principles from any of those suggested. A point is also made of the necessity of using cooling water in a compressor plant and the expense of providing such cooling water

By Bruno V. Nordberg*

A discussion of the factors governing the economy and efficiency of steam, air and electric hoists, in which it is shown that the Ilgner flywheel is efficient only during continuous hoisting; the storage battery abandoned in European practice.

*Chief engineer, Nordberg Manufacturing Co., Milwaukee, Wis.

in some cases, as a disadvantage of the compressed-air system. The fact is that the quantity of cooling water required for the intercooler and jackets of an air compressor is small and, if the Ilgner flywheel transformer is used with an electric hoist, the bearings of the transformer should be water jacketed and water be provided for this purpose.

It is further stated that claim is often made that the air for the hoist may be taken from an existing compressor plant and that this claim seldom if ever has any foundation. In regard to this matter I would say that in a great number of cases this can be done simply by providing sufficient air storage and by remodeling the cylinders of the hoisting engines so that air can be used economically, and this is the proper thing to do whenever possible. If, in the future, more air is needed, the new compressor can be placed in the same power house or adjacent to the old compressors, by which centralization of power running expense is saved.

In comparing the flywheel of the Ilgner transformer with an air receiver for the purpose of storing power, the drop of speed of the flywheel is given as 30%, which is about twice as great a drop as used in German practice, so that the storing capacity of the flywheel, instead of being 50% of the total energy, only becomes about half that much. The Ilgner transformer requires attention, and is subject to wear and tear, which is not the case with air receivers.

POWER FROM LOWERING UNBALANCED LOADS

The statement that, when lowering unbalanced loads, power is automatically returned to the power system with an electric hoist, cannot be true, except in cases where the load is lowered immediately after an approximately equal load has been hoisted, so that the reduction in velocity of the flywheel during the hoisting period is made up during the period of lowering the load. This case seldom exists in practice. As a rule, most of the unbalanced hoisting is done

during the less active periods of hoisting when, after long pauses, heavy loads of timber and tools are lowered into the mine. When this is done, the Ilgner flywheel is running at its normal velocity and, in order that it may absorb the power represented by the descending load, its velocity must be increased considerably above the normal. As the normal speed is high, it will be found impracticable to increase it. At Butte loads representing 66,000,000 ft.-lb. are sometimes lowered with the air hoists. As such a load is lowered in one minute, the equivalent work represented by the lowering is 2000 hp. Anyone interested can easily figure out how great an increase of velocity is required in a wheel of a given weight in order to store up 66,000,000 ft.-lb. of work. The normal rim speed of these wheels is at least 16,000 ft. per minute.

The statement that a system in which the braking is accomplished by compression of air in the hoist cylinders can only be done at the expense of simplicity of control, is not correct. The runners of the hoists in Butte, where such a system is used, declare that thereby the control is much simpler and that they like to run the air hoists better than the old steam hoists.

WORK AND POWER CONSUMPTION SHOULD BE CALCULATED GRAPHICALLY

The well known equations and textbook matter expressing the interdependence of volumes, pressures and temperatures of compressed air are presented in Mr. Pauly's paper. Such equations, while they may have some academic value, are of little use for the purpose of calculating the work, power consumption, etc., entering the air-hoist problem. There is only one way in which this can be done and that is the graphical way, and I refer all who are interested in this subject particularly to the paper written by Hans Behr, of Johannesburg, South Africa, in his analysis of the return-pipe system. As with compressed air we have no condensation to deal with, all problems involving the expansion and compression of air can be treated graphically and exact results can be derived by graphical methods, if the pressure losses and temperature effects are known from actual practice.

Little explanation is given in Mr. Pauly's article as to how the diagrams showing the consumption of power for reheating the air were obtained, on which diagrams, I understand, Mr. Pauly bases all his deductions. These diagrams also give the power consumption of the electric hoist. The power for operating an air hoist is evidently arrived at by figuring the mean effective pressures by the equation

¹Bull. 60, A. I. M. E., December, 1911.

$$M = aP_1 + \int_a^1 \frac{cl}{a} p dv - Pb =$$

$$P_1 \left(a + \frac{a-ak}{K-1} \right) - Pb$$

where a is cutoff expressed in fraction of stroke; v and p , volume and pressure at any part of the stroke beyond the point of cutoff; P_1 , the absolute pressure at admission; and Pb , the absolute pressure against which the engine exhausts. The conditions upon which this equation is based do not exist in a well designed air hoist, as the expansion even at the shortest cutoff is not carried below the atmospheric pressure. Devices are also provided whereby the effect of the clearance space is absolutely eliminated so that the clearance does not affect the efficiency. The curves 4 and 5 would, therefore, not apply to such a hoist. The frequency of hoisting, while not much affecting the power consumption of an air hoist, is the all-important factor covering the power consumption per ton hoisted or the efficiency of an electric hoist. No explanation is given how this is accounted for.

The statement that the temperature of the exhaust must be kept about 32° F. in order to prevent freezing of the moisture is not strictly correct, as experience shows that in a hoist a degree of expansion can be used with safety that would result in a theoretical final temperature of 10° or even 0° F. This temperature is, however, not reached on account of the heating effects of the cylinder walls, etc., upon the air, the specific heat of which is comparatively low.

THE CALCULATION OF OPERATING COSTS

In looking over the different calculations of power consumption and operating costs of air hoists and electric hoists, I find no itemized statement of the different charges. It is, however, apparent that in order to make a showing of the electric hoist against a compressed-air hoist, the latter has been arbitrarily loaded with an excessive labor cost. How the cost of power for the air hoist has been calculated is not clear, but I notice that it is arbitrarily assumed that this hoist has to be fitted with a 6000-cu.ft. compressor and a 1000-hp. motor. As a matter of fact, the experience in Butte would indicate that a compressor of less than half that capacity would be sufficient to do the work specified. It is, however, not necessary to go into the details of these operating costs, for the reason that neither the electric hoist nor the air hoist is the machine to use under the conditions given.

The conditions of hoisting upon which Mr. Pauly draws his conclusions are in short as follows: From an average depth of 2000 ft., 1200 tons of ore are to be hoisted per day, 275 days per year; the net load is 7000 lb., and the hoisting is in balance; 40% of the day's time is used

for hoisting ore and 20% for shifting and other work; this nonproductive work to be 50% of that necessary for hoisting ore (productive work); hoist to be idle 40% of the day; coal of 12,000 B.t.u. per lb., costing \$4.50 per ton, to be used.

From these data I deduce the following: The load is 3½ tons, therefore the hoist has to make 1200 ÷ 3½, or about 343 trips per day for hoisting ore; 40% of the total time of the day, 24 hours = 86,400 sec., or, 0.4 × 86,400 = 34,560 sec. = 567 min., is the actual time necessary to make these trips, so that each trip is to be made in 34,560 ÷ 343, or about 100 sec. The travel of the skip is 2000 ft., so that the average rope speed is 2000 ÷ 100 = 20 ft. per sec., or 1200 ft. per min. The maximum rope speed in this case can be taken at 1500 ft. per min.; Mr. Pauly gives 2200 ft., and the drum diameter 7 ft., coiling the rope in several layers. As the maximum rope speed only results in a drum speed of 68 r.p.m., a geared hoist, which is favorable for the electric equipment, can be used to good advantage, as thereby the cost of the motor can be reduced to a minimum. It is also clear that about 20 sec. can be taken for accelerating the load, making a rate of acceleration of about 1¼ ft. per sec. With such a low rate of acceleration, the hoist becomes very efficient, particularly as the loads and drums are light. The effective work done per trip averages here, 7000 × 2000 = 14,000,000 ft.-lb. as the total work in hoisting ore, or, expressed in effective horsepower distributed over the total time of 24 hours, shaft horsepower (14,000,000 × 343) ÷ (24 × 60 × 33,000) = 101 shaft hp. As the nonproductive work was assumed to be half of the productive work, or, ½ × 101 = 50½ shaft hp., the total work to be done during each day is 151½, or, say, 152 shaft hp. The effective work during a single trip when hoisting ore is (14,000,000 × 60) ÷ (100 × 33,000) = 254 effective horsepower.

As the nonproductive work was assumed to be half that of the productive work, and was to be performed in one-half the time required for productive hoisting, the effective horsepower of a single trip (unproductive) averages the same as that for the productive trip; that is, 254 effective hp. The ratio of work done per individual trip to the average shaft work is therefore: 254:154, or, 1.67:1. It would be highly desirable if such ideal conditions were possible in practical hoisting. In that case, there would be no difficulty in producing highly economical results with machinery of moderate cost.

The conditions actually existing in deep-mine hoisting are different. Instead of 40% being available for hoisting ore, only 20% is given for that part of the work, and usually the product is greater

than 1200 tons per day. The load, instead of being 7000 lb., is from 5 to 10 tons and the acceleration from 5 to 10 ft. per sec., instead of 1¼ ft. per sec., which condition much impairs the efficiency. For this reason a geared hoist is seldom suitable for a deep mine. The nonproductive work is also in the majority of cases much greater than assumed by Mr. Pauly, and so is the ratio of the work done per individual trip to the average shaft work. This ratio is the measure of the regularity of hoisting and the principal factor governing the economy and the efficiency of the hoist and, on that factor, depends the selection of the type of hoist. The condition that 60% of the time is used for hoisting is also seldom found in deep mines. At Butte the conditions are about as follows: Hoisting loads, 5 tons, as against 7000 lb., as given by Mr. Pauly; hoist in motion 20% of time, as against 60% of time as given by Mr. Pauly; work per individual trip divided by average shaft work is 7½; average load of individual trip (nonproductive) divided by average shaft work is 8¾; maximum work (unproductive trip) divided by average shaft work is 30, as against 1.67 deduced from Mr. Pauly's data; acceleration 5 to 10 ft. per sec., as against 1¼ ft. per sec., deduced from the data given by Mr. Pauly.

The hoisting conditions vary so much that it is not possible to lay down any general rules or draw diagrams from which the power consumption or economy or operating cost can be determined, but every case requires careful study and renders different results governing the question, whether it would be more economical to operate the hoist by power directly applied or by power transmitted from a distance.

NO PEAKS IN LOAD AT ANACONDA

To develop the theory of the air engine, and by formulas and figures try to prove its efficiency in hypothetical cases, would be of little use. The fact that the air engine has been successfully operated, and its economy proven in four installations at the mines of the Anaconda Copper Mining Co., at Butte, and that 18 additional installations are now being made by the same company, is of some value as a proof of the efficiency of the air engines for deep-mine hoists. The compressors operating these hoists are driven by electric motors, and the power consumption of these motors is lower than what it would have been if an Ilgner transformer had been used instead of an air compressor as an equalizer of the loads; in addition, the load on the motors is perfectly steady, there being absolutely no peaks. Even the starting of the large compressors has no effect upon the electrical loads, as that is done by air. The advantage of an absolutely steady load on a power system, in which the electric

power is transmitted 150 miles, is of considerable advantage.

DIFFERENT WAYS OF DRIVING HOISTS

I shall now discuss the different methods of driving hoisting engines in a general way, and analyze a few actual cases of electric hoisting engines as far as can be done with the incomplete data of the hoisting conditions available. The power may be either steam, water power, or, as in the practice in Germany, gas engines, operated by blast-furnace gas. Oil engines have no application in deep-mine hoists. Only steam power can be directly applied to a hoisting engine. All the other powers have to be indirectly applied by transmission from a distance. There are only two methods of transmission practicable in the case of a hoist. One is electric current (electricity as an independent power does not exist), the other is air under pressure.

Where the power is derived from gas engines operated with blast-furnace gas, electricity is the most common means of transmitting the power, and it is for this purpose that the electric hoist was originally designed, and it is in this connection that it can be used to greatest advantage. This mode of transmission of power is extensively used in mining in the province of Westphalia, in Germany. In that country it is the practice at many coal mines to convert a quarter of the total output into coke, which coke is used in blast furnaces. The gases from the blast furnaces furnish power that is transmitted electrically. The heat from the coke ovens at the mines furnishes steam power for the mines for hoisting and pumping. The mines that make no coke use electric power for these purposes. The electric hoist is thus by no means in general use in Germany, as is often supposed or inferred.

STORAGE BATTERY ABANDONED IN EUROPE

The electric current, when used for transmission of power, acts in many respects as an inelastic fluid. The actions and reactions between a generator and a motor operated thereby are the same as if they were connected by an inflexible shaft, so that any fluctuations in the power delivered by the motor produce a simultaneous and equal fluctuation in the power generated by the generator. Electricity cannot be stored. It can, however, be converted into chemical energy, which afterward can be reconverted into electrical energy. That is the purpose of the electric accumulator or storage battery. The conversion of electric into chemical, and back again into electric energy, cannot, of course, be accomplished without loss. This loss is from 15 to 30% of the energy stored², depending on the rate at which the battery is unloaded.

A storage battery requires good atten-

tion and great care, and is a delicate piece of apparatus. The first German electric hoists for deep mining were fitted with storage batteries; they are no longer in use, having been abandoned. The only hoist in Europe of any considerable size that was attached to a storage battery in the year 1907 was one at the Grangesbergs iron mines, in Sweden. I was told that this battery was expensive and hard to keep up, and the company was considering replacing it with an Ilgner transformer.

The fact that in Europe, storage batteries are much used for equalizing street-car loads, but have been abandoned for hoisting engines, indicates that there are grave practical objections to them where they have to handle the enormous fluctuations in a hoisting-engine load.

ILGNER TRANSFORMER USED AT EUROPEAN MINES

The Ilgner flywheel transformer has in Europe superseded the storage battery as an equalizer of loads on hoisting engines. This device is well known. The electric hoists in the German coal mines, all of which are now fitted with this device, work under favorable conditions. Not only is the hoisting regular, the conditions being much like those given in Mr. Pauly's paper, but the hoisting is always in static balance and from one level. These hoists are not equipped with drums, but with the Koepe sheave and tail ropes. The tail ropes are sometimes made considerably heavier than the main rope, so as to reduce the power necessary for acceleration. Under such conditions the Ilgner transformer and its flywheel are not called upon to store much energy in order that the power delivered to it be kept constant, and even under favorable conditions, the flywheel must be heavy. Thus, the transformer wheels at the Matthias Stinnes mines, near Essen, are about 13½ ft. in diameter, weigh 40 tons each, and are run at a speed of 370 r.p.m. There are four wheels, serving four hoists of a size that in this country would not be regarded as large.

The energy that can be delivered by these flywheels depends on the drop of their speed when delivering energy. In the modern German hoists this drop is 15%. As much as 25% has been used, but it was stated to me that, by experience, they have been compelled to come down to 15%, so that less than 30% of the energy of the wheel can be converted into work.

The flywheels of the Ilgner transformers run at a rim speed of 16,000 to 21,000 ft. per min. As the factor of safety against bursting is not large, they must be practically perfect and free from internal strains. The bearings carrying the flywheel are heavily loaded and the surface speed is high, so that they have to be run on a film of oil which is pressed

into the bearings by force pumps. The German practice is to install these pumps in duplicate so as to guard against the failure of lubrication. Furthermore, the bearings are always water jacketed.

It is evident from this that the Ilgner transformer is a fine piece of mechanism that requires considerable care and attention. The power to run this apparatus without load is considerable. It was stated to me when visiting the Matthias Stinnes hoisting plant, referred to above, that from 140 to 150 kw. was required to run the Ilgner transformer without load. It is therefore clear that during the periods when the hoist is at rest the Ilgner apparatus requires considerable power which, when the hoist is in motion only 20% of the time, greatly reduces the efficiency. It is also clear that with any system in which a revolving mass is used for the purpose of storing energy, no energy can be stored when the hoist stands still during long periods. These periods may have a duration of from ten minutes to several hours. If, during this time, energy could be stored for use during active periods, then the power-generating plant can be much reduced in size and cost and the hoist can be operated even if the power generating plant is shut down for a short time.

ADVANTAGES OF COMPRESSED-AIR HOISTS

Compressed air is the only practical transmitting medium whereby that can be accomplished. The compressed air can be stored in any quantity. The air-receiver system needed for this purpose is comparatively inexpensive and involves no waste of energy. Electric batteries are subject to local action, which dissipates some of the stored energy and gradually destroys the battery. Air can be kept in storage indefinitely and the air-storage plant does not deteriorate by use. In most cases air receivers can be cut in rock at a cost of \$10 per cubic fathom and perfect equalization of the hoisting load can be accomplished by the air system and, if required, the reheating can be carried far enough so as to absolutely eliminate the loss occasioned by the heating of the air during compression and the subsequent cooling in the pipe lines and receivers. There are means whereby this can be done without using excessive air temperatures. It is, however, not necessary to go into any extraordinary refinements in design of the air motor in order that it may show up favorably when compared with an electric hoist. It is, however, necessary that means be employed to use the air expansively and to provide means to neutralize the effect of the clearance spaces.

The plant built by the Nordberg Manufacturing Co. and which I designed for the Anaconda Copper Mining Co. embodies all the features essential to the economical success of an air motor and the plant has proven to be economical

²Hütte, 20th edition, Vol. 2, p. 830.

and reliable in operation and in every way successful.

Compressed air is needed in every mine for operating the rock drills. It is therefore only necessary to extend the compressed-air system in order to also operate the hoists from the same source of power that operates the drills. The drills are operated all the time and therefore increase the load factor of the system. The necessary centralization of the compressors and the installation of high-grade large units reduce the running expenses both in regard to power and labor of the whole installation. The Butte plant is being enlarged so as to include 10 of the largest hoists of the Anaconda Copper Co., and 12 additional hoists of medium size that are now being built.

As mentioned above, the storage battery is not used for operating hoists except in a few mining camps and, while it was the first device used to equalize the loads of electric hoists, it has been abandoned in all but a few instances. It is safe to predict that any system for operating electric hoists which includes a storage battery, will not be a success, either commercially or mechanically.

(To be concluded)

Engineering Frauds

A number of the commoner frauds perpetrated on buyers of machinery, which is to fill certain specifications, are discussed in the *Electrical Review*, Apr. 5, 1912. Test bars, which are to be broken off the main castings for tensile-strength tests, etc., are previously made and cast into the main piece. Or, in case the test bar is a true one, it may be given a heat treatment or preliminary stretching before machining to size.

Porosity in iron castings which are to be subjected to hydraulic tests can be concealed by rusting up the bad places with sal ammoniac, or a cored place is filled with copper-sulphate solution, and later, hydraulic pressure is applied, forcing the soft copper into the pores. Light peening with a hand hammer will cure mild cases of porosity. In bronze castings soft solder may be applied, or boiled oil may be forced into the pores under hydraulic pressure, where it soon oxidizes. Still more effective is to put a blank flange, or a small concealed valve on the pipe leading from the pump to the casting. A pressure gage communicating with the interior of the casting gets around this, but it is possible in boiler tests that the gage may be directly connected with the pump inlet, and neither connected with the interior of the boiler. A boiler full of water conceals this.

Apparent steam consumption may often be helped out with a little superheat, or by a little preliminary adjustment of the vacuum gauge. An obvious

method is to run water out of the measuring tank during the test, or ammeter readings may be falsified, by tampering with the shunt, or using leads of lower resistance than those with which it was calibrated.

In testing dynamos or motors, aside from thermometers which may read a few degrees high or low, it should be noted whether the thermometer put up to test the temperature of the surrounding air is hung, "for convenience," near a steam pipe.

In conducting air-compressor tests, the method usually adopted is to measure the time taken to pump a reservoir of known capacity up to a given pressure, or by requiring the compressor to maintain a given pressure when the air is escaping through a sharp-edged orifice of known size. In both cases the temperature of the air in the reservoir should be noted, and this cannot be measured by holding a thermometer in the issuing jet, when the orifice method of test is used. When the reservoir test is being conducted, the usual method of fraud consists in having a quantity of water in the reservoir, thus reducing its capacity and shortening the time required to raise the air it contains to the specified pressure. The presence of water cannot easily be detected if the drain cock is fitted with an internal pipe terminating at a point above the bottom of the reservoir, so that air is always drawn from the cock when it is opened. Another method, largely practised when there are duplicate reservoirs, as in battleships; consists of slightly opening a junction valve for a few minutes and allowing air from another reservoir to enter the one to which the compressor is connected. By this means the compressor is helped to the desired extent, and if the trick is carried out unobserved, it is difficult of detection, as the gauge readings are not fine enough to make the transaction readily visible. When the output of a compressor is being gauged by the pressure maintained behind a sharp edged orifice, it is the inspector's duty not merely to measure the orifice, but to satisfy himself that there is no obstruction, temporary or otherwise, to the free flow of air to the orifice.

