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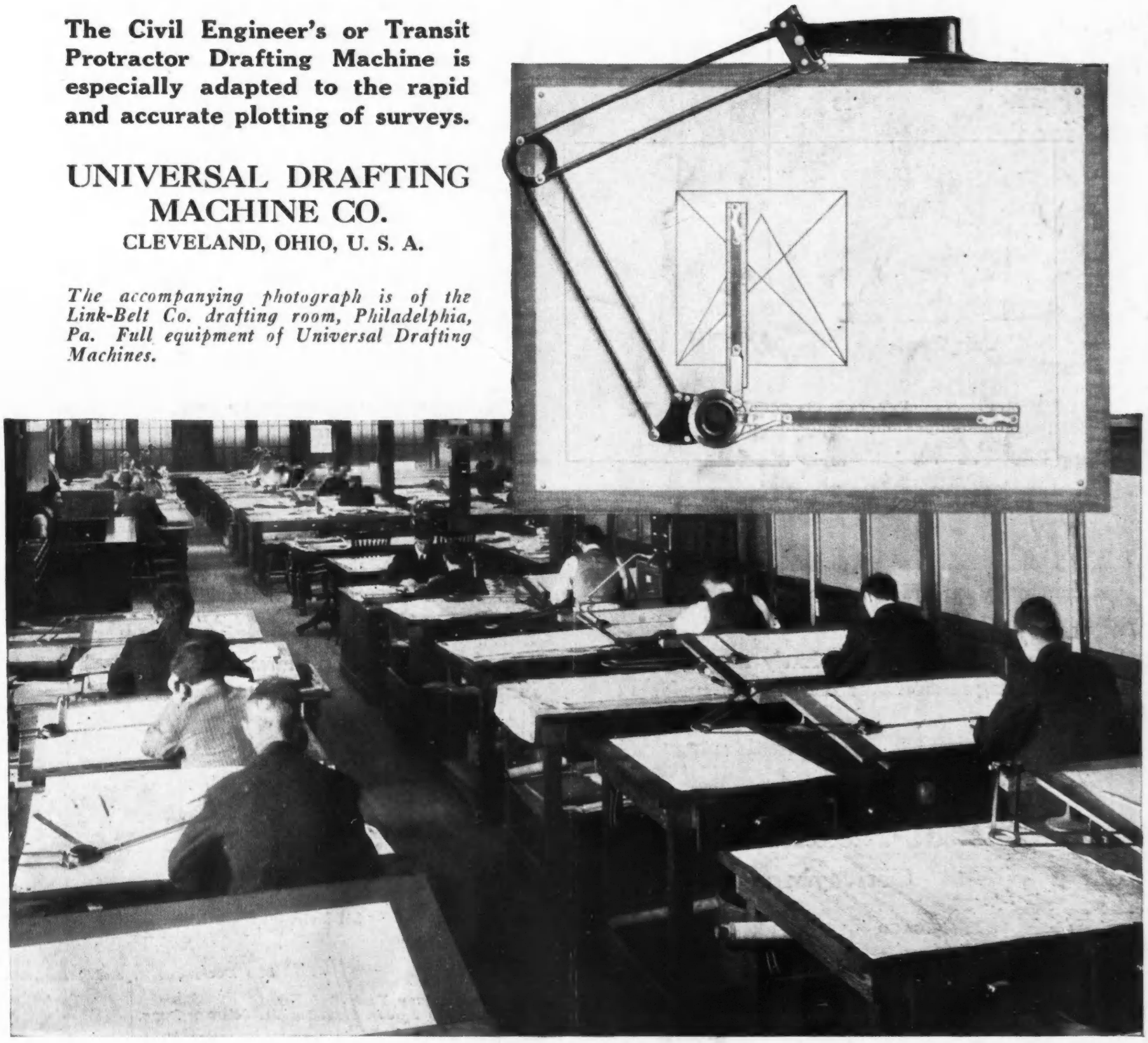

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BUNKER HILL PLANT FROM THE EAST

Lead Refining at the Bunker Hill Plant*

BY C. T. RICE

Refinery practice at the Bunker Hill plant is comprehensive, and both design and equipment merit more than passing notice. The paper presents descriptions of special apparatus, such as the Miller casting machine. Baghouse construction and operation, and the Cottrell system are described.