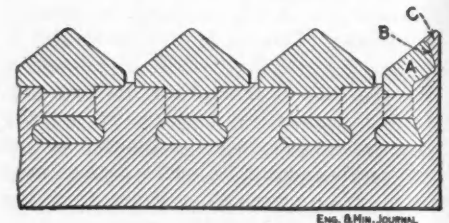
Talc Production in 1911

The talc output of the United States in 1911 declined slightly, according to J. S. Diller of the U. S. Geological Survey, the production amounting to 143,551 short tons valued at \$1,646,018. The 1910 production was about 7000 tons greater. Over 40% of the total output comes from the State of New York; the remainder is derived almost entirely from the Appalachian States, though there are deposits in nearly every state of the

Union. The imports of talc last year declined nearly 10 per cent. and amounted to only 7550 tons, most of which came from France and Italy.

The Canda Crusher Plate

A patent has been issued to F. M. Canda, vice-president of the Chrome Steel Works, for a particular design of bar, (U. S. pat. 1,015,871, Jan. 30, 1912) by which half corrugations may be made on the edge of the "Adamantine" tempered steel jaw plates made by this company. The crusher plates as previously patented by Mr. Canda, consisted of a plurality of hard ribs, usually of high-carbon steel and usually angle faced, and a cast metal base surrounding and interlocking with the lower portion of the ribs. Mr. Canda states that it is not practicable to produce edged ribs by cutting intermediate ribs down the middle; nor would there be sufficient body of the base metal outside of such edged ribs. He, therefore, devised for the edged ribs an angle bar of peculiar form, which is susceptible of being



CANDA CRUSHER PLATE

rolled readily and when in place in its plate has its base portion set at a considerable distance from the edge of the plate, while its face corresponds essentially to one side of an intermediate rib. When the plate is placed in the crusher, its edge is close against a cheek plate of the crusher, which prevents the rock from acting materially on the extension C, so that the extension though of soft metal is subject to relatively little wear. It will be noted that the edge surface B of bar A is beveled backward, so that the base metal outside of this edge helps to hold the bar in place.

Plates of this type are made by forging and rolling down the special-shaped chrome-steel bars in mill lengths, which are then sawed to the proper length to make the different size jaw plates. These bars are placed face downward in a mold, and a soft low-carbon steel is cast around the base of the bars, interlocking and cast welding them into an integral plate. This method enables the bars to be hardened without risk of cracking the entire plate. The company states that such plates are giving excellent satisfaction by reason of longer service at a number of important mines

Dredges on Upper American River

By Lewis H. Eddy

Two California-type bucket-elevator gold dredges are operating in the Placer-Eldorado Counties field of the American River district in California. One is working the bars and hydraulic tailings on both sides of the middle fork of American River in the vicinity of Cache Rock, about two miles south from Forest Hill; the other is within Placer County, about five miles west of the main stream of American River, and three miles south from Loomis. A reconstructed bucket-elevator dredge is in course of installation on the main stream of American River about eight miles south from Auburn, to work placer ground on both sides of the river. A new bucket-elevator dredge has been designed for installation to operate on both sides of the middle fork near Butcher Ranch.

In 1911 two bucket-elevator dredges were operated on the American River in Placer and Eldorado Counties, California, and a third is to start this year. The gravels on the middle fork were worked by crude methods from 1848 to 1860, when operations were abandoned, facilities for deep digging being lacking. Operations were resumed in August, 1910, when the Cache Rock dredge was installed.

portions of Placer County to its confluence with the middle fork about one mile northwest from Auburn. These confluent streams form the main stream of American River which flows southwesterly between Placer and Eldorado; thence through the northwest corner of Sacramento County and empties into Sacramento River at the city of Sacramento. The south fork rises in Eldorado County south of Lake Tahoe and flows southwesterly through the approximate center of Eldorado and empties into the main stream of the American at the junction of Eldorado, Placer and Sacramento Counties.

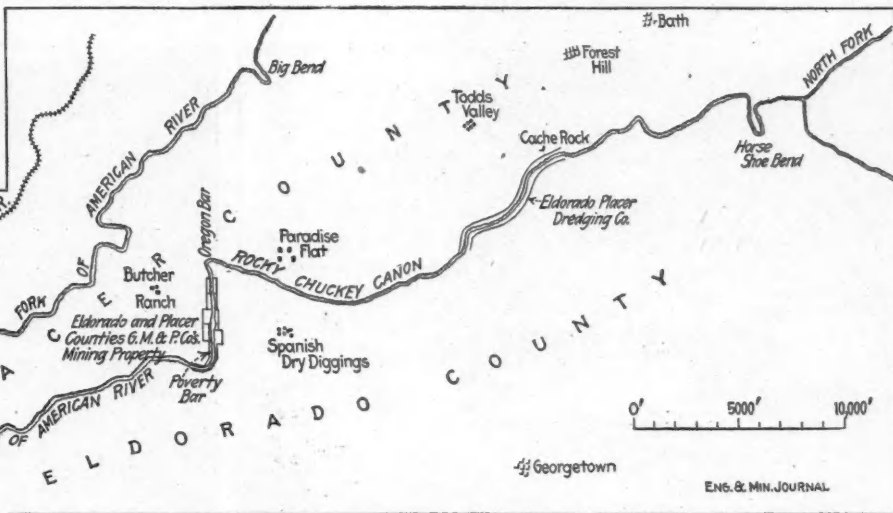
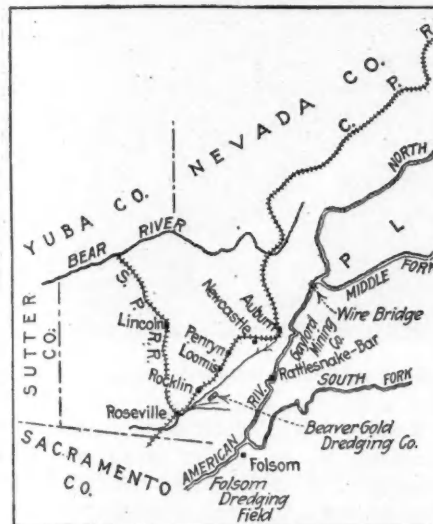
and installed in October of that year. The dredge handled about 64,500 cu.yd. of gravel per month, digging an average depth of 33.2 ft. at a cost of 5.41c.

EARLY WORKINGS ON MIDDLE FORK

The interesting history of placer digging on the middle fork of American River, although embracing only about 12

DREDGING ON BEAR RIVER ABANDONED

The Bear River field, containing territory in both Placer and Yuba Counties was operated from 1901 to 1911, in the vicinity of Wheatland. Exploration of the field in 1901 resulted in the installation of two reconstructed Risdon dredges



SITUATION OF DREDGING OPERATIONS ON UPPER AMERICAN RIVER, CALIFORNIA

from machinery shipped from Breckenridge, Colo. They were of 3½-cu.ft. bucket capacity and steam driven, and were found to be too light for the heavy ground. The initial installations were by the Bear River Exploration Co., whose holdings were later taken over by the Bear River Mining Co., which installed two new Risdon dredges especially designed, also equipped with 3½-cu.ft. buckets; and although one was changed to 5-cu.ft. buckets the result was not wholly satisfactory.

The company consolidated with the Oroville Dredging Co., Ltd., the two dredges were closed down, and in 1907 a 7-cu.ft. close-connected bucket dredge was built by the Yuba Construction Co.

per cu.yd. in the first 10 months. The dredge was closed down and a rock-crushing plant installed by the Natomas Consolidated; and gold dredging on Bear River was discontinued. Bear River forms a part of the northern boundary of Placer County and the southern line of Nevada County. It separates the northwest corner of Placer from a portion of Yuba County, and flows into the Feather River about 15 miles south of Marysville.

The American River, including the middle fork which has its source in the Sierra west of Lake Tahoe in both Placer and Eldorado Counties and a portion of the main stream, flowing southwesterly forms the geographical line of separation and the line of definite topographical demarcation between Placer County on the north and Eldorado County on the south. The north fork has its source northwest of Lake Tahoe and flows southwesterly through the northern and central

years, has an important bearing on present and prospective dredge mining covering the same region of river bars and the precise locations of many of the placer claims of the early days. Since the abandonment of placer mining in about 1860 the upper-river claims were not worked until the installation of the Cache Rock dredge by the Eldorado Placer Dredging Co. in August, 1910.

The first exploration of the middle fork was made in June, 1848 by Mormon miners who had left the diggings on the south fork to search for hill deposits. Their initial work was at Spanish Dry Diggings in Eldorado County 12 miles north in a direct line from Sutter's mill, and about one mile east of the river where it flows in an almost direct south course from Oregon bar to Poverty bar. Thence they and others who followed them made their way to the stream bed, located and worked the placers and made their camps on both sides of the stream.

From 1849 to 1860 many thousands of miners earned wages or wealth working the placers with the crude methods of the time. The chief method was to strip off with shovel and wheelbarrow 15 or 20 ft. of the overburden that would pay \$2 or \$3 per day to the man, and then go to the bedrock for the richer material. In 1859 there was a string of 12-ft. flumes two miles long extending below Poverty bar; while the rocker and the long tom were also employed. That the gravel was exceedingly rich is evidenced by the record of \$10,000,000 gold production from this stream in the first three years of operations. Following the abandonment of the placers the miners turned their attention to the seam diggings and hydraulic mines on both sides of the river along the hillsides.

The seasons for working the river bars were short, usually extending from about July to the middle of October. Much of the fluming operation was abandoned as early as 1855 owing to the recurrent destruction of the flumes by the winter

claims from Poverty bar to Oregon bar; that the Mariposa slate underlies the auriferous gravels of the river, and is probably the actual bedrock.

Men who mined in the river bed 50 years ago declare that the bars were never bottomed by the operations of that period. So the long abandonment of placer digging was not, in the opinion of men competent to say, the result of working out, but of a lack of methods to go deep enough. The problem of deep digging in the river bars of torrential streams should be satisfactorily solved by the adaptation of the modern dredge to this character of work. The fact that gold dredging in California was chiefly confined to the flood plains and bars removed from the live-stream channels is no proof that torrential streams cannot be economically and profitably dredged.

RISDON DREDGE AT CACHE ROCK

The adaptability of the modified and improved New Zealand type of stream

was not successful, and the boat was wrecked by flood. The Eldorado Placer Dredging Company was then organized and installed the Risdon dredge. The head office of the company is at Los Angeles; W. J. Variel, manager; C. T. Schooler, Forest Hill, superintendent. The dredge is being operated in 1912 by the Cache Rock Dredging and Mining Co. of Oakland, under lease which includes the placer claims owned by the holding company. The Holmes system of gold-saving tables has been installed to displace the canvas plant. A. W. Copps of Alameda is president; C. T. Schooler, superintendent; George L. Holmes of San Francisco, consulting engineer.

The stream has a general south-westerly course from Horseshoe bend to the head of Rocky Chuckey cañon at Slug gulch; thence westerly and north-westerly to Oregon bar where it turns almost due south continuing for a distance of about two miles to Poverty bar situated about two miles southeast of



CACHE ROCK DREDGE OPERATING ON THE MIDDLE FORK OF THE AMERICAN RIVER, CALIFORNIA

floods. The miners gradually extended their operations to the north of the river adopting the drift and hydraulic methods. A considerable proportion of the mining in Placer County is still done by those methods, although quartz ledge mining is an important branch of the mining industry.

Deep mining on the Mother lode does not extend north beyond the summit of the Georgetown divide in Eldorado County, between the south and the middle forks of American River. The Forest Hill divide, formed by the region of mountains lying between the middle and the north forks in Placer County, contains a greater area of drift and hydraulic mines than quartz ledges. Both these divides are feeders to the middle fork of the American. There is geological evidence that the Mother lode extends in its north strike across and under the stream along the course of the placer

dredge has been demonstrated by the almost continuous operation of the Risdon dredge at Cache Rock for the last year and a half. This dredge¹ is a 3½-cu.-ft. open-connected bucket-elevator type digging about 30 to 35 ft. below the water line, with a capacity of 45,000 cu.yd. per month. It is electrically driven, the power transmission line extending from the power station at Horseshoe bend and along the southern bank of the river to the southerly end of the placer claims owned by the dredge company. The claims cover the stream and bars for a length of about eight miles and a width of 500 to 800 ft., in unsurveyed lands, of T.13 N., R.10 E., extending southwesterly from the vicinity of Cache Rock to the vicinity of Fords bar.

Prior to the installation of this dredge a suction dredge was operated on these bars for about one year in 1908-1909, by the National Gold Dredging Co. It

Butcher Ranch. From that point the course of the stream is again south-westerly to its confluence with the north fork; and is covered with placer claims for a greater part of its length of six sectional miles west and two sectional miles south. Other portions of the river bed and bars are known to contain gold but are not workable by present-day methods. Gold has been produced from blasting the rocks in Rocky Chuckey cañon, which extends from Slug gulch to Todds valley ravine, in times of extreme low water; and the gravel and seam diggings on either side of the cañon have been profitably worked for many years.

The middle fork is torrential and generally tortuous from its source to the north fork. It has an average width of 75 ft. at low water and 150 ft. at high water. The river elevation at Cache

¹Eng. and Min. Journ., Sept. 30, 1911, p. 636.

Rock is 1100 ft.; at Poverty bar, 650 ft. The hill elevation at Cache Rock is 3300 ft.; at Butcher Ranch, 1800 ft. The hills forming the cañon pitch from 75 to 65°. The inclined tram at Cache Rock, which is used for the transportation of supplies and materials from the wagon road to the river is about one mile in length, at an incline of 65°.

Drift mining in the vicinity of Forest Hill and hydraulic mining between Oregon bar and Poverty bar followed the decline in placer diggings on the river. These mines were worked as late as 1890, and some of the richer mines are still in operation and are reported as being highly productive. The hydraulic and ground sluice mining of Red Hill and adjacent territory were profitable despite the short working seasons and small water supply. The ore was a soft vein-filling characteristic of the Mother lode; the gold associated with quartz was generally of a coarse and nugget charac-

ter; that of the soft rock was fine and light, and little of it is believed to have been recovered.

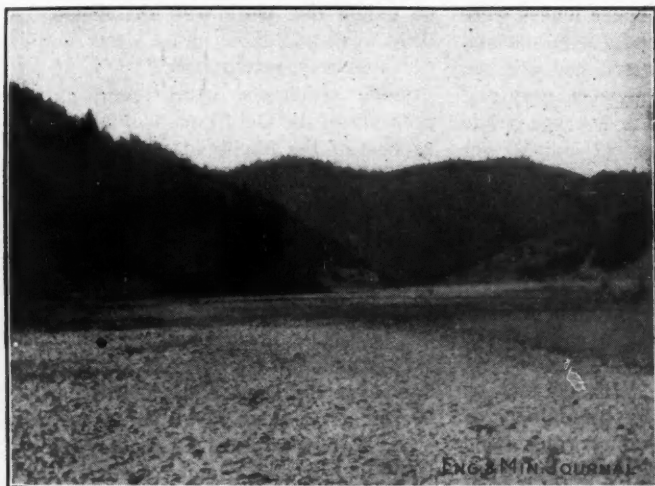
POVERTY BAR TO BE DREDGED

at Cache Rock is said to be profitable, and has induced another undertaking at Butcher Ranch. The per yard value of recovery is not made public, but based on the operation of the early placer mining by crude methods the gold content is believed to be greater than in the dredging fields of the flood plains and the shallow streams.

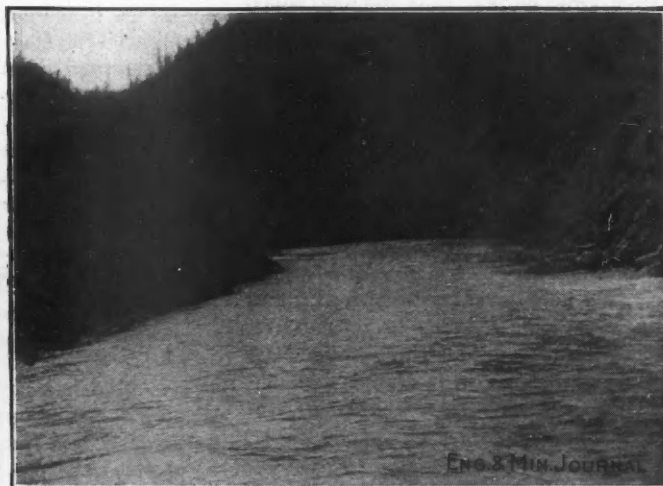
The Eldorado & Placer Counties Gold Mining & Power Co. has recently been organized with the purpose of installing a dredge at Poverty bar, and a hydraulic elevator on adjacent bars; and to work the hydraulic and seam mines on the west side of the river. A tentative design has been made for an electrically driven dredge to dig 35 ft. below the water line, working on a headline; and in general construction to follow the New Zealand type employed in river work.

One of the chief features of the design

tended down to and resting on the deck. The save-all grizzly will be built into the structure. The revolving screen and nozzle washers, and the Holmes type gold-saving tables will be used; the total area of gold-saving tables will be about 620 square feet. The screen and tables will be under one roof; the pilot house will be dropped so that the winchman may stand on the floor of the boat and look out over the roof; thus shortening all connections to the winches, and making the boat structure as light as possible consistent with strength. The company purposes installing an electric power plant, taking the water from Lorn Lake ditch. The dredge design is by George L. Holmes of San Francisco, consulting engineer of the company of which the following are the directors: A. Tregidgo (president), Charles D. Clarke, Joseph Chettle of San Francisco; Fred Emerson Brooks of New York, Fred Searls of Nevada City.



GRAVEL BED AT POVERTY BAR



HIGH WATER ON MIDDLE FORK OF AMERICAN RIVER

LONG WAGON HAUL NECESSARY

The initial cost of construction of a dredge on this stream is increased by the necessary wagon haul from Auburn, the nearest railway station. The distance to Cache Rock is 22 miles; the rise in elevation for a distance of 20 miles from Auburn is about 1900 ft. Added to this is the cost of transportation by inclined tram for a distance of about 5000 ft. The cost of construction at Poverty Bar may be lessened by the difference in distance of wagon haul from Auburn to Butcher Ranch, but increased by the further wagon haul from that point to the river, a distance of two miles, and a drop in elevation of 1150 ft. Notwithstanding the added cost of construction and the necessity for short periods of idleness during the season of winter floods the operation of the dredge

is the modification of the California type of inland dredges in hull construction. The bows of inland-type dredges are cut in so that the buckets may operate in the corners of the gravel beds as the dredge extends its work in an inclosed pond. In stream work the bows and the stern should be cut under so as to withstand the force of the river current. The design provides for a hull 87 ft. 6 in. long, 35 ft. wide, 7 ft. deep, and will require about 125,000 ft. of Oregon pine. The main gantry will be similar to that on the Lagrange dredge operated by the Hammon interests in Stanislaus County.

The digging ladder will be equipped with 85 close-connected cast carbon-steel buckets of 3½-cu.ft. capacity; the hoods of cast steel, the lips and bushings of manganese steel; 24 in. pitch, and weight 2800 lb. each. The form of the digging ladder will be of two 24-in. Bethlehem special I-beams, cross-beamed and trussed. The dumping hopper will be of steel, similar to the Lagrange, and ex-

The present gold dredging west of the main stream of American River in the vicinity of Loomis is on a tract of 80 acres in Secret ravine, a portion of which had been mined by drifting. The dredge was installed in June, 1911, by the Beaver Gold Dredging Company,² E. K. Hun, president; M. J. Martin of Loomis, superintendent. About seven acres have been turned over, the gravel paying 12 to 15c. per cu.yd. The dredge is a 4-cu.ft. bucket-elevator, built by the Risdon Iron Works. The land is flat and low; the elevation being about 100 ft. The dredge is worked on cable anchor, owing to the condition of the ground. The tailings are stacked with a belt conveyor in irregular piles. Whether the soil was capable of producing agriculture with proper drainage and cultivation had never been fully demonstrated, and the fact that it is not being replaced in its former or more favorable condition for

²Eng. and Min. Journ., Sept. 30, 1911, p. 640.

agriculture is due to the terms by which it was acquired for dredging purposes.

The dredge for operation on the river east of Loomis and eight miles south of Auburn was to be installed about February or March, 1912. The dredge was reconstructed from the machinery of Eldorado No. 1 dredge, designed by the Union Iron Works Co., and put in commission at Fair Oaks bridge in 1905 by the Eldorado Gold Dredging Co. The company's holdings on the south side of American river in Sacramento County, 554 acres, were taken over by the Natomas Consolidated in 1909, and the dredge was shut down in May of that year. In the fall of 1911 it was dismantled. The present installation is by the Gaylord Mining Co., C. McCarthy, San Francisco, president; E. C. Gaylord, superintendent.

THE REBUILT GAYLORD DREDGE

The dredge was redesigned by the Union Iron Works. The digging ladder will be equipped with 6-cu.ft. buckets, to dig 37 ft. below the water line. The conveyor will stack 41 ft. above water line. The hull construction will be especially strong to take care of the large gravel. The machinery will be electrically driven, power to be furnished by the Great Western Power Co., transmission being by pole line from Loomis about six miles. The dredge company holds about 380 acres of placer claims covering both banks of the river at Rattlesnake bar. This ground was formerly worked by hydraulic methods, and the vicinity was known as the Whisky bar diggings. The bar is elevated above high-water level. The tailings can be so disposed as to meet the requirements of the Caminetti act.

There are other areas of placer grounds, formerly worked by drift and hydraulic methods that can be economically worked with the modern dredge, which is adaptable to various forms of digging. Construction cost requiring initial outlay of a considerable sum is an obstacle not easily overcome by the small owner of placer claims, and the high prices demanded for such claims have prevented the investment of capital by individuals and companies. In the stream digging and much of the inland drift grounds the small dredge equipped with buckets of $3\frac{1}{2}$ to $4\frac{1}{2}$ -cu.ft. capacity are not only cheaper in initial cost, but more economical and can be operated at greater profit than the larger dredges. Experiments in the operation of small portable dredges for inland and dry digging are being made in other counties; and there are indications of complete success that will solve the problem of profitably working small holdings that can not be economically operated with the ordinary type of dredge.

Gold in Michigan

It may not be generally known that Michigan at various times in its history has experienced the excitement attendant upon gold booms. The following information, obtained from the advance sheets of "Mineral Resources of Michigan" soon to be published by the Michigan Geological Survey, should be of interest as indicating the extent of the gold occurrences, even though they have not proved of much commercial importance.

While gold was known to occur in the rocks of Michigan as early as 1864, the first discovery that led to any serious work was made by Julius Ropes, of Ishpeming, in 1880. As a result of this discovery the Ropes mine, the first mine in the State of Michigan, was opened about three miles northeast of Ishpeming.

The ore formation had a width of from 30 to 50 ft. and was made up of talcose slates, in which the ore occurred in lenses generally running transversely across the formation. These lenses were composed of narrow bands of quartz and slate and the minerals associated with the gold were galena, iron pyrites, gray and yellow copper ores. The average grade of the ore was between \$2 and \$3 per ton. In sinking a vertical shaft a better and stronger vein was encountered at a depth of 850 ft., the average grade being \$6 per ton.

SEVERAL CONDITIONS FAVORED CHEAP MINING

The mine had solid walls so that no timbering was required; the mine was particularly free from water; water could be obtained cheaply from the Carp River, about a mile distant. Machine drills were used in the mine and the overhand-stopping method was employed.

The ore was milled at the mine, the system including crushing by stamps, amalgamation in the mortars and on plates and concentration on Frue vaners. What concentrates were saved were shipped to Aurora, Ill. for treatment. The sticky nature of the ore made it difficult to stamp, so that only 65 tons could be treated per day. Notwithstanding this small capacity, a ton of rock is reported to have been milled for \$1.85 per ton. From the small territory worked, about 550 ft. on the trend of the lode, the gross production of gold and silver was \$605,057. This embraces the product from the commencement up to Jan. 1, 1896.

The Ropes mine was unfortunate in that it lacked sufficient funds to carry on mining work as it should have been done in order to secure the best results. Much time and money were expended in becoming familiar with the ore and when the best methods were learned, the money had been spent. The shareholders grew

discouraged after paying a few assessments and in 1897 the work was abandoned.

Another venture was that of the Michigan mine, situated $2\frac{1}{2}$ miles west of the Ropes mine. It was at its busiest in 1890 when there was a lively trading in its shares. The veins were in diorite, differing in this respect from the Ropes, and the trend was nearly east and west, the dip being nearly vertical. The gold where found was free milling, and little or no silver or any other mineral was present in the rock aside from the gold. Some of the ore was of specimen quality and it is believed that "high-grading" resulted in much loss.

The rock stamped easily and with ordinary Cornish stamps a large amount could be treated daily. In January, February and March, 1890, the mine produced \$12,675 in bullion. The total yield was valued at \$17,699. Two exploratory shafts sunk to a depth of 80 ft. showed that the grade of ore diminished to such an extent that work was abandoned. A little work was done in 1895 but nothing of value was accomplished.

Good specimens were found on the property of the Gold Lake Co. immediately west of the Michigan company and of the Superior Gold Mining Co. immediately east of the Michigan property; but the ore pinched out at comparatively shallow depths and little work was done. Other properties were worked more or less at the time the excitement was at its height, but in 1896 all work had ceased.

A promising territory at one time is known as the Dead River district, which begins in the Dead River Valley, starting about 8 miles north of Ishpeming and extending northward to Lake Superior. Following a discovery of gold in this district in June, 1890, a company was formed under the title of the Fire Center Mining Co. In 1892, a trial lot of rock of 254 tons was treated in the Ropes mill and \$2063 in gold or about \$8.12 per ton was produced. The gold was 697 fine and the percentage of saving in the mill, including concentrates, was 76.7. The Fire Center company ordered a Crawford mill which was set up but proved an utter failure. Two 100-ft. shafts were sunk but at this depth, as in the previous instances, the gold content had diminished to such an extent that work was abandoned.

The gross value of bullion produced from Michigan gold mines is given as \$625,329. Placer gold from fluvio-glacial deposits of the state were reported from a number of places, some of them being well authenticated. The source of the gold is doubtless in the gold-quartz veins which are known to occur widely distributed in the Archean formation of the Lake Superior region. No deposits of workable extent have so far been found.

NEW PUBLICATIONS

- AMERICAN YEAR BOOK, 1911. Edited by Francis G. Wickware. 5¼x8, pp. 863. D. Appleton & Co., New York.
- THE TEACHING OF PHYSICS FOR PURPOSES OF GENERAL EDUCATION. By C. Riborg Mann. 5x7½, pp. 304. \$1.25. MacMillan Co., New York.
- DIE BINAEREN METALLEGIERUNGEN. Teil II. By K. Bornemann. 7½x11, pp. 55, 13 plates; paper, 9.60 marks. Wilhelm Knapp, Halle, a. S., Germany.
- REPORT OF THE DEPARTMENT OF MINES OF NOVA SCOTIA, 1911. Pp. 298, illus. Ernest H. Armstrong, Commissioner of Public Works and Mines, Halifax, N. S.
- UEBER DIE BEDEUTUNG DER MIKROSKOPIE FÜR DIE LAGERSTAETTENLEHRE. By R. Beck. 6¼x9½, pp. 16, paper; 70 pfennig. Craz & Gerlach, Freiberg, Germany.
- NEW ZEALAND OFFICIAL YEAR BOOK, 1911. By M. Fraser, Government Statistician. 5¼x8¼, pp. 1005, cloth. John Mackay, Government Printer, Wellington, New Zealand.
- REPORT OF THE COMMISSION APPOINTED TO INVESTIGATE TURTLE MOUNTAIN, FRANK, ALBERTA, 1911. Pp. 84, illus. Memoir No. 27, Canada Dept. of Mines, Ottawa, Canada.
- DER "MABUKI"-PROZESS. Die Japanische Gewinnungsmethode des metallischen Kupfers aus kupferstein. By Yoichi Okada. 6¼x9½, pp. 21, illus.; 50 pfennig. Craz & Gerlach, Freiberg, Germany.
- L'INDUSTRIE MINIERE ET METALLURGIQUE EN ALSACE 40 ANS APRES L'ANNEXION. By Eugène Ackermann. 5¼x8, pp. 143, paper; 2 francs. Leon Schmitt, Rixheim, Alsace, France.
- REPORT OF THE BUREAU OF MINES, MINING AND MINE INSPECTION OF THE STATE OF MISSOURI FOR THE YEAR ENDING DEC. 31, 1910. Pp. 184. George Bartholomaeus, Sec'y, Jefferson City, Mo.
- LE FONDAZIONI DELLE OPERE TERRESTRI E IDRAULICHE E NATIZIE SUI SISTEMI PIU' IN USO IN ITALIA. By Raffaele Ingria. 3¼x5¼, pp. 674, illus.; cloth, 7.50 lira. Uirico Hoepli, Milan, Italy.
- TRAITE PRATIQUE DE FONDERIE. Fonte—Fonte Malleable—Acler—Cuivre et Allages. By A. Lelong and E. Malry. Volumes I and II. 7x10½, pp. 659 and 512, respectively; illus. Ch. Béranget, Paris, France.
- DIE GOLDERZLAGERSTAETTEN UND DER GOLDBERGBAU DER RUDAER ZWOELF-APOSTEL-GEWERKSCHAFT ZU BRAD IN SIEBENBUERGEN. 7¼x11, pp. 120, illus. Max Krahnmann, Berlin, Germany.
- REPORT OF THE DEPARTMENT OF MINES OF PENNSYLVANIA, 1910. Part I, Anthracite—Part II, Bituminous. Pp. 607 and 983, respectively. James E. Roderick, Chief of Department of Mines, Harrisburg, Penn.
- STEAMING TESTS OF COALS AND RELATED INVESTIGATIONS, SEPT. 1, 1904, TO DEC. 31, 1908. By L. P. Breckenridge, Henry Kreisinger and Walter T. Ray. Pp. 380, illus. Bull. 23, U. S. Bureau of Mines, Washington, D. C.
- THE GEOLOGY OF THE GREYMOUTH SUBDIVISION, NORTH WESTLAND, NEW ZEALAND. By Percy G. Morgan. 8¼x11, 159 pp., illus.; paper. Bulletin No. 13 (New Series), Department of Mines, Geological Survey Branch, Wellington, New Zealand.
- REINFORCED CONCRETE BUILDINGS. A Treatise on the History, Patents, Design and Erection of the Principal Parts Entering into a Modern Reinforced Concrete Building. By Ernest L. Ransome and Alexis Saurbrey. 6x9, pp. 235, illus.; \$2.50. McGraw-Hill Book Co., New York.
- THE STRENGTH OF REINFORCED CONCRETE BEAMS: RESULTS OF TESTS OF 333 BEAMS. By Richard L. Humphrey and Louis H. Losse. 7x10, pp. 200, illus.; paper. Technical Papers of the Bureau of Standards, No. 2. Department of Commerce and Labor, Washington, D. C.
- OIL FUEL. 5x8, pp. 149, illus. The Texas Co., New York.
- This book contains a brief resumé of the various services to which fuel oil has been put: Steamship firing; metallurgical operations; factory use; as adjunct to coal in power stations during peak-load periods. Boiler tests are given under these various conditions, as well as much valuable information on fuel-oil use. In addition there are valuable thermal tables concerning coal, steam, piping, etc.
- POOR'S MANUAL OF INDUSTRIALS, 1911. Second Annual Number. 6x8¼, pp. 2260. Poor's Railroad Manual Co., New York.
- In this volume the section on railroads has been omitted, so as to allow several hundred new names of industrials to be added to the list. The book is divided into: (I) Light, water and power companies; (II) manufacturing and miscellaneous; (III) mining; (IV) telephone and telegraph. There are 94 pages to the index alone, from which we roughly calculate there must be at least 10,300 titles indexed, truly a monumental work.
- ELECTRO-ANALYSIS. Fifth edition, revised. By Edgar F. Smith. 5¼x7½, pp. 332, illus., leather. \$2.50. P. Blakiston's Son & Co., Philadelphia.
- The work of Edgar F. Smith on electro-analysis is so well known that the author's name constitutes almost a review of the book. The volume treats of the electrolytic determination of: Ag, As, Au, Bi, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Pd, Pt, Rh, Sb, Sn, Te, Ti, U, and Zn, the halogens, and nitric acid. We believe that Dr. Smith's book represents the coming analytic practice, and advise the chemists' getting used to electro-analysis as soon as possible, the present work being a good means to that end.
- THE METALLURGY OF IRON AND STEEL. By Bradley Stoughton. 6¼x9½, pp. 537, illus.; \$3. McGraw-Hill Book Co., 239 West 39th St., New York.
- This is the second edition of a book first published three years ago, and already well known to iron metallurgists. It is far from being simply a reprint, however, for nearly the whole book has been rewritten to cover recent improvements, especially in blast-furnace and openhearth steel practice, the duplex-openhearth steel process and electric smelting. The recent progress in metallurgy has been so rapid that this volume appeared necessary. Some minor changes have added to the convenience of arrangement and reference.
- TRANSACTIONS OF THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, VOL. III, 1910. 6¼x9¼, pp. 407, illus.; \$6. Published by the Institute and for sale by D. Van Nostrand Co., New York.
- Outside of the various official proceedings of the second semi-annual meeting, reports of committees, etc., this volume contains papers on the following subjects: The evolution of portland cement processes; the study of materials in chemical engineering; on chemical-engineering education; commercial manipulation of refractory elements for incandescent-lamp purposes; manufacture and uses of ozone; changes in industrial chemistry caused by electricity; on the corrosion of iron and steel; protal (a rubber substitute); chemical industries of Canada; underground water for industrial purposes; loss of coal in storage; nitric and mixed acids plant design; the Fitzgibbons boiler; manufacture of hydrated lime; bleaching oils with fuller's earth; and a symposium on sewage disposal.
- STRAIGHT LINE ENGINEERING DIAGRAMS. By Manifold and Poole. 4¼x7¼, pp. 96, illus.; \$3. Technical Publishing Co., San Francisco, Cal.
- The idea of this book is well stated in the introduction. "Field engineers must frequently make rough-and-ready estimates for construction. They have neither time nor information available for careful calculation, yet the expenditure of large sums is based upon the accuracy of their estimates." The volume contains various diagrams, so arranged, that given two factors of a problem, represented graphically, a third is read off merely by placing a straight-edge between the known points. There are 44 of these diagrams, the principal subjects treated being as follows: Bearing power of piles; masonry arches; strength of concrete; wiring; costs of power; flow of water in pipes and canals; size and strength of pipe lines; stadia measurements; shafting; gearing; belting. There is also an appendix giving methods of resuscitation from electric shock, and care of burns.
- SECOND SUPPLEMENT TO THE DIRECTORY OF THE IRON AND STEEL WORKS OF THE UNITED STATES. Prepared by the American Iron and Steel Association, James M. Swank, General Manager. \$5. Philadelphia.
- The elaborate directory prepared by the American Iron & Steel Association is issued at intervals of about four years, and during the intervals, supplements are issued to bring the information up to date. The present issue brings down to the close of 1911 all essential details concerning new iron and steel plants which have been completed or undertaken since the appearance of the "Directory" in 1908; also important changes that have since taken place in the ownership and equipment of plants that had previously been described. It also contains a complete list of the blast furnaces in existence or under construction in the United States at the close of 1911; and a list of the furnaces abandoned since 1908. There is also a new department devoted to the electrical and ferro-alloy plants which are identified with the iron trade or are largely dependent upon it.

PERSONALS

Mining and metallurgical engineers are invited to keep *The Engineering and Mining Journal* informed of their movements and appointments.

Frank H. Probert has left Los Angeles for Salt Lake City to consult with D. C. Jackling, on matters in connection with Ray Central.

N. V. F. Wilson, recently at Irondale, Wash., has been appointed general manager of the Pacific Coast Steel Co. at San Francisco.

C. F. Rand, general manager of the Spanish-American Iron Co., has sailed for Cuba to inspect the mining operations of his company in that country.

Henry Bevan has been appointed general manager of the works of the Western Steel Corporation at Irondale, Wash., by the trustee for the bondholders.

Peter Donaldson, of Glasgow, Scotland, president and managing director of the Dayton Coal & Iron Co., Dayton, Tenn., has been inspecting the company's plant at that place and has returned to Scotland.

C. T. Brodrick is on his way from the Kyshtim mines in the Perm Government, Russia, to Boston, by way of Vladivostok, Yokohama and San Francisco. He expects to return to Russia, by way of London, in July.

John D. Ryan gave a dinner to 117 friends at Sherry's on May 8 in honor of U. H. Broughton, formerly president of the United Metals Selling Co., who is about to remove to England where he will henceforth reside.

Frederick E. Browne has closed his office at Salt Lake City for the summer, and has gone to Hart, in San Bernardino County, Calif., for the California Big Chief Mining Co. He intends to construct a stamp mill there for the developed ores of the company.

Henry M. Payne has become associated as mining and metallurgical specialist with the firm of Stephen T. Williams & Staff, at No. 346 Broadway, New York. He will leave New York about the end of May for the Yukon goldfields, expecting to return late in the summer.

John Harland Nelson has been elected professor of applied science of Worcester Polytechnic Institute, Worcester, Mass., to succeed the late Prof. Edward L. Hancock. Prof. Nelson has been at the head of the department of applied science at Case School of Applied Science, Cleveland.

George D. James, consulting engineer, of Salt Lake City, Utah, will leave shortly for an exploration of the regions tributary to the San Juan and Little Colorado rivers in Utah, Colorado and Arizona, with the intention to make connections with the Santa Fé R.R. at some convenient point in the vicinity of Flagstaff, Arizona.

OBITUARY

Howard W. Kemper shot and killed himself at Kingman, Ari., May 2. He had been prominent as a mining engineer in Mohave County for a number of years.

Edward Coleman Freeman died at Lebanon, Penn., May 6, aged 56 years. He was one of the largest owners in the Cornwall iron-ore banks in Pennsylvania, but had taken no active part in the management for some years.

Baron Denzaburo Fujita died at Osaka, Japan, Mar. 30. He was head of the Fujitagumi, one of the larger private companies in Japan. He was best known from his connection with the Kosaka copper mine, and from his activity in public affairs. Under his charge the Kosaka, originally worked as a small silver mine, was developed into an important copper mine, and methods were devised for treating successfully its complex ores.

Victor L. Mason, of Passaic, N. J., was killed by falling with an aeroplane, in which he was a passenger, at Brooklands, England, May 13. He was 42 years old. He was born and educated in Washington, was employed for some years in the War Department. About 1901, he removed to Passaic, when he was connected with a metal-stamping company. In recent years, he became an investor in many mining enterprises. He was vice-president of the Development Company of America, President of the Passaic Board of Trade and a director of the Imperial Copper Co., Tombstone Consolidated Mining Co., Poland Mining Co. and Gila Copper Sulphide Co. In New York he was a member of several clubs. He was in England on business.

Societies and Technical Schools

University of Missouri—The annual commencement address of the Missouri School of Mines will be given by James R. Finlay, of New York. Exercises will be held on the morning of May 31. The graduating class numbers 40 men.

College of the City of New York—A lecture, with illustrations, on "The Synthesis of Precious Stones" was given in the Doremus lecture theater of the College on May 17 by Isaac H. Levin, chief engineer and chemist of the International Oxygen Co., at the instance of Prof. Charles Baskerville.