THE refined lead at the Bunker Hill & Sullivan plant goes by steel launders to one of the four 50-ton merchant kettles. From this it is sent by centrifugal pump to one of the two Miller casting machines, where it is molded into 100-lb. pigs that assay 99.989% lead, 0.002% antimony, 0.0005% copper, a trace of zinc, and 0.15 oz. silver per ton—arsenic and bismuth nil—being practically all of corroding grade. The casting machine is the invention of John F. Miller, of Salt Lake City, and has been in use at Trail for several years. Recently two machines were installed at the Port Pirie smeltery, Australia, but with these exceptions the Bunker Hill machine is the only one constructed since the invention was originally brought out, in British Columbia. As the machine casts under pressure, the 100-lb. pigs produced at the Bunker Hill plant vary only a few ounces in weight. With one of these machines, four men can cast and load into a railroad car 20 tons of pig lead in an hour. Other lead smelters have failed to show due appreciation for an admirable labor-saving device.

The Miller casting machine, Figs. 1 to 3, consists of a wheel rotating upon a horizontal axis that carries a series of water-jacketed molds under a fixed water-jacketed cover-plate, in which a diaphragm is placed. Through a slot in this diaphragm the stream of metal enters the mold. As there is a pipe, through which molten lead is constantly circulating, the pig is formed under pressure. The excess lead is returned from the diaphragm through a pipe to the kettle. The molten metal is thus prevented from solidifying when it comes in contact with the water-jacketed cover of the molds. The cooling of the mold by the jacket water causes the outside of the pig to solidify quickly, so that, as the mold moves ahead with the rotation of the shaft, the slot on the diaphragm becomes sealed and the excess lead returns to the kettle by a pipe, as shown in Fig. 2. Another empty mold then comes up in front of the slot, and another pig is immediately formed.

By the time the pigs have traveled far enough to drop out of the mold, the metal has not only solidified completely, but has also contracted sufficiently for the pig to fall out by its own weight on the truck placed under the machine to catch it. Guard rails, as shown in Fig. 3, hold the pigs in place. The uniformity with which the pigs are cast, when the machine has once become warm, is shown in Fig. 4. During the first half hour a little trouble will probably be experienced with the pump and the casting machine because of cold metal (the lead must be about 720° F. for good castings), and an occasional pig that is not full size will be formed. But as soon as the pipes have become thoroughly warmed, this trouble ceases.

The skim from the zincking kettles is taken to the silver refinery, where it is charged into graphite crucibles, and the zinc is distilled in Faber du Faur furnaces (Figs. 5 and 6), leaving the gold and silver behind in the lead. The zinc as it distills is caught in a condenser and tapped into molds from time to time, as shown in Fig. 6. The retort metal is poured into bars and sent to

*The fifth and last of a series of articles on the design and operation of the Bunker Hill & Sullivan smeltery and refinery which began in the July 20 issue.