University of Idaho—Apr. 20 to May 3 the upperclass miners spent at Rossland and Trail, B. C., on their annual mining trip. One week was devoted to the geology around Rossland and the other week was spent in visiting the mines and taking notes on the machinery used and also in studying the smelting processes at Trail. Professors R. S. McCaffery, D. C. Livingston, and C. Stewart accompanied the students.

Montana Society of Engineers—The annual meeting was held at Anaconda, April 11-13. Reports of the officers and committees were received and visits made to many points of interest. The following officers were elected: President, Robert A. McArthur; vice-presidents, John H. Klepinger and Reno H. Sales; secretary and librarian, Clinton H. Moore; treasurer and member of the board of managers of the Association of Engineering Societies, Samuel Barker, Jr.; trustee for three years, George A. Packard.

American Institute of Consulting Engineers—The officers of this body for 1912 are: President, Alfred P. Boller; vice-president, Alfred Noble; secretary and treasurer, Eugene W. Stern, No. 103 Park Avenue, New York. The council is as follows: Rudolph Hering, C. O. Mailloux, G. F. Swain, Alfred P. Boller, J. E. Greiner, C. C. Schneider, Alfred Noble, E. C. Shankland and Frank J. Sprague. The chairmen of committees are: On admission, Alfred Noble; on professional practice and ethics, Rudolph Hering; on legislation, Frank J. Sprague; on relations between consulting engineer, manufacturer, contractor and client, C. C. Schneider.

Royal Society of Canada—At the meeting at Toronto, May 14 and 15, a number of papers were read. In the Geological-Biological Section the leading paper was on "The Gold of the Klondike," by J. B. Tyrrell. The position, topographic features and bedrock geology of the Klondike area are first briefly outlined, and then the later dynamic geology of the country is discussed. Three great subdivisions or cycles of erosions are indicated, the first cycle being represented by the Dome Peneplain, the second cycle by the mature topography of the White Channel Period, and the third cycle by the more youthful valleys of the Recent Period. The growth of the valleys of the second and third cycles is considered and it is shown that they began as narrow gorges and subsequently extended their width by lateral stream planation. As incidents of growth pay-streaks are shown to have been formed in the bottoms of the V-shaped valleys, and where such pay-streaks now run beneath extensive flood-plains they represent the positions formerly occupied by the bottoms of old narrow valleys. The recognition of this law of the formation of pay-streaks is important to the placer miner in assisting him to find the gold on his claim, and also to the physiographer in furnishing him with a recognizable feature in the history of the growth of a mature valley. The extent to which gold has been concentrated into the gravels is shown to furnish some clue to the quantity of the precious metal which was contained in the rock from which it was originally derived.

Editorial Correspondence

From our Representatives at Important Mining Centers

San Francisco

May 8—A demonstration of the thio-gen process was made by Doctor Young, the inventor, at Stanford University on May 3, before representatives of the Department of Justice and the U. S. Bureau of Mines. The postponement and the transfer from the Penn smeltery to the university resulted from the damage done to the experimental plant by recent rains. The construction there was purposely temporary, in order to make corrections as the experiments progressed. The laboratory test demonstrated satisfactorily the theory of the process. The essential difference between the laboratory test and the experimental flue demonstration was, that in the laboratory apparatus the SO₂ and the oil gas were applied direct, while in the experimental flue the smoke containing the sulphur dioxide is taken from McDougal roasters and the hydrocarbon vapor is generated from crude petroleum. The Department of Justice was represented by Ligon Johnson and the Bureau of Mines by Dr. F. G. Cottrell. The smelters were represented by A. E. Wheeler and M. W. Krejei of the Amalgamated; E. N. Engelhardt of the Selby and Balaklala; G. W. Metcalfe of the Mammoth; C. B. Sprague, inventor of the Sprague process installed at the Mammoth; John B. Keating of the Bully Hill; M. E. Ditmar of the Afterthought. The Thio-gen Co. was represented by John T. Overbury and H. G. McMahon, managers, and others.

The records of 441 suits against delinquent corporations by the State controller, through the office of the attorney-general, show that the largest amount sued for is \$843.75, owed by the Vancouver-Midway Oil Co., a foreign corporation. Most of the delinquencies are less than \$60. Evidently the delinquents are mostly small companies. Of the 441 suits, 359 are against domestic corporations and 82 against foreign corporations. One suit has been in the courts for some time and has developed some interesting features which may appear also in the trial of some of the recent suits. The Nevada-California Power Co., for a period of years has refused to pay all the demands of the license and tax collectors of the state and of Inyo County. The refusal was based on alleged unjustness of assessment on transmission lines. The lines cost \$1200 for construction and were assessed at \$1000 and then raised to \$5000. The power company tendered payment of other assessments, but the

tenders have been regularly declined. A settlement was reached through the office of the attorney-general and the county attorney, on a basis of payment of \$17,823 for the years 1909 and 1910 and the suits were dismissed without costs. The new tax law makes the issue of tax assessment direct between the state and the corporation, so that hereafter similar complications cannot arise between the counties and the corporations. Arbitrary and unjust assessments of corporations by county assessors have greatly discouraged investments, especially in mining and power enterprises.

The Empire mines and the Pennsylvania Mines Syndicate, at Grass Valley, in Nevada County, have announced their purpose of abandoning the system of payment of wages through the company stores. The North Star Mines Co. has so far signified no intention of abandoning the system. The operation of company stores by or with the approval of the large mining companies in California is the exception rather than the rule. The existence of the system in Grass Valley is rather surprising for the reason that the commercial advantages of the town are not limited. The abandonment of the system was not the result of any expressed dissatisfaction. There is probably no district in California where the mine operators and their employees work in greater harmony than in Grass Valley and Nevada City, and this is particularly true of the mines that have operated company stores for many years.

Butte

May 8—The Anaconda company has begun the remodeling of one section of the Washoe concentrator, in which will be introduced a more perfect development of classification, which is expected to accomplish a very much better extraction of copper along with some increase in capacity. The improved system has already been worked out in the Great Falls concentrator and the remodeling of the Washoe will be on the lines determined at Great Falls. It is expected that the alterations to the first section of the Washoe concentrator will be completed early in the fall.

The Timber Butte Milling Co. was incorporated in Butte, May 2, by W. A. Clark, W. A. Clark, Jr., W. D. Mangam, Alexander J. Johnson and J. K. Heslet, with a capitalization of \$100,000, divided into 1000 shares. The purpose is the erection of

a new zinc concentrator for the treatment of the ore from the Elm Orlu and Poser mines. It has been decided to build the new works on the west side of Timber Butte, two miles south of Butte, as the ore and products can be taken care of entirely by the gravity plan, and a short spur will connect the plant with the Milwaukee railroad. Mr. Clark owns considerable land there, and it is a good site for a zinc smeltery, should Mr. Clark decide to build one. Funds amounting to \$49,900 have been subscribed by Mr. Clark and his son toward the erection of the concentrator, and it is thought that the work will be commenced soon.

Fire was discovered in the stope on the 1700-ft. level of the Pennsylvania mine May 6. The morning shift was just going on. A hurried search was made and the timbers in an old manway were found blazing. After about two hours of hard work, the blaze was subdued.

Denver

May 9—The Western press is full of the fact that the zinc output of Colorado for 1911 was worth \$5,696,188, a gain of 69% over 1910, and this is coupled with a statement to the effect that electric smelting with furnaces at or near the mines, is rapidly approaching the commercial stage (which is questionable), and that then this state will be exporting spelter instead of concentrates, which may become true providing power can be had at such rates as would render the operation profitable, but at present such is not the case, nor is the process of electric smelting yet developed. Zinc, however, has taken second place in the total output of metals from Colorado in 1911, and uranium and vanadium occupy for the first time a prominent position in the state's production. This came from San Miguel and Montrose Counties. The state commissioner of mines estimates that about 30 tons per day of roscoelite are being treated at the mill of the Primos Chemical Co., at Newmire in San Miguel County. The product is vanadic acid of about 1% metallic vanadium content and the output is figured on a basis of \$2.50 per lb., making a total of \$547,500 for 1911. During that year 1515 tons of ore were hauled by wagon from the mines in Paradox Valley, Montrose County, to Placerville and from there shipped via Galveston to Liverpool. The ore averaged 3.5% vanadium and brought \$70 per ton, f.o.b. Placerville.

The Leadville Mines Pumping Co. is receiving much encouragement in its project of draining the mines of East Fryer Hill. Blank contracts have been drawn up whereby it is agreed that certain royalties will be paid the company as compensation for unwatering the mines, and that the properties will be worked; two of these have already been signed. The contract provides that if 95% of the claim owners sign, an electrical plant will be installed and pumping will begin on or before Apr. 1, 1913, thus giving claim owners plenty of time to consider the proposition and the company 11 months in which to install pumps in the Harvard or El Paso shafts. Aug. 1 is the date by which the 95% of the contracts must be signed, and when the company begins the installation of a plant with a capacity of not less than 1000 gal. of water per minute.

In Cripple Creek mines, the recession of water has been 141 ft. since connection was made with the deep drainage tunnel from the El Paso shaft, in November, 1911. The recession for April was 16 ft. It is estimated that the saving to the mines to date has been \$1,000,000, or more than the entire cost of the tunnel.

Salt Lake City

May 9—An official of the company states that plans for a third lead stack to the International smeltery, at Tooele, have been drawn, and sent East for approval.

In spite of the frequent snows and rains of early spring, good progress is being made on the 10-mile branch road to Ophir, from St. Johns, on the Salt Lake route. Grading has been completed to within one mile of Ophir and rails have been laid for three miles out of St. Johns. The opening of the new line will mean much to the Ophir district, the chief mines of which are the Cliff, Ophir Hill and Lion Hill.

There is no change in the strike situation at Murray. The works are closed, and the furnaces banked, with no settlement in sight.

It is stated that by May 20, the 10th and 11th sections of the Arthur mill, of the Utah Copper Co., will be placed in commission.

Deadwood, S. D.

May 10—Black Hills operators were much pleased at the action of the House of Representatives in placing the appropriations for U. S. assay offices in the bill under consideration. As is quite generally known, it was proposed by the appropriation committee to abolish the assay offices and it was believed that this would be done. The Deadwood office is convenient for the producers of this section, and to close it would work a hardship. In addition to the bullion business,

the office is making assays to determine the gold and silver, for \$1. It is now the only custom assay office in the Black Hills and is well patronized. During the quarter ended Mar. 31, the office purchased gold bullion worth \$1,883,000, all of which was produced in the Black Hills district. Considering the severe weather prevailing during a portion of this period, this showing is gratifying.

The first strike of high-grade ore recorded this spring was made by Nickoli brothers, who have a lease on the Monarch property, in the Two Bit district. They are taking out ore from a small stringer, which will average well over \$100 per ton. Many assays show better than \$150. A shipment is being prepared, which will go forward soon.

As the first step in a reorganization and resumption of work, the Imperial company has paid \$10,000 back taxes into the treasury of Lawrence County. The company will soon resume work on its property, in the Bald Mountain district, milling its ore at the plant in Deadwood.

Negaunee, Mich.

May 11—Navigation on the Great Lakes is in full swing. The Lake Superior ports, which were the last to get in operation, on account of ice in the narrow waterways at the Soo, are shipping iron ore, though not yet with mid-season activity. At Marquette, both the Duluth, South Shore and Atlantic R.R. docks in the city, and the Lake Superior & Ishpeming Ry. docks at Presque Isle, are loading boats with Marquette Range ore. The Cleveland-Cliffs Iron Co. and the Jones & Laughlin Co. are shipping over the L. S. & I. Ry.; the Oliver Iron Mining Co. and the Breitung-Kaufman mines are shipping via the D. S. S. & A. R.R. The Chicago & Northwestern Ry., with docks at Escanaba, gets some of the Marquette Range traffic, as this port is open for navigation two weeks before the Lake Superior ports, and its situation is convenient for shipping to Chicago; Escanaba gets practically all of the Menominee Range shipments over the C. & N. W. and Chicago, Milwaukee & St. Paul railroads.

The long-awaited extension of the Chicago, Milwaukee & St. Paul Ry., from Crystal Falls to Iron River, seems assured by the announcement that the contract for the building of 22 miles of line has been let to the Fleet Construction Co., of Dubuque, Iowa. The road will touch at the Chicagon and Rogers mines, in Bates township, and the station in Iron River will be erected near the Beta mine. This, with the Chicago & Northwestern Ry., will give the Iron River district two ore carrying railroads and better passenger service. The entrance of this railroad into the district has doubtless been influenced by recent mining developments which have been satisfactory.

Toronto

May 10—Owing to the increased use of concrete there is a great demand for water-washed gravel and sand, the sources of supply of which are the shores and beds of the lakes and rivers. In consequence the Ontario Department of Lands, Forests and Mines has issued regulations providing for the surveying and leasing of all lands under the large lakes and their connecting rivers, including the St. Lawrence and Lake Nipissing. These lands cannot be staked out and the sand and gravel taken, as could have been done under the Mining Act, but hereafter all such lands held by the Crown are to be leased at \$1 per acre for the first year and 35c. per acre for subsequent years, no lease to be longer than 10 years. In case of competition for an area, tenders are to be called for and the lease given to the highest bidder.

Captain Janes, a member of the Canadian exploration party sent out under Captain Bernier on the S.S. "Arctic," states that two large coal fields, 100 miles apart, have been discovered in Baffin's Land. The coal, he states, can be dug from the surface with a shovel.

It was recently announced that the executive of the Lake Superior Corporation, of Sault Ste. Marie, Ont., had adopted a plan of consolidating its subsidiary companies into natural groups to be financed and managed independently. Arrangements have been made for the consolidation of what is known as the "steel group," comprising the following companies: Algoma Steel Co., Lake Superior Iron & Steel Co., Lake Superior Power Co., Fiborn Limestone Co., Cannelton Coal & Coke Co., and Algoma Iron Works. The new company will be The Algoma Steel Corporation, Ltd., with an authorized capital of \$30,000,000, and an authorized bond issue of \$30,000,000. Of the latter an immediate issue of \$13,000,000 has been underwritten to provide for the retirement of notes outstanding, given to secure funds for extensions and improvements. The Lake Superior Corporation guarantees the bonds, but the new arrangement does not involve any additional charges on it.

Cobalt

May 10—Navigation in the Montreal River opened May 1, although the steamboat company is not running a regular service yet. The river is full of logs, and it will take about two weeks to clear the river of these. Next year, when the railroad is in operation, there will be no necessity for these boats, as the lower freight rate will take all this traffic away from them. At present, the minimum freight rate between the railroad at Latchford and Elk Lake, a distance of 50 miles, is 75c. per 100 lb., and on account of the portages, it is impossible to lower the rate and make a profit.

The Mining News

The Current History of Mining

Alaska

Alaska-United—During March 36,883 tons of ore were crushed yielding \$90,818 gross and net \$32,807. Operating expenses were \$56,186; construction \$1825; development 608 ft. The Ready Bullion ore averaged \$2.82 and the 700 Claim, \$2.17 per ton.

Alaska-Mexican—During March 19,215 tons of ore were crushed, yielding \$57,347 gross and net \$24,285. Operating expenses were \$30,752; construction \$2309; development, 306 ft. The ore averaged \$3.01 per ton.

KETCHIKAN DISTRICT

Rush & Brown—Stopping is proceeding on the first and second levels of the sulphide orebody, and 1000 tons have been shipped this year. It is the intention to begin stopping on the magnetite-chalcopyrite orebody soon, when further development will be undertaken in this body on the first level. Development is also proceeding on the second level in the sulphide ore. The management contemplates the purchase of another locomotive and a compressor plant during the year.

Arizona

GILA COUNTY

The suit of the Arizona Eastern R.R. in condemnation proceedings against property owners along the right-of-way of the proposed extension of the line to the Inspiration mine, is now being heard at Globe.

Copper Reef—At the mine 15 miles south of San Carlos, the new engine and air compressor is expected to be finished in about 10 days, after which the driving of the tunnel will be resumed. The tunnel is about 1000 ft. long and it is proposed to drive it about 1800 ft. to cut four veins at a depth of about 1200 ft. Charles Saxman is superintendent.

Southwestern Miami—Churn-drilling continues steadily. Holes 4, 5 and 6 are 500, 420 and 400 ft. deep respectively. Hole No. 5 has passed out of the conglomerate into dacite and No. 6 has reached the schist. Hole No. 4 is still in conglomerate.

Barney—One drill is in operation on hole No. 3 which is hole No. 5 of the Southwestern Miami.

Radium Mines Co.—At the annual meeting in Globe, May 6, W. H. Mercer was elected president. The company owns

60 claims three miles north of Globe and the ground was a producer of silver ore in the early days. Negotiations are being conducted for the sale of the property.

Douglas Copper Co.—A small force of men is at work developing the 23 claims, eight miles northwest of Ray. T. C. Hendricks, of Globe, president, has gone east in the interest of the company.

Arizona Commercial—The retimbering of the Copper Hill shaft has been completed to a point below the fourth level.

South Live Oak—The exploration of the Schultze group of 16 claims three miles west of Miami has been started. An unusually large deep-well drilling machine is being used, the boiler, engine and derrick being mounted on separate trucks. The hole was started with a 17½-in. bit, the largest ever used in the district and it is estimated that a depth of 2000 ft. can be attained if necessary.

Needles—This group recently optioned by the Guggenheim interests consists of 27 claims and 13 adjoining claims three miles west of Miami. The Needles group is owned by Daniel R. Williamson and the deal was conducted by F. W. Hoar, of Globe. It is proposed to explore the group by churn-drilling. George H. Garrey, mining geologist and engineer for the various Guggenheim corporations, will supervise the work of exploration and Ralph C. Nowland, chief engineer for the Ray Consolidated Copper Co., will have direct charge of the drilling.

McMillen-Stonewall—After a month spent in examination and sampling, a group of Michigan men has obtained an option on the 600,000 shares of treasury stock of this company and are placing 125,000 shares on the market at 50c. per share to raise money for the development of the property. The Stonewall Jackson mine, 16 miles northwest of Globe, was a silver producer 30 years ago. It is hoped that low-grade silver sulphide ore will be opened below water level.

SANTA CRUZ COUNTY

Austerlitz—This mine, at Oro Blanco, has been sold to an Eastern company and the mill is being repaired for early operation. T. C. Woodworth is in charge.

YAVAPAI COUNTY

United Verde Extension—Reports state that the shaft has been unwatered and the pumps placed in readiness for active development.

YUMA COUNTY

Arizona Mining Co.—This company has been organized by South Dakota men and has secured 59 claims of 20 acres each, in the Harcuvar Mountains, 11 miles north of Wenden. The Arizona & Swansea R.R. is 12 miles north of the mine. The ores are said to contain copper and gold. No. 1 claim has a shaft 125 ft. deep and it is proposed to continue this shaft. Machinery will be installed. Seth Bullock, Deadwood, S. D., is president.

California

AMADOR COUNTY

East Eureka—The new 20-stamp mill at the Poundstone mine was commissioned May 1. The stamps weigh 1050 lb. each and drop 6 in., 100 times per minute. The mill is equipped with eight 6-ft. Pacific vanners. The whole plant, including the hoist, is electrically driven by G. E. motors. The capacity of the mill is five tons per stamp. The machinery was built by the D. D. Demarest Co., at Altaville, Calaveras County. E. A. Davis, Sutter Creek, is superintendent.

South Amador—This mine, near the Hardenberg and owned by the latter interests, will be in charge of N. S. Kelsey of the Hardenberg. J. J. McSorley, it is reported, will undertake the development of the Alma at Jackson.

BUTTE COUNTY

United States Diamond Mining Co.—The suit brought by this company against the Oro Electric Corporation for \$10,000 water damages is reported to have been settled by compromise. The plaintiff is developing blue rock near Cherokee where diamonds have been found. M. J. Cooney, of Oroville, is manager.

Leggett—No. 3 dredge, formerly owned by James H. Leggett, will resume operations under the ownership of R. S. Kittrick and O. C. Perry, when repairs are completed.

CALAVERAS COUNTY

Petticoat—This mine on the east belt, near Railroad Flat, is in operation under the management of A. T. Copely, of Los Angeles. The indebtedness has been paid. Sinking will be resumed in both shafts, one of which is 650 ft. deep. J. E. King is superintendent.

Boire—A Cox pan and other machinery will be installed to handle the gravel in

this mine near Railroad Flat. F. W. Boire and H. W. Seaman are owners.

INYO COUNTY

Santa Rosa—The purchase bond on this group of mines held by B. F. Edwards and W. J. Douglas, of Tonopah, and others, has been exercised and the property taken over by the Independent Silver-Lead Co. There are 18 claims situated three miles east of Keeler and eight miles from Cerro Gordo. The company contemplates the installation of auto trucks for transportation of ore to the railroad at Keeler. It is said that the West End company, of Tonopah, is interested.

Skidoo—During March, 1175 tons of ore were milled. Total receipts were \$14,408; development, \$1334; operating expenses, \$8207, and \$4865 net profit.

NEVADA COUNTY

Pacific Gas & Electric—Surveys have been ordered in contemplation of the auxiliary power plant to be erected on Bear River. The construction of the new dam at Lake Spaulding is also being considered.

Oakman—The main drift is being continued and raising for stopes has commenced. The 5-stamp mill is being run steadily.

Red Ledge—Development work is being done on this and the El Capitan groups of claims. Trenching and underground drifting and crosscutting are being pushed. K. S. Twitchell is superintendent.

SAN BERNARDINO COUNTY

California Big Chief—This company, at Hart, will erect a 5-stamp mill this summer for the treatment of developed ores. Frederick E. Browne, mining engineer, of Salt Lake City, will have charge of construction.

SHASTA COUNTY

Afterthought—No definite conclusion has been reached as to the reopening of the mine. Operations for the extraction of zinc may depend somewhat upon the result of the Bully Hill experiment and the solution of the smoke problem in Shasta County.

Mammoth—The 500 adit, in process of construction for over a year, is practically completed. It is 2641 ft. long, and, at 1063 ft. from the portal, has a crosscut extending north 860 ft. The main adit was constructed to tap the new orebody, while the crosscut extends under the old orebody. Two raises from the crosscut to the 300 level have been completed, and two more from the main adit have been started. The new level will be primarily for haulage purposes, but exploration work will be carried on from it. Up to the present, all ore has come out by way of the 300 level, having been transported in 5-ton cars. This method will be superseded by the use of 25-ton

cars of the gondola type, and ore will be carried down to the 500 level from the sublevels above. A trial train of four cars and motor was run into the adit on May 1 with no accidents.

SISKIYOU COUNTY

Highland—This mine has installed a 40-hp. gasoline engine and a 10x10-in. duplex compressor.

TUOLUMNE COUNTY

App—Another reported sale of this mine is current, but had not been consummated as late as May 7. The Tonopah-Belmont Development Co. has been making an examination for the last month, and it is generally understood that the company is satisfied with the character and extent of the mine; it is also learned in San Francisco that the consummation of the sale rests wholly with the proposed purchasers. This is the third time the mine has been examined under an option of purchase.

Magnate—It is reported that the Central Mother Lode Co. will reopen this mine for development. A proposition has been made to Jamestown men to take an interest in the property.

Colorado

BOULDER COUNTY

Boulder Tungsten Production Co.—The property is equipped with a hoisting plant and compressor, and development is underway with two shafts in ore. The intention is to drive a tunnel to cut the main orebodies at about 500 ft. depth, and to build a 50-ton mill at the portal.

CHAFFEE COUNTY

The larger mines in the Buena Vista district are idle because of the condition of the metal market. Considerable difficulty is being met with in interesting outside capital and prospects will probably develop slowly.

CLEAR CREEK COUNTY

Stanley—Drifting is in progress on the 400-ft. level but it is reported that the ore has not yet been encountered.

Oneida—During the last winter, this mine has been extensively developed, and large reserves of mill ore opened. The erection of a mill is contemplated.

Specie Payment—Shipments total about 200 tons per month and are being gradually increased. Manager Owen has been opening stopes and a larger tonnage will be produced.

CRIPPLE CREEK

Pride of Cripple Creek—This mine's April output was 10 cars of smelting ore.

Doctor-Jack Pot—The output for April was 10 cars of \$30 ore.

Jefferson—The St. Paul Mining & Milling Co. has been organized to work this mine, on Victor Avenue, under bond and

lease to W. J. Davenport, who is producing ore.

Kittie Wells—Two cars of \$15 to \$20 gold ore are being shipped to the Cope-land smeltery by W. A. Thompson, lessee.

Gold Dollar Consolidated Co.—Fourteen sets of lessees are working at this mine, and the output for April was 36 cars of about 1-oz. gold ore.

Dante—This mine, under lease to Edwin Gaylord, will be equipped at once with a mill for treatment of the low-grade ores. Three sets of sublessees are working in No. 1 shaft.

GUNNISON COUNTY

In the Ohio City district five large tunnels are being driven approximately parallel, by the following companies: Sandy Hook Mining & Milling Co., Belzora-Bassick, Gold Links, Raymond and Carter. The tunnels vary in length from 7000 ft. on the Carter to 1000 ft. on the Sandy Hook. All these properties except the Belzora-Bassick are equipped with mills, containing from 10 to 40 stamps each, with concentrating tables, amalgamation plates, etc. The ore is stated to be easy of treatment and of the same general character in all the mines.

LAKE COUNTY—LEADVILLE

Colonel Sellers—About 150 tons per day of zinc sulphide ore are being hoisted.

Sunday Tunnel—All the bins are full of ore, but the lessees have been compelled to suspend operations temporarily, because of the deep snow and bad roads.

Birdelia—In this tunnel, now in 1450 ft., a vein, said to be the Pickaway, has been cut in the granite. It carries low-grade silver ore.

Ibex—The total shipments of high-grade and medium ores and carbonate of zinc ores are about 7000 tons per month. At No. 2 shaft, on the Hahnwald lease, after months of prospecting work, ore has been found. At No. 5 shaft, the Garbutt vein is being developed and the lessees are shipping ore.

Henriette & Maid—Daily shipments amount to 250 tons of carbonate-of-zinc ore, and 50 tons per day of the same grade are being shipped by the Waterloo.

OURAY COUNTY

Great Western—This mine, at Ouray, for many years idle, is to resume operations under Blanchell & Pierson, lessees, who will mill the dump ore at the local smeltery. This mine is within the town limits.

Revenue Leasing Co.—The company develops its electric power from water-power plants. Ore from development work will be treated in the mill on the

property. So far development has been in ore of satisfactory grade and width.

Silver Ledge—The mine, near Chattanooga, is being unwatered by Daniel McNaughton, superintendent, and the shaft will be sunk another lift.

Esmeralda—This mine is said to have accumulated a large amount of ore during the winter, and this will be shipped as soon as the trails are opened.

SAN MIGUEL COUNTY

Ophir—Active construction of the 150-ton cyanide plant is expected to start June 1. After passing the stamps, the ore will be reground in Hardinge mills. The pulp, after being thickened in Dorr thickeners, will be agitated in Pachuca tanks. The pulp will be separated from the solution and washed by continuous decantation in Dorr thickeners.

Carbonero—Operations have been handicapped somewhat by the heavy snow and bad trails, but production has been maintained.

Favorite—The mine is being operated at a profit by leasers. The vein is from 2 to 6 ft. wide and carries gold and lead. The ore keeps 10 stamps busy at the Suffolk mill.

Idaho

American Mines Co.—This company has been organized with a capital of \$500,000 in 50,000 shares, and a lease and bond have been taken on properties in the Salmon River district, Idaho County. A. W. Paterson, Lewiston, is president.

Michigan

COPPER

Hancock—No. 2 vertical shaft is bottomed in copper-bearing material at 3560 ft. The formation is generally believed to be not the Pewabic lode, but the west branch, which overlies the Pewabic about 60 ft., although the formation is highly mineralized and has the characteristics of the main lode.

Oneco—This company's shaft is down about 1250 ft. A station was cut at 1225 ft. and a crosscut started to explore No. 5 lode, from which a good drill core was taken about two years ago.

New Arcadian—At the annual meeting, held recently at Houghton, the old officers and directors were reelected. It was also decided to start shaft sinking soon. This company has opened some promising formations with its drilling.

Quincy—No. 9, or Pontiac shaft, is down over 2000 ft. and is entering much better mineralization. At the 2300-ft. level, it will be connected with the drift from No. 8 shaft.

Algolah—The crosscut driving from the 200-ft. level has encountered a good

amygdaloidal formation, about 550 ft. from the shaft. Drifting has been started in both directions.

St. Louis—This property, under the management of the Calumet & Hecla, is being opened by a shaft, where drifting is going on at the second level in both directions. Results are gratifying. Two drills are in operation, one about 250 ft. east of the shaft, in an endeavor to locate the Mayflower lode.

South Lake—R. M. Edwards, of Houghton, has been elected a director of this company, and will have charge of this development, which is expected to start soon.

New Baltic—During 1911, expenditures totaled \$27,142, leaving a balance of \$50,279, Jan. 1, 1912. President Beahan says that the year's developments afford liberal encouragement and justify continuing the work. Shaft-sinking amounted to 195 ft.; drifting and crosscutting, 1531 feet.

IRON

Norrie—A cavein, on May 13, buried 13 men, 2000 ft. underground. Two bodies were recovered soon after. A pipe was later driven into the cave and disclosed the fact that six were still alive. Forty workmen were in the vicinity of the cave, but the majority escaped.

Beaufort—This old mine, west of Michigamme, on the southwest quarter of Sec. 22-T, 48-R, 31, is to be explored this summer by independent interests, to whom an option for lease has been given by the owners, George Thoney and John McEncroe. The property has been operated intermittently since 1882; in conjunction with the Ohio mine, just to the east, and was last worked under the management of George L. Woodworth. The ore is a peculiar yellow ocher. The iron content is about 50% and the phosphorus is rather high.

Florence Iron Co.—This Ladenburg-Thalman company, which has been operating the Florence mine at Florence, Wis., for a number of years, has conducted considerable exploration work in the vicinity, as the ore reserves in the Florence mine are small. Exploration in the vicinity of Keyes Lake was not successful, and diamond drilling has been conducted north of the old Commonwealth mine.

Lucky Star—Temporary buildings have been erected, including a dry and office, combination engine and boiler house, and a blacksmith shop. About 20 men are employed, 12 of whom are working in the shaft on three shifts.

Mary Charlotte—A vertical diamond-drill hole is being started on surface, about 300 ft. west of the Sunrise shaft. This territory has not been thoroughly explored, as the underground workings of the mine lie east of the shaft.

Missouri

JOPLIN DISTRICT

The heavy rain last week raised Center Creek and Spring River to the highest point they have been for years and drowned out the Yellow Dog, Golden Glow and Minor Heir mines, at Webb City, and the Yellow Jacket.

Yellow Jacket—This mine, belonging to O. W. Sparks, has purchased the Sunshine mill, at Galena, and will erect it. The mine has been thoroughly drilled and a good body of ore has been indicated.

Blue Jay—A deposit of barite at this mine, at Thoms Station, has reduced the grade of ore so that it is impossible to work it profitably. This is one of the few instances where barite has been found in the district.

Engineers Drill Co.—This company, organized for drilling leases in the district, is drilling the Lily land, on the Mexico-Joplin tract, at Thoms Station, and has struck ore in the first hole. C. H. Plumb, of Joplin, is manager.

Federal Lead Co.—The company has been looking over the district and will probably take over the Hackett mine, west of Joplin.

Onandaga—Jamot Brown and associates have organized this company and will build a 250-ton mill on the Brown land at Porto Rico, near the Whitsett.

PERRY COUNTY

Prospecting will begin soon in this county, drills being on the way. Surface indications are said to be good.

WASHINGTON COUNTY

R. J. Briscoe, of Potosi, is contemplating the installation of a hydraulic plant, at Tiff, for running barite ore, and J. W. Wood is consulting engineer for the work.

Point Milling & Manufacturing Co.—The company is installing tube mills, a roll crusher, classifier and slime pumps for grinding barite ore. A sulphuric-acid system in connection with the Hendryx agitators is being installed to dissolve the iron in the barite. J. W. Wood is in charge.

Montana

BUTTE DISTRICT

North Butte—The crosscut connection with the High Ore mine on the 2800 level has been accomplished and crosscutting will be started on the same level to intersect the Edith May and Jessie veins.

Anaconda—At the Pennsylvania mine 470 ft. of drifting, 250 ft. of crosscutting and 70 ft. of raising were done during April. An average of 490 men were employed underground and on surface, and about 940 tons of ore per day were hoisted. The crosscut being driven south on the 1800-ft. level has advanced over 1500 ft. from the shaft, and an air fan

has just been installed to drive air into the face. This fan is run by a 20-hp. electric motor. The air is forced from the fan through a 14-in. galvanized-iron pipe leading to within a few feet of the breast of the crosscut.

Davis-Daly—The shaft of the Colorado mine has reached the 1900-ft. level and a station cut. Drifting east and west has been started on that level. Fifty tons of ore per day are being shipped to the East Butte smeltery, the ore averaging 6% copper and 8 oz. of silver per ton.

DEER LODGE COUNTY

Butte & Anaconda—The company is preparing to operate on its property of 11 claims, two miles northeast of the Southern Cross mine in the Georgetown district. Joseph C. Keppler, of Anaconda, is president. D. E. McPherson, a Butte mining engineer, has been retained to take charge of operations.

JEFFERSON COUNTY

Washington—John D. Pope, general manager of the North Butte Mining Co., and associates have incorporated the Washington Mining Co. with a capitalization of 100,000 shares, par \$5. The company will operate a property in the Wickes district.

LINCOLN COUNTY

Montana Smelting Co.—This new organization of California men is about to commence operations at the Snowshoe mine, 12 miles from Libby, and Robert C. Davis, a Butte mining engineer, has taken charge of the property. He expects to have the mill on the ground ready for ore treatment by June 1. The mine contains silver-lead ore, and is opened by a tunnel and a 500-ft. shaft.

Hazel T.—The company has crosscut a body of silver-lead ore at 250 ft. from surface. The tunnel has penetrated the vein for 10 ft. without striking the hanging wall. The property is known as the Shaughnessy Hill group, comprising 11 claims, and John H. Town, of Libby, is the principal stockholder.

Nevada

CLARK COUNTY

Quartette—Development work has been discontinued on company account and the main workings and adjacent properties have been opened to leasers whose ore is being treated in the company mill.

COMSTOCK LODGE

C. & C.—The United Comstock Pumping Association has authorized the engineering department to prepare designs and specifications for new hydraulic pumps for the 2500-ft. station of this shaft. The pumps will be large, slow moving, plunger pumps, and will resemble a large steam pump, except that instead of having a steam piston and a water plunger, they will have power plungers driven by water, and a driven

plunger that will lift the mine water 900 ft. to the Sutro tunnel drain. Three of these pumps will be installed, each having a capacity of 1500 gal. per min., two to be in constant use, and the third to be held in reserve. A large station will be cut out on the 2500 level for the new pumps. The new centrifugal, electrically driven pumps will be placed at the head of winzes, and will pump the water from the deep levels below the 2500. The association has just authorized a contract with the Truckee River General Electric Power Co., for an additional 1000 hp., which will make a total of 3500 hp. utilized by the association in pumping.

Crown Point—Run No. 6 has been completed at the Yellow Jacket mill, and one railroad car of concentrate shipped to the smeltery. The mill is now treating ore from the Yellow Jacket surface dumps.

Mexican—Additional clarifying presses for the new mill have been ordered and are on the road; when installed, they will increase the tonnage and percentage of extraction. Last week, the mill crushed 501 tons of ore of an average assay value of \$25.49 per ton, and \$12,000 gross value.

ELKO COUNTY

Pavlak—After an expenditure of nearly \$400,000 in developing the mine and building a mill, which was run intermittently for eight months, operations have been suspended, with \$8000 owing for labor and a \$50,000 mortgage on the property.

Clark-Fletcher—This mill has been closed for some time with debts of \$7000 for labor, and a bill for supplies, with a balance yet to be paid on the machinery. The Bourne mine of this company has considerable ore in sight, running from \$10 to \$18 per ton and negotiations are pending, whereby Salt Lake men may remodel the mill.

Alpha—This mine recently changed hands after several examinations, the final one having been made by H. L. Hollis, of Chicago. The shaft will be equipped with a hoist, and a car and track have been purchased for the tunnel. The tunnel will follow the vein and meet the shaft at a depth of 300 feet.

Flaxie—This mine has a good showing of ore. At 85 ft. in a nearly vertical shaft, a drift was run 200 ft. along the vein showing ore.

ESMERALDA COUNTY

Goldfield Consolidated—It is reported that a contract has been entered into with the Steptoe smelting works, for the treatment of a quantity of refractory ore, found in development, between the 950 and 1000 levels, about three years ago. The ore contains about 2½ oz. gold, 15 oz. silver and 4% copper, a total of about

\$70 per ton. The ore is not adapted to treatment in the mill. Shipments will be about one car per day.

EUREKA COUNTY

Under the new name, Eureka-Nevada Railway Co., the Eureka & Palisade narrow-gauge railroad resumed operation May 6. The road runs from Palisade on the Southern Pacific R.R., to Eureka. For the present a tri-weekly service will be given.

HUMBOLDT COUNTY

F. C. Alsdorf, mining engineer, of New York, has resumed development of his copper properties in the Red Butte district. Boston men are reported to be interested.

NYE COUNTY

Shipments in tons from Tonopah mines to date and for the week ended May 2, are as follows:

Mines	Week	Year to Date
Tonopah Mining.....	3,200	58,869
Tonopah Belmont.....	2,050	28,126
Montana-Tonopah.....	1,052	18,109
Tonopah Extension.....	1,012	17,022
West End.....	845	12,734
Midway.....	.....	180
MacNamara.....	458	5,850
North Star.....	.....	80
Totals.....	8,617	150,970
Estimated value.....	\$215,425	.....

Tonopah Merger Mining Co.—This company, under the management of John G. Kirchen, has resumed the sinking of the Golden Anchor shaft from the 830-ft. level, to open two veins known to pass through the property.

Tonopah 76 Consolidated—The company has commenced the sinking of a main working shaft on its property between the West End and Tonopah Extension mines.

Midway—The north crosscut from the 535-ft. level has opened a 12-ft. vein in virgin ground. The vein shows several stringers of ore, one 17 in. wide, averaging over \$200 per ton.

Montana-Tonopah—A new Trent agitator has been installed in the mill, and is expected to increase the capacity and also secure a higher recovery from the better ores now being treated.

Keane Wonder—It is reported that Philadelphia men have purchased the holdings of Thomas B. Rickey in this mine and have acquired control. It is understood also that Homer Wilson will remain as manager. The production recently has been increased.

WHITE PINE COUNTY

Smokey Development Co.—The company owns about 175 acres of land between the Federal Ely and the Chainman Consolidated companies. Churn drilling last year disclosed ore of varying thickness, some of which is of commercial grade. It has been decided to drive a tunnel in the hopes of developing the porphyry ore and of intersecting the con-

tact at 400 ft. depth. The contact on surface is stated to have disclosed a good copper showing. The offices of the company are at 50 Congress Street, Boston, and S. Herbert Williams is president.

Ninety-Nine—This property is situated eight miles north of Goodsprings, and maintains a production of several cars of copper ore per month. It is the intention to increase the working force to 25 men soon. J. B. Jensen is general manager.

New Mexico

GRANT COUNTY

Philadelphia—This mine, near Hanover, has been taken over by a new company, the United States Copper Mines Company.

Cleveland—George H. Utter, owner, was recently in Denver, where he purchased crushers, rolls, trommels and jigs from the Hendrie & Bolthoff Manufacturing & Supply Co. These are expected to increase the capacity of the mill which may resume operation by June 10. Meanwhile assorted ore is being shipped.