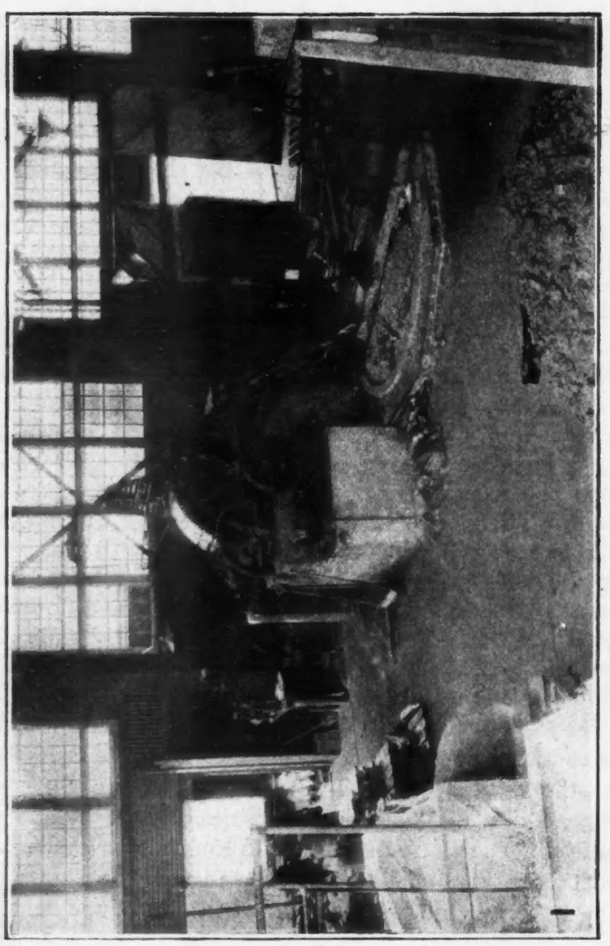


FIG. 1. MILLER CASTING MACHINE, LEAD PUMP, AND MERCHANT KETTLE

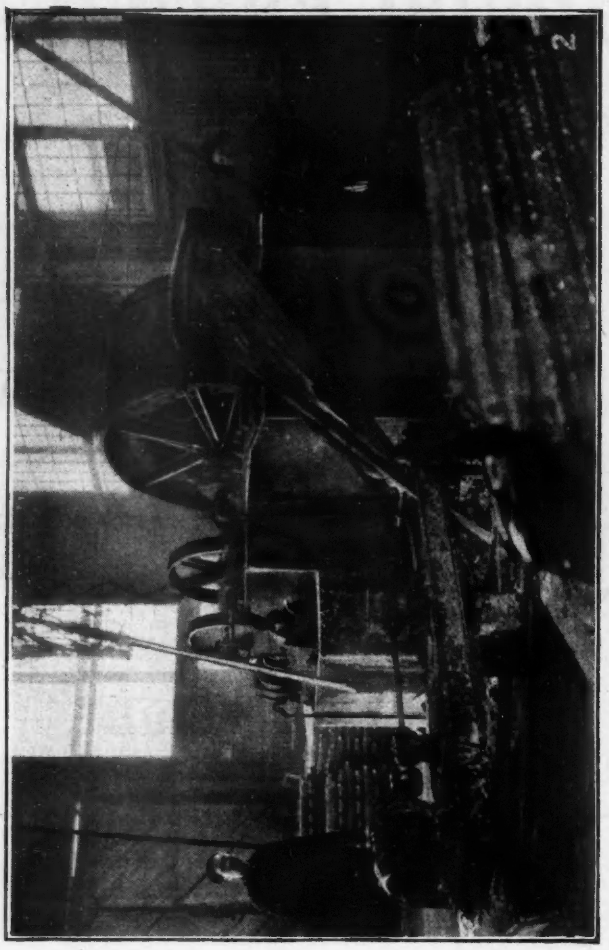