Chino—Steam shovels are operating on the sulphide ore of the Hearst section, marking the initial treatment of this ore at this mine. The amount of sulphide ores handled is increasing.

SIERRA COUNTY

Bi-Metallic Mining & Milling Co.—Alfred G. Strum, president, has been visiting the properties near Lake Valley, which are being systematically developed.

SOCORRO COUNTY

Ernestine—The last 10-day cleanup in April yielded 10,135 oz. of bullion and 9800 lb. of concentrates. During April 3000 tons were milled, producing 28,700 oz. of gold and silver bullion and 31,000 lb. of high-grade concentrates. This property is now producing every 50 days, the price paid for the Last Chance mine by the present owners.

Oaks—In April 145 tons were treated from 128 ft. of development on the Pacific mine, which will be sufficiently opened to begin stoping within 30 days. At the Johnson mine, the full width of the new shaft is in ore, which is being transported to the Deadwood mill.

Socorro—Approximately 5000 tons were milled during April.

Oklahoma

Petersburg—This company, at Quapaw, has installed another centrifugal pump to handle the additional water caused by the heavy rains.

30-acre—This company, at Miami, has sunk two shafts to the ore, and will build a mill soon.

Standefer Brothers—The company is drilling the Palmer land, south of Miami, and has struck ore.

South Dakota

LAWRENCE COUNTY

Gilt Edge-Maid—Briquetting machinery will be installed in this company's concentrating mill, at Galena, in order to make a suitable product for the furnaces of the Black Hills Smelting Co.

Golden Reward—Construction work has been resumed on the roasting plant at the Asoria mine. The first unit will have a capacity of 75 tons per day. Wedge mechanical furnaces are to be installed. Oil from the Casper, Wyo., field, will be the fuel.

Titanic Gold Mining Co.—This company, which owns a large acreage in the Carbonate district, has elected directors, as follows: W. H. Bonham, I. A. Webb and W. S. Elder, Deadwood, S. D.; Col. E. Bright, Columbus, Ohio, and J. M. Rothwell, Martinsburg, West Virginia.

Mascot—This property, owned by J. Treber and A. T. Roos, of Deadwood, is under bond to Denver, Colo., men, who are conducting an examination.

PENNINGTON COUNTY

Mystic—Some minor changes are being made, and the dredge put in shape to operate. Work was suspended in December, on account of cold weather, after a 6-months' run, which was quite satisfactory for the first season. Better results are expected this season.

Mica—Harry Francis is filling a contract with a Denver concern for a limited amount of mica, which will be used in the manufacture of asbestos shingles. The mica is being secured from properties near Keystone. Only scrap is being shipped to the Denver plant, the better grades being stored.

Golden Summit—D. Canfield and associates, are sacking some high-grade ore for shipment to smelters. The lower grades are being piled, and the 5-stamp mill will be started soon. The orebody is 5 to 6 ft. wide, with a 2-in. streak worth \$2 per pound.

Utah

BEAVER COUNTY

Majestic—Work in the Harrington-Hickory is being done on two veins of lead-silver ore east and west of the shaft, 300 ft. apart. The work is above water level. A car of ore was shipped recently, and other shipments are to follow.

Red Warrior—It is thought that this property is on the same north-south ore channel as the Moscow. Both mines have been opened to about the same depth, and the lowest workings are about 1500 ft. apart. Shipments are being made from the silver-lead orebody opened in April below the 500-ft. level, the lowest one in the mine. The present output is stated to average two cars per month. Ten men are employed.

Old Hickory—Work has been resumed, and the workings are being cleaned out, preparatory to shipping copper ore.

Dippie—These claims are west of Copper Mountain. The shaft is down 30 ft., with ore in the bottom. It is expected that a car of silver-lead ore will be ready for shipment soon.

King-of-the-Hills—Work is being done at this property on the east side of the mineral range.

JUAB COUNTY

Tintic shipments for the week ended May 3 were 164 cars.

Eagle & Blue Bell—The shaft has about reached the 1350-ft. level, where about 400 ft. of drifting will be done to get under the orebodies on the 1200 and 1300 levels.

Black Jack—Repairs to the hoist have been completed, and prospecting is being done on the 300- and 600-ft. levels. Preparations are being made to continue a drift on the 300 into Dragon Consolidated ground.

Mammoth—The raise from the 700-ft. level has reached the 600, where drifting is being done to meet it. Later, raising from the 600 to the 500 will be undertaken. Shipments for the week ended May 3 amounted to four cars.

Beck Tunnel—Drifting is being done on the 175-ft. level of the No. 2 shaft, for the point where ore was found near the Uncle Sam line, and work is in quartz carrying ore.

Plutus—The Tetro claim has been leased to J. Lester Mangum and J. H. McChrystal. Lead-silver ore has been opened on the 400-ft. level. Royalties are stated to range from 25% on low-grade ores to as high as 50% on ores of higher grade.

Colorado—Shipments for the week ended Mar. 25, were reduced to four cars. The shipping ore has practically been mined out, present shipments coming from small stringers of rich ore. There is considerable low-grade siliceous ore in sight. There is stated to be about \$100,000 surplus in the treasury, which could be applied to a search for new orebodies.

SALT LAKE COUNTY

Utah-Apex—Proceeds for March were: Gold, \$4049; \$14,500 from silver; \$35,009 from lead. The total gross value was \$53,557, and less smelting and freight charges of \$15,410 and mining, milling and developing charges of \$21,089, gave net returns of \$17,089. The total profits were \$20,109, including \$3020 in royalties from lease ore.

South Hecla—Development work has been financed and operations resumed.

Cardiff—The new lower tunnel is in over 30 ft. The south drift from the main tunnel level is being extended, and there is lead mineralization in the face.

SUMMIT COUNTY

Park City shipments for the week ended May 4 were 3,421,480 pounds.

Daly-Judge—Production for the first quarter of 1912 amounted to 18,319 tons of concentrating ore and 813 tons of shipping ore. There were marketed 5558 tons of lead concentrates and 184 tons of zinc concentrates, shipments of the latter beginning in March. The lead concentrates averaged \$28.53 per ton; zinc, \$25.09, and shipping ore, \$29.81 per ton. Monthly development expenses were \$7668; mining costs, \$3.05 per ton; milling costs, 71c. Monthly earnings averaged \$27,700. The balance on hand Apr. 1, after payment of dividend No. 4, was \$469,700.

TOOELE COUNTY

Cliff—Shipments are being made in spite of bad roads. Ore has been opened in a drift 550 ft. below the tunnel level in the Tony incline, 1250 ft. vertically below the surface.

Wyoming

FREMONT COUNTY

Beck—The company's equipment at the Duncan mine includes a 15-hp. gasoline hoist, a 10x10-in. air compressor, both Fairbanks, Morse & Co., machines and a 20-hp. boiler to operate a Cameron No. 7, and a Cameron "Prospector" sinking pump. The shaft is 250 ft. deep, and there are four levels with a total of about 1275 feet of drifts and crosscuts. The mill contains a 7x12-in. Blake-type crusher, four 1350-lb. Nissen stamps with 50 sq. ft. of plate area per stamp. The mill is operated by a Fairbanks, Morse, standard 25-hp. gasoline engine. There is also a 10-hp. special gasoline engine, operating a 6-kw. generator for lighting.

Canada

BRITISH COLUMBIA

Granby—During April, 103,464 tons of ore were shipped. Development included: Raising, 435 ft.; drifting, 440 ft.; diamond-drilling, 710 ft. Ore was received at the smeltery as follows: From Republic district, Wash., Surprise mine, 1628 tons; North San Poil, 292; Republic, 31; Snowstorm, Ida., 664; Granby, Phoenix, B. C., 103,464; total, 106,079 tons.

British Columbia Copper Co.—About 1600 tons of ore per day are being shipped to the smeltery at Greenwood.

Kingston—This mine, adjoining the Nickel Plate, has been taken over by A. Creelman for Eastern men. A small force is prospecting the copper showings, in an attempt to find suitable fluxing ore to use in smelting the gold arsenical ores. An aerial tram is to be installed, also power and air for mine purposes.

Apex—This property east of the Nickel

Plate is being prospected by T. D. Pickard, of Vancouver. A power site has been located on the Similkameen River and a plant may be installed.

Pollock Mines, Ltd.—Tunnels and drifts have opened ore and a mill may be erected.

NOVA SCOTIA

Dominion Steel Corporation—The output in tons for April was as follows: Coke, 42,495; pig iron, 25,610; steel ingots, 29,710; blooms 24,955; rails, 15,980; rods, 3965. The small output of rods is due to the closing down of the rod mill during part of the month.

ONTARIO

Kendall—On this Lake-of-the-Woods claim, which is being developed by the Canadian Homestake Co., three parallel veins have been uncovered, one of them running from 2 to 6 ft. in width. Samples taken at intervals for a distance of 300 ft. pan gold.

ONTARIO-COBALT

Shipments of ore and concentrates, in tons, from Cobalt for the week ended May 10, and for the year to date, are:

La Rose	33.75	1,181.07
Coniagas	31.10	697.75
O'Brien	32.03	263.24
Right of Way		148.60
Chambers-Ferlagh		161.60
McKinley-Darragh		955.74
Nipissing	66.38	695.44
Hudson Bay		249.88
Buffalo		382.37
Crown Reserve	20.45	190.93
Cobalt Townsite	68.27	474.99
City of Cobalt		145.84
Trethewey		174.19
Colonial	21.60	41.60
Kerr Lake		292.79
Cobalt Lake		176.26
Drummond		300.32
Temiskaming		320.64
Beaver		132.34
Wetlaufer		111.21
Provincial		22.22
Casey Cobalt		24.50
Totals	273.58	7,012.52

Bullion Shipments in Ounces

Mine	Week	Year to Date
Nipissing	84,455.00	1,376,939.72

Cobalt Gem—The property is now being worked under lease.

Maidens Central—An effort is being made to finance this South Lorrain mine, so that work may be resumed.

Silver Queen—At the annual meeting held recently it was stated that there had been some negotiations looking toward the reopening of the property by a leasing company.

Paragon—A small plant is being installed at this Elk Lake property.

Syracuse—This Elk Lake company has let a contract for 100 ft. of sinking.

Nipissing—During April production totaled 380,937 oz., of silver, worth \$225,145. Ore worth \$220,683 was shipped. Good ore was opened in a raise on vein 122 above the first level. Work on the new low-grade mill is proceeding satisfactorily. The small sampling plant on May 1 started operation.

ONTARIO—PORCUPINE

Swastika—The management is now considering plans for a small mill.

Jupiter—The pool in these shares has been extended for another year. The date of the annual meeting is May 20, when it is expected that the old board will be replaced by Drummond supporters.

Porcupine Gold—The mill may be completed by May 20. A new vein has been encountered in crosscutting on the 20-ft. level, 30 ft. north of the Godfrey vein. The shaft is below 300 ft., where a station has been cut.

Crown Chartered—The main shaft has been completed to the 200-ft. level, at which point a new level will be opened. Additional machinery is being installed.

Scottish Ontario—Additional capital has been subscribed for this company, and active mining operations are expected to start soon.

Laughton—Considerable diamond drilling is to be done on these claims which adjoin the Hughes.

Hughes—A complete compressor plant will be installed soon.

Rea—At the annual meeting held in Toronto, all but two of the old directors were replaced. It is believed that this change in the directorate will result in the reopening of the property.

Three Nations—This company is considering the purchase of a 10-stamp mill.

Little Pet—Work on the small mill has been delayed for a short time.

West Dome—Part of the force has been laid off and work confined to the day shift, owing to the scarcity of fuel. Coal will have to be shipped in at an expense for freight exceeding the price of the coal.

Dome—A shipment of 120 lb. of gold was made to New York on May 7, being the result of the second cleanup from the plates.

McIntyre—A churn-drill hole, put down at the west end of Pearl Lake, has gone through several feet of quartz. The discovery is regarded as important. Shaft No. 1 is down 20 ft. and No. 4, is 40 ft. below the 200-ft. level. Stopping has been commenced from both shafts.

Mexico

MEXICO

El Oro—During April, the mill treated 17,810 tons of ore and 15,270 tons of tailings, yielding bullion worth \$169,340. Working expenses were \$90,510; development, \$24,740, and \$62,510 total profit from mine and railway.

SONORA

Greene-Cananea—April production amounted to about 4,600,000 lb., compared to 2,500,000 in March and February, when labor troubles interfered.

The Market Report

Current Prices of the Metals, Minerals, Coal and Mining Stocks

COAL TRADE REVIEW

New York, May 15—The coal trade in the West has nothing new, except the beginning of active shipments for the Lake trade. Locally, the markets are rather dull and heavy.

The seaboard bituminous trade is also dull and heavy, and prices have declined. This is due to large shipments made last month, which have brought a larger supply to tide than can be worked off quickly. Some sales on demurrage have helped to bring prices down.

Scarcity of anthracite is beginning to be felt, though the approaching warm weather has prevented any pressure on domestic sizes. Steam sizes, however, are scarce and bring high prices. The miners' convention assembled yesterday, when the compromise conditions were submitted. Opinions differ as to their acceptance. It may be several days before the result is known. The foreign miners are getting uneasy, and there has been local rioting at several collieries, though the region is generally quiet.

Anthracite shipments in April were only 266,625 long tons, against 5,804,915 in April, 1911. For the four months ended Apr. 30 the total was 22,766,874 long tons in 1911, and 18,475,976 in 1912; a decrease of 4,290,898 tons, or 23.2%, due to the suspension of mining in April.

Coastwise shipments of coal from chief Atlantic ports, three months ended Mar. 31, long tons:

	Anthracite	Bituminous	Total
New York.....	4,738,476	2,841,152	7,579,628
Philadelphia.....	539,855	928,307	1,468,162
Baltimore.....	62,117	891,456	953,573
Newport News.....		677,133	677,133
Norfolk.....		1,225,363	1,225,363
Total.....	5,340,448	6,563,411	11,903,859
Total, 1911.....	4,302,037	6,480,418	10,782,455

Total increase this year, 1,121,404 tons, or 10.4%. New York covers all the harbor shipping points, including barge shipments to city and adjacent wharves.

IRON TRADE REVIEW

New York, May 15—The iron and steel markets continue active. Business continues to come in, and the indications are that the production of finished steel is at a high point.

The heavy orders for new cars referred to last week will require a large tonnage of plates, and ship-building orders recently placed on the seaboard will call for more. A large business in plates and shapes is assured. Structural

steel is also active, while the jobbing demand for bars, wire and other small material is good. There seems little doubt that our steel production this year will reach a high figure. Prices are held at the higher level lately reached, with few exceptions.

Pig iron has not been quite as active, but orders have been good, and there is a tendency to hold prices more firmly. While ore quotations are lower, coke is higher, and there is not an overabundant supply. In the Connellsville region, there is beginning to be some scarcity of labor and it will be difficult to increase production as fast as it is needed. The coke question has deterred some merchant furnaces from going into blast, to meet the increased demand for pig iron.

The taking of evidence in the Steel Corporation suit has continued during the week, the testimony relating chiefly to the existence of pools and agreements before the formation of the Corporation, and to the organization of the various subsidiaries which made up the consolidation. With the exception of a few minor details nothing new was brought out.

The United States Steel Corporation reports that the total unfinished orders on its books on Apr. 30 were 5,664,884 tons. This is 360,044 tons more than on Mar. 31; 560,124 tons more than on Dec. 31, and is the largest total reported since Dec. 31, 1909. The increase in April was made notwithstanding an active production during the month.

Pig Iron Production—The reports of the blast furnaces, as collected and published by the *Iron Age*, show that on May 1 there were 241 coke and anthracite stacks in blast, having an aggregate daily capacity of 79,700 tons; an increase of 1300 tons over Apr. 1. Making allowance for the charcoal furnaces, the estimated make of pig iron in the United States in April was 2,399,000 long tons; for the four months ended Apr. 30 it was 9,025,700 tons.

Birmingham

May 13—While the sales of pig iron in the Southern territory have not been as active in the last few days as they were during the past four weeks, the market conditions are regarded as strong. The quotations are holding firm around \$11 per ton, No. 2 foundry. A few sales have been made at that price for delivery during the last half of the year. A number of inquiries for iron during the last quarter of the year have

been answered with a price above \$11 per ton, in some instances as high as \$11.50 per ton. There has been so much of the lower grades of iron sold by Southern manufacturers that care is being taken in handling business for the future; in fact one or two of the manufacturers are not accepting business for No. 3 and 4 foundry and gray forge iron. The make is holding up nicely. During the month of April Alabama produced several thousand tons more iron than the previous month and efforts are being made to make another increase in May. Two furnaces are in condition for operation and will shortly be lighted.

The cast-iron pipe trade is as active as it can be, and all plants are working on full time. New orders were recently received for a big tonnage. A few small orders for steel rails, fabricated and steel wire goods, are reported again and a fairly steady operation of the several plants in this section of the country is assured. The foundries and machine shops report no change in conditions. Mississippi floods will have some effect in these trades.

Baltimore

May 13—Exports for the week included 4,107,117 lb. structural steel, 334,378 lb. steel rails and rail fastenings and 1,242,423 lb. miscellaneous iron and steel to Panama. Imports included 678 tons ferromanganese from Liverpool; 2042 tons pyrites from Huelva, Spain; 12,100 tons iron ore from Cuba.

Chicago

May 13—The iron market remains strong, with the demand for nearly all products as good as it has been and in some cases better. Pig iron is relatively quiet, but firm; the advanced prices on Northern iron have quieted the demand somewhat, but the consumer is possessed of the idea that he is facing an advancing market, consequently it is a seller's market.

Northern No. 2 brings now \$15 furnace, on all future business, and Southern No. 2 holds to \$11, Birmingham, or \$15.35, Chicago, with 25 or 50c. more asked on last-half sales that favor strongly the producer. In Northern charcoal iron, there is a large and steady demand, with the price a little higher, \$15.75@16.25, and a few contracts made at \$16.75 or slightly less.

As regards finished material, the structural market is stronger at 1.43c., with

much business being done in bridge and building work throughout the territory tributary to this center, west and north-west chiefly. Railroad business is brisk in track fastenings and light rails, with orders for standard rails occasional and of fair tonnage, and many rail inquiries received. Bars are a strong line; soft steel at 1.38@1.43c. and iron bars at 1.20@1.25c. are selling actively. Billets are in very good demand, openhearth holding to \$28. Plates remain quiet at 1.43c. for ¼-in. or less, and sheets are also quiet. Wire goods are backward, but in improving demand.

Cleveland

May 12—No ore sales are reported. Season contracts have generally been closed.

Pig Iron—The total sales in April were large, and the business keeps up, both in large and small orders. Demand is good, both locally and for shipment to other points. The quotations, Cleveland delivery, are \$15.15 for bessemer, \$13@13.50 for No. 2 foundry, \$12.50@12.75 for forge and \$15.50@16 for Lake Superior charcoal.

Finished Material—New business has been of a moderate order, but prices are quite firmly held. The specifications on contracts are heavy.

Philadelphia

May 14—Stocks at furnaces are a negligible quantity. Much heavier buying has been quietly going on for the past two or three weeks than makers and brokers permitted to come to the surface. The Southern furnaces have monopolized a good deal of this quiet business. It is given out today that we may look for a quiet period for a few weeks, but this conclusion is hardly borne out when consideration is taken of the numerous inquiries that have been slipping in for third- and fourth-quarter delivery. One fact that would keep iron up is that coke is considerably higher than a few months ago and another is that stocks are, as stated, practically nonexistent. Much depends upon the course that the users of steel irons will pursue during the next 30 days. The point on which the market hinges is the extent to which the requirements of the third and fourth quarters may be anticipated within the next few weeks. Foundry iron is gaining in strength. Furnace repairing necessities may lessen the output during the summer months. Basic iron is 25c. higher and forge is following suit. Quotations may be fairly given at \$15.50 for No. 2 X, \$14.75 for gray forge and \$15.50 for basic.