FIG. 2. RETURNING EXCESS LEAD FROM CASTING MACHINE

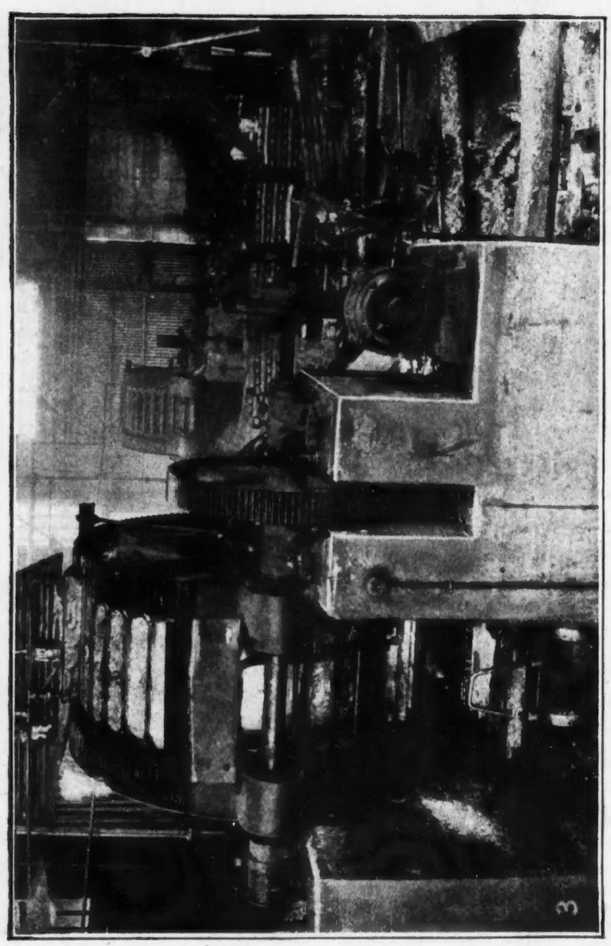


FIG. 3. DELIVERING THE MOLDED LEAD PIGS TO CAR UNDERNEATH

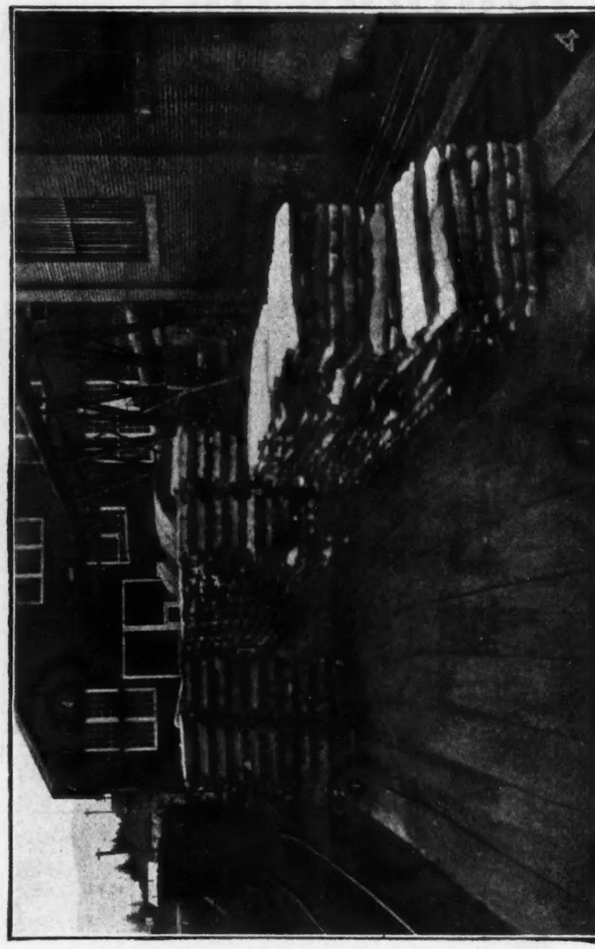