Steel Billets—Inquiries for steel billets are crowding in and prices are liable to advance any day. Consumers are poorly supplied with stock excepting in two or three cases. The turn in billets to scar-

city and high prices has taken this market by surprise.

Bars—The activity in car-building circles has turned to the advantage of bar iron and recent inquiries for large lots have already resulted in a marking up of quotations on small lots for retail delivery and jobbing demand.

Sheets—Sheets have been moving in larger lots, mainly through contracts placed by the larger consumers. Jobbers and smaller buyers are ordering freely and deliveries on contracts placed a few weeks ago are being urgently called for. Prices are pointing upward.

Pipes and Tubes—Tubes are particularly active under exceptional activities in boiler works. Cast pipe is remarkably active and some foundries have overloaded with work.

Plates—The extraordinary activity in the plate market is putting some buyers to considerable trouble who failed to specify fixed dates for delivery. Makers are taking advantage of the opportunity and some work in the smaller shops is dragging in consequence. The rush in car building is drawing out inquiries and contracts for large supplies of plate will be placed within a few days. Tank is also active and marine steel is under better inquiry than for many months.

Structural Material—But few good-sized orders have been placed, though this dullness is offset by known requirements for large quantities which are due in the market some time in June.

Scrap—Scrap continues active. Stocks are declining. Dealers are scouring the country and the supply is sufficient for pressing requirements.

Pittsburg

May 14—The pressure upon mills for delivery of bars, plates and shapes has increased, and the question of delivery has become one of considerable importance. Upon plates the mills are particularly well filled, most of the large mills having sufficient specifications for four to six weeks of steady rolling. The leading local interest is chary about incurring any fresh obligations upon plates this side of July 1, as it is already fairly well specified up to that date and some of its customers may increase their requirements further.

New business is relatively light all along the line, but in bars, plates and shapes the pressure for deliveries is such as to cause no uneasiness. In pipe, wire and sheets specifications continue fairly good, the various mills in these lines operating at from 75 to 95 per cent. of capacity. There is practically no fresh buying of wire products at prices currently quoted, deliveries being made on old contracts, some at \$1 a ton, some at \$2 a ton, below the present basis. Occasional reports of shading appear, but

such transactions are believed to be simply extensions of old contracts.

Pig Iron—There is considerable quiet inquiry for basic and bessemer iron, but not a great deal moves in the open market. The Carnegie Steel Co. has purchased 15,000 tons of bessemer from the Brier Hill Steel Co. at \$14.50, furnace, but special conditions are believed to have surrounded the transaction, inasmuch as there is bessemer still to be had at \$14.25. Demand for foundry iron is light, but the furnaces operating are well sold up, and buying of a moderate tonnage would undoubtedly send prices upward. Production cannot be increased materially except by the blowing in of idle furnaces which would have to contract afresh for coke, paying perhaps \$2.40, when the majority of the operating furnaces have old contracts at \$1.55@1.65, so that higher prices would have to be obtained for pig iron to warrant an increase in output. We quote: Bessemer, \$14.25; basic, \$13; No. 2 foundry, \$13.25; forge and malleable, \$13, all f.o.b. Valley furnaces, 90c. higher delivered Pittsburg.

Ferromanganese—The market has been quiet since the advance, consumers being well covered at old prices, but prompt metal is scarce. We quote prompt at \$46@50 and forward at \$46, Baltimore.

Steel—Consumers are calling for better deliveries of billets and sheet bars on their contracts, and are filing specifications unusually early. In some cases mills have asked that some of their June steel be shipped this month. While consumers are short of steel they are not in position to pay the higher prices now asked upon fresh sales, and so transactions are light. Steel is offered in a limited way by brokers. We quote the market approximately as follows: f.o.b. mill, Pittsburg: billets, \$21@21.50; sheet bars, \$21.50@22; f.o.b. mill, Youngstown; billets, \$20.50@21; sheet bars, \$21@21.50. Rods are about \$25, Pittsburg.

Sheets—Prices of sheets have firmed a trifle more since last report, but are not quotably higher. The leading interest's prices are 1.95c. for black and 3.00c. for galvanized, and it is booking a fair amount of business in the circumstances, though the prices are being shaded by some of the independent mills \$1 a ton. The leading interest and some of the independents are operating practically full, while other independents are operating at 70 to 90 per cent. of capacity. The industry as a whole is probably operating at between 85 and 90 per cent. of capacity. We quote: Black sheets, 28 gage, 1.90@1.95c.; galvanized, 2.95@3.00c.; blue annealed, 10 gage, 1.40c.; painted corrugated, \$1.35; galvanized, \$2.55. The American Sheet & Tin Plate Co. is now selling corrugated material on a weight basis, at its usual extras over flat sheets.

St. Louis

May 13—The pig-iron market seems to be on the up grade both in regard to demand and price. In fact, the general outlook is better than for several years past. The strengthening of the market has had a tendency to bring buyers into the market for future requirements. A number of inquiries for third-quarter delivery are coming in and quite a tonnage has been contracted for in the last week for both immediate and future delivery. Immediate delivery iron can be purchased for \$11@11.25, Birmingham, or \$14.75@15, St. Louis, for No. 2 foundry. A premium of 25@50c. per ton is being asked for last-half delivery. Northern No. 2 foundry is quoted at \$14.50@15 per ton.

Coke is in better demand. Good foundry is bringing \$5@5.10 per ton, St. Louis.

Iron Ore Trade

April shipments of Lake Superior iron ore were light, owing to the heavy ice still remaining at several points on the upper Lakes. The total shipments were, in long tons:

Port	1911	1912	Changes
Escanaba.....	98,532	80,530 D.	18,002
Marquette.....	14,838	..... D.	14,838
Ashland.....	41,337	8,288 D.	33,049
Two Harbors.....	54,157	32,571 D.	21,586
Superior.....	76,739	64,416 D.	12,323
Duluth.....	51,042	18,237 D.	32,805
Total.....	331,645	204,042 D.	127,603

The movement of ore from Lake Erie docks to furnaces in April, was 1,314,627 tons, or 325,053 tons more than in April last year.

It is stated that the Great Northern trustees intend to organize a company to take over and operate the Mesabi lands now held by the Steel Corporation under lease, as fast as they are surrendered by the Great Western Co., the subsidiary which has been operating them for the Corporation. Whether the lands will be operated directly or subleased to other interests is not yet determined.

British Iron and Steel Trade

Exports and imports of iron and steel, and of machinery, in Great Britain, three months ended Mar. 31, are valued by the Board of Trade returns as below:

	Exports	Imports	Excess
Iron and steel	£12,339,318	£2,909,896	Ex. £9,429,422
Machinery...	7,812,470	1,622,483	Ex. 6,189,987
Cutlery and hardware...	3,142,505	1,967,128	Ex. 1,175,377
New ships....	1,175,729	.....	Ex. 1,175,729
Total.....	£24,470,022	£6,499,507	Ex. £17,970,515
Total, 1911..	20,041,066	5,867,377	Ex. 14,173,689

Increase in exports this year, £4,428,956; increase in imports, £632,130. The quantities of iron and steel were, in long tons:

	1911	1912	Changes
Exports.....	1,095,567	1,287,091	I. 191,524
Imports.....	445,951	459,239	I. 13,288

Tinplate exports to the United States decreased from 7653 tons in 1911 to 580 tons this year.

METAL MARKETS

New York, May 15—The metal markets have been quite active, and remain rather strong, and inclined to be speculative in some lines.

MONTHLY INDEX NUMBERS

Month	1911	1912	Month	1911	1912
January....	110	111	July.....	112	.....
February..	115	109	August....	117	.....
March.....	112	111	September.	111	.....
April.....	114	120	October....	112	.....
May.....	118	.....	November..	111	.....
June.....	115	.....	December..	110	.....

Year 1909, 115; 1910, 115; 1911, 112. Numbers for each month and year calculated on approximate sales of pig iron, copper, tin, lead, zinc and aluminum.

Gold, Silver and Platinum

UNITED STATES GOLD AND SILVER MOVEMENT

Metal	Exports	Imports	Excess
Gold			
Mar. 1912..	7,453,589	4,335,678	Exp. \$3,117,911
" 1911..	505,615	4,119,063	Imp. 3,613,448
Year 1912..	19,958,088	12,414,195	Exp. 7,543,893
" 1911..	1,854,014	19,465,737	Imp. 17,611,723
Silver			
Mar. 1912..	5,806,307	3,711,734	Exp. 2,094,573
" 1911..	5,896,795	3,197,409	Exp. 2,699,386
Year 1912..	16,955,988	11,860,220	Exp. 5,105,768
" 1911..	16,001,842	10,646,781	Exp. 5,355,061

Exports from the port of New York, week ended May 11: Gold, \$24,490; silver, \$1,555,259, chiefly to London and Paris. Imports: Gold, \$400,692, largely from Mexico; silver, \$178,653, chiefly from South America.

Gold—The price of gold on the open market in London remained at the usual level, 77s. 9d. per oz. for bars and 76s. 4d. per oz. for American coin. There was no special demand.

Sales of gold bars for industrial purposes at the New York Assay Office in May were \$2,406,879. For the four months ended Apr. 30 the total was \$9,313,225, an increase of \$310,647 over last year.

Platinum—The market continues steady and rather quiet, but with no change in prices. Dealers ask \$45.50 per oz. for refined platinum and \$48 per oz. for hard metal, up to 10% iridium.

A considerable shipment of crude platinum was recently received at New York from Colombia.

Iridium—Prices are unchanged at \$64 per oz. for pure metal, New York.

Silver—The market has ruled steady without special feature the past week, fluctuating between 27½ and 28½d. Market closes quiet at 28d. in London.

SILVER AND STERLING EXCHANGE

May	9	10	11	13	14	15
New York....	60½	60½	60½	60½	60½	60½
London.....	27½	27½	27½	28½	27½	28
Sterling Ex.	4.8670	4.8675	4.8680	4.8680	4.8685	4.8680

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

An official statement, just published in London, gives the imports of gold into India for the calendar year 1911 as £22,389,000, against £18,023,000 in 1910, and £10,068,000 in 1909.

Copper, Tin, Lead and Zinc

NEW YORK

May	Copper		Tin	Lead		Zinc	
	Lake, Cts. per lb.	Electrolytic, Cts. per lb.	Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.
9	15½	15.60	46½	4.20	4.02½	6.55	6.40
10	15½	15.70	46½	4.20	4.02½	6.55	6.40
11	15½	15.70	46½	4.20	4.02½	6.55	6.40
13	16	15.80	46½	4.20	4.02½	6.65	6.50
14	16	15.85	46½	4.20	4.02½	6.65	6.50
15	16	15.95	46½	4.20	4.02½	6.65	6.50

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

LONDON

May	Copper			Tin		Lead, Spanish	Zinc, Ordinaries
	Spot	3 Mos	Best Sel'td	Spot	3 Mos		
9	70½	70½	75	210½	206½	16½	25½
10	70½	71½	75½	211½	206½	16½	25½
11	.....	.....	.....	.....	.....	.....	.....
13	72½	72½	77	212½	208	16½	25½
14	72½	72½	77	211½	207	16½	25½
15	71½	72½	77	210	205½	16½	25½

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26c.; £25 = 5.44c.; £70 = 15.22c. Variations, ± £1 = ± 21½c.

Copper—The statistics published on May 8 were received favorably, especially from their showing of continued large deliveries, and a renewal of the demand was stimulated, following a sharp rise in the London standard market. This cleaned up all the cheap copper offered on May 9 and before the end of that day first hands made some small sales at 15½c., delivered, usual terms, which price was well established on May 10.

On May 13 a greatly increased demand developed which carried the market through the price of 16c., delivered, for which one prominent agency had been holding out and to 16 1/8c., which two others had been asking. In the aggregate a rather large volume of business has been transacted, divided between foreign and domestic buyers, apparently preponderating with the latter, who have been interested both in the nearer and later deliveries. Lake copper was sold at 15 3/4@16c. up to the middle of the week; since then as high as 16 1/4c. has been realized upon special brands. The market closes firm at 16@16 1/4c. for Lake, and 15.95@16c. for electrolytic in cakes, ingots and wirebars. Casting copper is quoted nominally at 15 1/2@15 3/4c. as the average for the week.

European speculators were favorably impressed by the American statistics and the more active market, and higher prices prevailed for refined copper. Standard copper on Tuesday reached £72 3s. 9d. for spot and £72 12s. 6d. for three months, and closes at £71 18s. 9d. for spot, and £72 7s. 6d. for three months.

Copper sheets are 21@22c. base for large lots. Full extras are charged and higher prices for small quantities. Copper wire is 17 1/8@17 1/4c. base, carload lots at mill.

Copper exports from New York for the week were 6762 long tons. Our special correspondent gives the exports from Baltimore at 2654 tons.

Copper production of Russia in 1911 is reported at 25,919 long tons, which compared with 22,600 tons in 1910; an increase of 3319 tons.

Tin—The market retained its firm undertone all through the week, even though the advance of Monday last was not maintained. The excellent statistical position of the metal becomes more and more apparent, and very bullish views on the future are being expressed by the large London interests. In this market the tendency to realize developed, and sales were made at below the importation point. The close is steady at £210 for spot, and £205 10s. for three months, and 46 1/2c. in this market.

Messrs. Robertson & Bense report the arrivals of tin ore and concentrates at Hamburg, Germany, in April at 1363 tons; 1351 tons from Bolivia and 12 tons from South Africa.

Tin shipments from the Straits in April were 4290 long tons, an increase of 1150 tons over April of last year.

Lead—The cheap lead offered last week by second hands and certain independent producers seems to have been absorbed, and this week we have heard of no business at less than 4.20c., New York, which is the price of the A. S. & R. Co. Lead at St. Louis is quoted at 4.02 1/2@4.07 1/2 cents.

The London market is also firm, Spanish lead being quoted at £16 10s., and English 2s. 6d. higher.

Spelter—Several large galvanizing interests became buyers this week and entered into extensive contracts, the transactions amounting in the aggregate to many thousands of tons for June-July-August delivery. This large demand advanced prices. At the close, St. Louis is quoted at 6.50@6.60c., and New York at 6.65@6.75 cents.

The London market is unchanged, good ordinaries being quoted at £25 15s., and specials at £26 per ton.

Base price of zinc-sheets is \$8.65 per 10 lb., f.o.b. La Salle-Peru, Ill., less 8% discount.

Zinc dust is quoted at 7 1/8c. per lb., New York, in carload lots.

Other Metals

Aluminum—Business is quiet but the market is firm. Some small lots of low-priced metal can still be had, but the higher level of prices seems to be well held. We quote 21 1/2@22 1/2c. per lb. for No. 1 ingots, New York.

The convention of European producers was organized on Apr. 27. Details of the agreement have not been published.

Antimony—Business has been fair, and prices are a little firmer. Cookson's is still quoted at 8c. per lb. and Hallett's at 7 3/4c.; but 7@7 1/4c. is named for Chinese, Hungarian and other outside brands.

Quicksilver—The market remains steady, with a fair business going. New York quotations are \$41@42 per flask of 75 lb., with 60c. per lb. charged for retail lots. San Francisco, \$41.50 for domestic orders and \$39 for exports. The London price is £8 5s. per flask, with £8 quoted from second hands.

Nickel—Large lots, contract business, 50@45c. per lb. Retail spot from 50c. for 500-lb. lots up to 55c. for 200-lb. lots. The price of electrolytic is 5c. higher.

Spanish Metal Exports

Exports of metals and minerals from Spain, two months ended Feb. 29, reported by *Revista Minera*, in metric tons:

Metals	1911	1912	Changes
Pig and manuf. iron	13,328	9,241	D. 4,087
Copper	1,772	2,017	I. 245
Copper precipitate	2,516	2,195	D. 321
Lead	27,745	24,916	D. 2,829
Zinc	44	545	I. 501
Quicksilver	206	414	I. 208
Minerals			
Iron ore	1,534,901	1,411,792	D. 123,109
Manganese ore	8,148	5,837	D. 2,311
Copper ore	99,304	127,719	I. 28,415
Lead ore	495	614	I. 119
Zinc ore	21,812	24,545	I. 2,733
Pyrites	267,983	407,784	I. 139,801
Salt	81,270	76,003	D. 4,267

Pyritic ores are not classed as copper ores unless they carry 2.5% or over in copper; below that they are classed as pyrites.

Zinc and Lead Ore Markets

Platteville, Wis., May 11—The highest price paid this week for zinc ore was \$56; the base price, 60% zinc, was \$55. The base price paid for 80% lead ore was \$53@54 per ton.,

Camps	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Benton	1,089,200	.....	596,550
Galena	1,060,400	.....	.....
Mineral Point	985,670	.....	.....
Platteville	573,570	.....	60,000
Harker	390,680	.....	.....
Cuba City	321,860	99,600	302,400
Hazel Green	260,000	.....	.....
Linden	192,510	.....	.....
Shullsburg	.....	415,900	.....
Total	4,873,890	515,500	948,950
Year to date	73,326,520	2,801,290	9,001,700

Shipped during week to separating plants, 2,117,410 lb. zinc ore.

Joplin, Mo., May 11—The high price of zinc sulphide ore this week is \$61, the base, per ton of 60% zinc, is \$52@58.50. Zinc silicate sold at \$26@30 per ton of 40% zinc. The average price, all grades of zinc, \$54.50 per ton. The high price of lead ore is \$54 and the average price \$52.10 per ton.

Never before in the history of this district was zinc ore \$7 per ton higher than lead ore, and seldom has zinc been even as high in price as lead ore. There is at

SHIPMENTS, WEEK ENDED MAY 11

	Blende	Calamine	Lead Ore	Value
Webb City-Carterville	4,225,710	.....	1,207,070	\$150,306
Joplin	1,414,180	.....	225,850	45,355
Alba-Neck	1,921,320	.....	47,860	30,852
Duenweg	769,920	63,670	.....	21,741
Galena	741,020	.....	18,340	21,200
Jackson	477,890	.....	7,630	13,090
Miami	243,370	.....	215,110	11,215
Cave Springs	387,380	.....	.....	10,845
Carl Junction	263,900	.....	.....	7,900
Spurgeon	56,940	128,440	157,550	7,305
Oronogo	176,900	.....	125,780	7,251
Granby	63,860	300,810	1,330	6,090
Lawton	123,850	.....	.....	3,465
Wentworth	84,080	.....	.....	2,828
Springfield	84,000	.....	.....	2,400
Aurora	60,950	.....	.....	1,700
Sarcofie	58,460	.....	.....	1,578
Carthage	53,820	.....	.....	1,478
Totals	10,307,550	492,920	2,006,520	\$346,599

19 weeks... 190,060,010 11,731,270 32,024,470 \$5,649,826
Blende val., the week, \$286,841; 19 weeks, \$4,602,129
Calamine, the week, 7,479; 19 weeks, 170,860
Lead value, the week, 52,279; 19 weeks, 876,937

MONTHLY AVERAGE PRICES

Month	ZINC ORE				LEAD ORE	
	Base Price		All Ores		All Ores	
	1911	1912	1911	1912	1911	1912
January	\$41.85	\$44.90	\$40.55	\$43.54	\$55.68	\$58.92
February	40.21	45.75	39.16	43.31	54.46	52.39
March	39.85	51.56	38.45	49.25	54.57	54.64
April	38.88	52.00	37.47	50.36	56.37	54.18
May	38.25	.....	36.79	.....	55.21	.....
June	40.50	.....	38.18	.....	56.49	.....
July	40.75	.....	38.36	.....	58.81	.....
August	42.50	.....	41.28	.....	60.74	.....
September	42.63	.....	41.29	.....	59.33	.....
October	42.38	.....	40.89	.....	54.72	.....
November	45.40	.....	43.25	.....	57.19	.....
December	44.13	.....	40.76	.....	62.03	.....
Year	\$41.45	.....	\$39.90	.....	\$56.76	.....

NOTE—Under zinc ore the first two columns give base prices for 60 per cent. zinc ore; the second two the average for all ores sold. Lead ore prices are the average for all ores sold.

present no competition in the lead-ore market. The local smelters are making no fight, permitting the St. Louis Smelting & Refining Co. to take the pick of the ore, and they are dividing the remainder.

Two weeks of fair weather was again broken yesterday and today with more rain. But for the extra stimulus of strong prices as an incentive to combat the constant disadvantages and damage from the surfeit of rain, the output could not be maintained on the present scale.

New Caledonia Ores

Exports of ore from New Caledonia, as reported by the *Bulletin du Commerce*, of Noumea, for the two months ended Feb. 27, were 3321 metric tons nickel ore and 10,033 tons chrome ore. Exports of metals were 687 tons nickel matte.

Chemicals

New York, May 15—The general market is more active than it has been.

Copper Sulphate—Sales have been on a good scale. Quotations are unchanged at \$5.25 per 100 lb. for carload lots and \$5.50 per 100 lb. for smaller parcels.

Arsenic—Buyers are less pressing. The feature of the past few weeks has been the scarcity of supplies, largely due to the troubles in Mexico. This week the Anaconda Co. offered 75 tons for June delivery, which has eased the situation. Other American producers are reported in the market. Quotations are \$3.50@3.75 per 100 lb. for white arsenic.

Nitrate of Soda—Business has been rather quiet and prices are a shade off. The market is quoted at 2.40@2.45c. per lb. for spot; 2.40c. for futures up to Aug. 1, and 2.37½c. for deliveries after that date.

Sulphur—In November last, the Treasury Department issued an order to the effect that sulphur mined in Hokkaido, Japan, and exported through Hakodate, should be held to be crude sulphur and admitted free of duty under paragraph 686 of the tariff act. This sulphur, which is of volcanic origin, is roasted in furnaces, and contains from 90 to 97% pure sulphur. At that time the sulphur from Bongo, Japan, was excepted from the order. Now the Board of General Appraisers has decided that the Bongo sulphur, being over 99% pure, is dutiable under paragraph 81 as refined sulphur. The Bongo sulphur is obtained from geysers, and is so nearly pure that it is not submitted to any artificial treatment. The board held that it was immaterial whether the heat applied to the sulphur was phenomenal or artificial. Imports of Japanese sulphur are made chiefly on the Pacific Coast.

MINING STOCKS

New York, May 15—On May 9, the selling pressure on the Exchange was relaxed, and there was some recovery in

quotations. The market, however, was rather narrow. Steel common recovered from its recent low price. Business on the Curb was rather variable. Mining stocks were in fair demand and inclined to be strong, with the exception of the coppers, which were slow and heavy.

May 10 was marked on the Exchange by a general recovery in prices on dealings almost entirely professional. On the Curb, mining stocks were sluggish, the coppers gaining fractionally. Cobalt and Porcupine stocks were moderately active and firm.

May 11 the Exchange was not especially active, and quotations were stationary. On the Curb, there was a good deal of trading in coppers, on advancing prices. Other mining stocks were quiet.

May 13 there was a halt in the advances on the Exchange, and at the close the market was under some pressure. Trading on the Curb was active, with advances in coppers, and strength in other mining stocks. Lehigh Valley Coal Sales was in demand at high quotations.

May 14 the market was slow and prices on the Exchange remained steady. The Curb also was dull and changes were only fractional. The markets continued inactive on May 15, with no changes of importance.

Sales at auction in New York, May 10, included the following mining securities: La France Copper Co., \$172,000 bonds, at 5% of par value; Ohio Copper Co., \$15,000, first-mortgage bonds, at 48; United Copper Co., preferred, 7452 shares, at \$5 per share; Caudle (Alaska) Hydraulic Gold Mining Co., 14,675 shares, at 1c. per share; Isabella Connellsville Coke Co., of West Virginia, 500 shares, \$100 par, \$500 for the lot; Wise Coal & Coke Co., 167 shares, \$100 par, \$15,160 for the lot; Western Development Co., preferred, 346 shares, \$100 par, \$125 for the lot.

Boston, May 14—Sharp recessions in the prices of Mayflower and Old Colony mining stocks during the week have tended to restrict trading in the mining-share list, although the market cannot be considered otherwise than a healthy one, particularly in view of the strength of the metal market. Stop-loss orders in these two stocks caused a break to \$9.87½ in the case of Mayflower and to \$8.12½ in Old Colony. The former made a high record at \$18.50 on Apr. 23 and the latter one at \$13.25 on May 1. Disappointment that drill cores at each property have not struck the lode at the expected depth has caused considerable selling of each. The Mayflower's No. 18 drill was expected to encounter the vein at a depth of 1400 ft., but today it was stated that the drill was down 1441 ft. Old Colony's No. 14 drill was expected to reach the vein at a depth of about 870 ft. but is now beyond that point. Partial recoveries have followed from the above recorded low prices.

COPPER PRODUCTION REPORTS

Copper contents of blister copper, in pounds

Company	Feb.	March	April
Alaska shipments.	2,662,243	4,987,916	1,243,911
Anaconda.....	27,450,000	25,900,000	25,480,000
Arizona, Ltd.....	3,020,000	3,150,000	3,400,000
Copper Queen.....	6,046,860	7,197,121	.....
Calumet & Ariz....	4,452,004	4,652,000	4,104,000
Detroit.....	2,068,370	2,246,238	.....
East Butte.....	1,440,000	1,480,000	.....
Mammoth.....	1,732,954	1,939,310	.....
Mason Valley.....	1,100,000	1,140,000	.....
Nevada Con.....	4,888,790	6,380,000	.....
Old Dominion.....	2,039,000	2,432,000	2,167,000
Ray.....	2,140,000	2,300,000	2,612,500
Shannon.....	1,300,000	1,388,000	1,544,000
South Utah.....	283,838	299,000	284,215
United Verde*.....	2,250,000	2,250,000	.....
Utah Copper Co....	8,612,739	8,160,000	.....
Lake Superior*....	19,000,000	19,750,000	18,250,000
Non-rep. mines*...	8,000,000	8,400,000	.....
Total production.	98,476,798	104,051,585	.....
Imports, bars, etc..	18,976,513	23,519,215	.....
Total blister.....	117,453,311	127,570,800	.....
Imp. in ore & matte	10,432,438	8,736,874	.....
Total.....	127,885,749	136,307,674	.....
Miami.....	2,475,996	2,755,000	.....
Brit. Col. Cos.:			
British Col. Copper	860,003	.....	.....
Granby.....	1,773,496	1,882,073	.....
Mexican Cos.:			
Boleo.....	2,204,720	2,424,800	2,149,280
Cananea.....	2,948,000	2,834,000	4,654,000
Moctezuma.....	2,687,712	2,446,731	.....
Other Foreign:			
Cape Cop., S. Africa	786,440	725,760	.....
Kyshtim, Russia..	1,055,000	.....	1,545,000
Spasky, Russia....	649,600	.....	.....
Famatina, Argen..	.....	.....	.....
Tilt Cove, Newf'd..	109,059	104,992	.....
Exports from:			
Chile.....	6,720,000	3,584,000	6,496,000
Australia.....	7,164,000	8,064,000	9,408,000
Arrivals in Europe†	10,868,680	12,559,680	12,064,640

Figures are reports received from companies, unless otherwise stated. Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.

*Estimated. †Does not include the United States, Australia or Chile.

STATISTICS OF COPPER.

Month	United States Product'n	Deliveries, Domestic	Deliveries for Export
IV, 1911.....	118,085,223	52,407,650	62,129,899
V.....	126,962,544	64,543,963	61,978,557
VI.....	124,554,312	61,655,561	71,460,519
VII.....	112,167,934	56,982,582	74,880,658
VIII.....	125,493,667	59,935,364	69,855,660
IX.....	115,588,950	57,311,584	60,824,011
X.....	118,255,442	64,068,307	60,084,349
XI.....	111,876,601	68,039,776	67,049,279
XII.....	122,896,697	65,988,474	79,238,716
Year.....	1,431,938,338	709,611,605	754,902,233
I, 1912.....	119,337,753	62,343,901	80,167,904
II.....	116,035,809	56,228,368	63,148,096
III.....	125,694,801	67,487,466	58,779,556
IV.....	126,464,644	69,513,846	53,252,326

VISIBLE STOCKS

	United States	Europe	Total
V, 1911.....	165,555,908	212,284,800	377,840,708
VI.....	165,995,932	202,540,800	368,536,732
VII.....	157,434,164	195,932,800	353,366,964
VIII.....	137,738,858	191,891,840	329,630,698
IX.....	153,441,501	191,228,800	324,670,301
X.....	140,894,856	191,945,600	332,840,456
XI.....	134,997,642	176,825,600	311,823,242
XII.....	111,785,188	164,261,600	276,046,788
I, 1912.....	89,454,695	158,323,200	247,777,895
II.....	66,260,643	154,851,200	221,111,843
III.....	62,989,989	141,142,400	204,082,388
IV.....	62,367,557	136,819,200	199,186,757
V.....	65,066,029	134,176,000	199,242,029

Figures are in pounds of fine copper. U. S. production includes all copper refined in this country, both from domestic and imported material. Visible stocks are those reported on the first day of each month, as brought over from the preceding month.

These rather severe declines had no particular effect on the copper-share list as a whole, for most stocks are selling at prices better than a week ago.

Curb trading has been light but prices hold steady to firm. South Lake weakened fractionally upon the \$2 assessment levied last week.

Assessments

Company	Delinq	Sale	Amt
Algoma, Mich.	Jan. 22	.....	\$1.00
Alpha Con., Nev.	May 29	June 18	0.05
Andes, Nev.	.....	.....	0.02
Black Horse, Ida.	.....	.....	0.01
Black Jack, Utah.	Feb. 6	.....	0.10
Caledonia, Nev.	May 21	June 11	0.005
Cedar-Talisman, Utah.	Apr. 20	.....	0.005
East Tintic, Utah.	May 30	June 25	0.005
Ely Con., Nev.	.....	.....	0.05
Eschequer, Nev.	May 23	June 13	0.05
Federal Ely, Utah.	May 8	June 8	0.01
Glen Dale, Utah.	May 25	June 25	0.00
Gould & Curry, Nev.	Apr. 19	May 10	0.05
Hancock, Mich.	Mar. 28	.....	1.00
Houghton Copper, Mich.	May 17	.....	1.00
Julia, Nev.	May 15	June 5	0.05
Lohi Tintic, Utah.	Feb. 29	.....	0.01
Lower Mammoth, Utah.	Mar. 16	.....	0.01
Michigan Cop. & Gold, Utah.	May 15	May 30	0.002
New York Bonanza, Utah.	May 8	.....	0.02
O. K. Extension, Utah.	Apr. 26	May 15	0.002
Ojibway, Mich.	Jan. 10	.....	1.00
Raven, Mont.	Feb. 1	.....	0.10
Savage, Nev.	June 4	June 26	0.105
South Lake, Mich.	June 3	.....	2.00
Southwestern Miami, Ariz.	Jan. 15	.....	1.00
Union Con., Nev.	May 9	May 31	0.15
Utah Antimony, Utah.	June 1	.....	0.03

Monthly Average Prices of Metals SILVER

Month	New York			London		
	1910	1911	1912	1910	1911	1912
January	52.375	53.795	56.260	24.154	24.865	25.887
February	51.534	52.222	59.043	23.794	24.081	27.190
March	51.454	52.745	58.375	23.690	24.324	26.875
April	53.221	53.325	59.207	24.483	24.595	27.284
May	53.870	53.308	.....	24.797	24.583	.....
June	53.462	53.043	.....	24.651	24.486	.....
July	54.150	52.630	.....	25.034	24.286	.....
August	52.912	52.171	.....	24.428	24.082	.....
September	53.295	52.440	.....	24.567	24.209	.....
October	55.490	53.340	.....	25.596	24.594	.....
November	55.635	55.719	.....	25.680	25.649	.....
December	54.428	54.905	.....	25.160	25.349	.....
Year	53.486	53.304	.....	24.670	24.592	.....

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

COPPER

Month	NEW YORK				London, Standard	
	Electrolytic		Lake		1911	1912
	1911	1912	1911	1912		
January	12.295	14.094	12.680	14.387	55.600	62.760
February	12.256	14.084	12.611	14.329	54.974	62.893
March	12.139	14.698	12.447	14.868	54.704	65.884
April	12.019	15.741	12.275	15.930	54.034	70.294
May	11.989	.....	12.214	.....	54.313	.....
June	12.385	.....	12.611	.....	56.365	.....
July	12.463	.....	12.720	.....	56.673	.....
August	12.405	.....	12.634	.....	56.266	.....
September	12.201	.....	12.508	.....	55.253	.....
October	12.189	.....	12.370	.....	55.170	.....
November	12.616	.....	12.769	.....	57.253	.....
December	13.552	.....	13.768	.....	62.068	.....
Year	12.376	.....	12.634	.....	55.973	.....

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

TIN AT NEW YORK

Month	1911	1912	Month	1911	1912
January	41.255	42.529	July	42.490	.....
February	41.614	42.962	August	43.319	.....
March	40.157	42.577	September	39.755	.....
April	42.185	43.923	October	41.185	.....
May	43.115	.....	November	43.125	.....
June	44.606	.....	December	44.655	.....
			Av. Year	42.281	.....

Prices are in cents per pound.

LEAD

Month	New York		St. Louis		London	
	1911	1912	1911	1912	1911	1912
January	4.483	4.435	4.334	4.327	13.009	15.619
February	4.440	4.026	4.266	3.946	13.043	15.738
March	4.394	4.073	4.238	4.046	13.122	15.997
April	4.412	4.200	4.262	4.118	12.889	16.331
May	4.373	.....	4.223	.....	12.984	.....
June	4.435	.....	4.292	.....	13.260	.....
July	4.499	.....	4.397	.....	13.530	.....
August	4.500	.....	4.406	.....	14.260	.....
September	4.485	.....	4.356	.....	14.744	.....
October	4.265	.....	4.139	.....	15.332	.....
November	4.298	.....	4.181	.....	15.821	.....
December	4.450	.....	4.332	.....	15.648	.....
Year	4.420	.....	4.286	.....	13.970	.....

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

SPELTER

Month	New York		St. Louis		London	
	1911	1912	1911	1912	1911	1912
January	5.452	6.442	5.302	6.292	23.887	26.642
February	5.518	6.499	5.368	6.349	23.276	26.661
March	5.563	6.626	5.413	6.476	23.016	26.048
April	5.399	6.633	5.249	6.483	23.743	25.644
May	5.348	.....	5.198	.....	24.375	.....
June	5.520	.....	5.370	.....	24.612	.....
July	5.695	.....	5.545	.....	25.006	.....
August	5.953	.....	5.803	.....	26.801	.....
September	5.869	.....	5.719	.....	27.750	.....
October	6.102	.....	5.951	.....	27.256	.....
November	6.380	.....	6.223	.....	26.795	.....
December	6.301	.....	6.151	.....	26.849	.....
Year	5.758	.....	5.608	.....	25.281	.....

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

PIG IRON AT PITTSBURG

Month	Bessemer		Basic		No. 2 Foundry	
	1911	1912	1911	1912	1911	1912
	January	\$15.90	\$15.12	\$14.40	\$13.32	\$14.75	$14.00
February	15.90	15.03	14.50	13.28	14.81	14.01
March	15.90	14.95	14.65	13.66	14.96	14.10
April	15.90	15.13	14.65	13.90	15.00	14.15
May	15.90	.....	14.30	.....	14.72	.....
June	15.90	.....	14.06	.....	14.56	.....
July	15.90	.....	14.03	.....	14.53	.....
August	15.90	.....	14.00	.....	14.47	.....
September	15.90	.....	13.57	.....	14.40	.....
October	15.43	.....	13.44	.....	14.34	.....
November	14.92	.....	13.30	.....	14.25	.....
December	15.15	.....	13.10	.....	13.90	.....
Year	\$15.72	.....	\$13.94	.....	\$14.49	.....

STOCK QUOTATIONS

COLO. SPRINGS May 14			SALT LAKE May 14		
Name of Comp.	Bid.		Name of Comp.	Bid.	
Acacia	05		Beck Tunnel	14	
Cripple Cr'k Con.	01		Black Jack	17	
C. K. & N.	16		Cedar Talisman	02	
Doctor Jack Pot.	05		Colorado Mining	17	
Elkton Con.	62		Columbus Con.	13	
El Paso	79		Crown Point	03	
Findlay	04		Daly-Judge	03	
Gold Dollar	10		Grand Central	25	
Gold Sovereign	10		Iron Blossom	74	
Isabella	12		Little Bell	40	
Jack Pot	05		Lower Mammoth	02	
Jennie Sample	05		Mason Valley	11.00	
Lexington	01		May Day	10	
Moon Anchor	01		Nevada Hills	1.80	
Old Gold	03		New York	04	
Mary McKinney	68		Prince Con	1.42	
Pharmacist	01		Silver King Coal'n	2.15	
Portland	89		Sioux Con	04	
Vindicator	73		Uncle Sam	19	
Work	01		Yankee	10	

TORONTO May 14

Name of Comp.	Bid	Name of Comp.	Bid
Coniagas	6.90	Hollinger	10.90
Hudson Bay	70.00	Imperial	03
Temiskaming	37	Pearl Lake	13
Wettlaufer-Lor	63	Porcu. Gold	36
Apex	03	Porcu. Tisdale	03
Central	15.56	Preston E. D.	05
Crown Chartered	22	Rea	45
Dobie	30	Standard	06
Dome Exten	30	Swastika	19
Foley O'Brien	20	West Dome	12

SAN FRANCISCO May 13

Name of Comp.	Clg.	Name of Comp.	Bid
COMSTOCK STOCKS			
Alta	17	Belmont	10.00
Belcher	90	Jim Butler	.60
Best & Belcher	06	MacNamara	.26
Caledonia	1.20	Midway	.61
Challenge Con.	13	Mont. Tonopah	3.23
Chollar	06	North Star	.22
Confidence	87	West End Con.	2.10
Con. Virginia	72	Atlanta	.25
Crown Point	65	Booth	.10
Gould & Curry	06	C.O.D. Con.	.11
Hale & Norcross	2.80	Comb. Frac.	.10
Mexican	55	Jumbo Extension	.42
Occidental	1.47	Pitts.-Silver Peak	1.35
Ophir	1.05	Silver Pick	.12
Overman	1.05	St. Ives	.30
Potosi	06	Tramp Con.	1.01
Savage	10	Burgonaut	2.25
Sierra Nevada	31	Bunker Hill	4.50
Union Con.	1.05	Cent. Eureka	.94
Yellow Jacket	92	So. Eureka	3.70

N. Y. EXCH. May 14		BOSTON EXCH. May 14	
Name of Comp.	Clg.	Name of Comp.	Clg.
Amalgamated	83 1/2	Adventure	8%
Am. Agri. Chem.	61 1/2	Ahmeek	310
Am. Sm. & Ref. com	86	Algoma	7 1/2
Am. Sm. & Ref. pf.	108 1/2	Allouez	44 1/2
Am. Sm. Sec. pf. B	88	Am. Zinc	30
Anacoda	42 1/2	Ariz. Com. cfts.	5 1/2
Batopilas Min.	12	Bonanza	.45
Bethlehem Steel pf.	72 1/2	Boston & Corbin	7
Chino	29 1/2	Butte & Balak	4
Federal M. & S. pf.	40	Calumet & Ariz.	73
Goldfield Con.	4	Calumet & Hecla	470
Great Nor. ore. ctf.	42 1/2	Centennial	24 1/2
Homestake	93	Con. Mercur	.06
Miami Copper	25 1/2	Copper Range	59 1/2
Nat'l Lead com.	57	Daly West	5 1/2
National Lead, pf.	109	East Butte	13 1/2
Nev. Consol.	22	Franklin	13
Pittsburg Coal, pf.	89	Granby	55
Ray Con.	19 1/2	Hancock	34 1/2
Republic I & S. com.	24 1/2	Hedley Gold	16 1/2
Republic I & S. pf.	80 1/2	Helvetia	1 1/2
Sloss Sheff. d. com.	52	Indiana	2