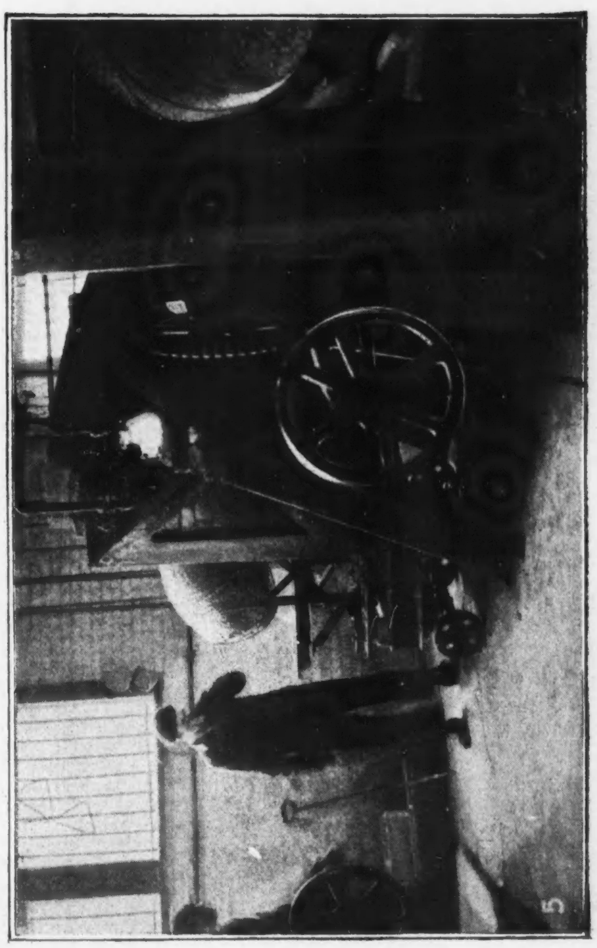
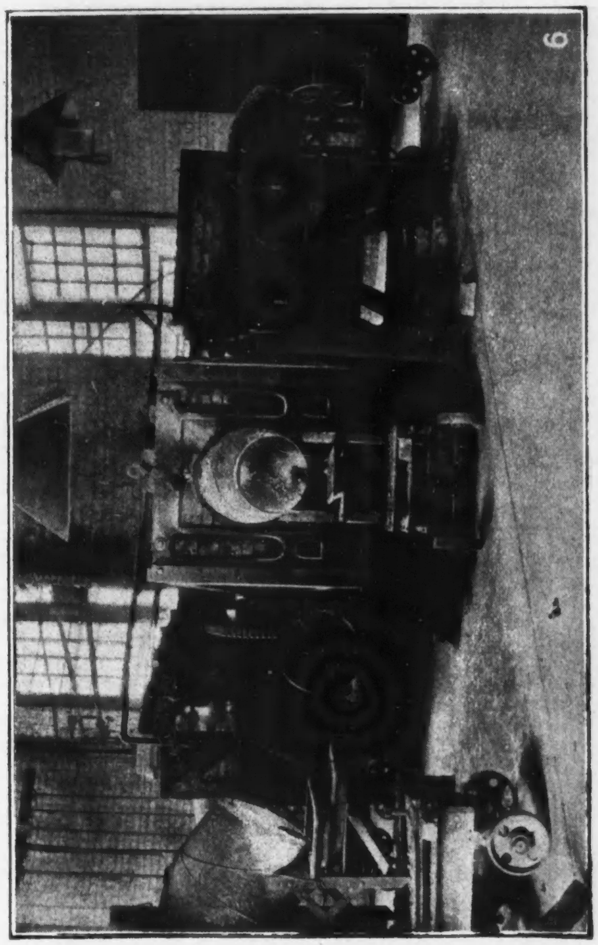
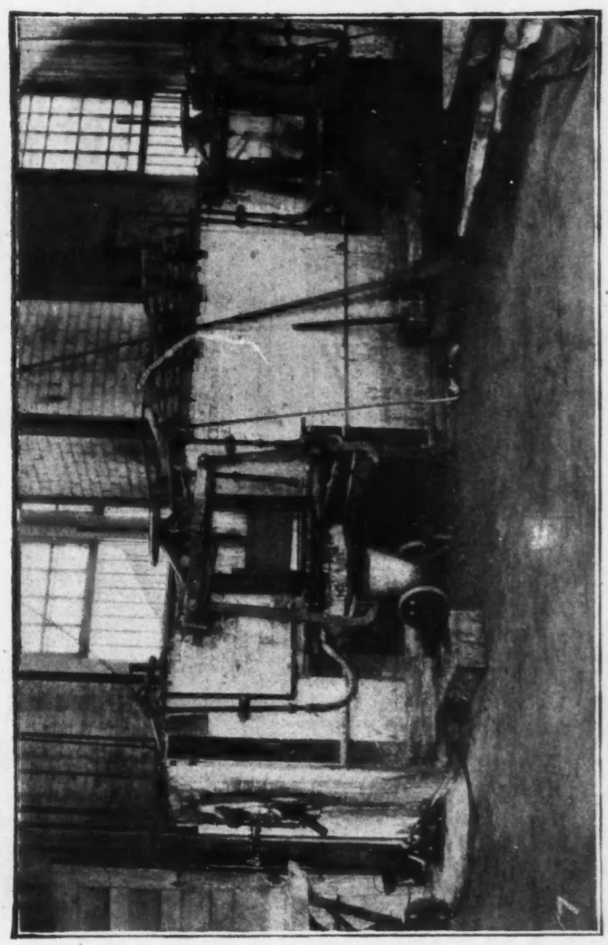


FIG. 4. LEAD PIGS READY FOR LOADING







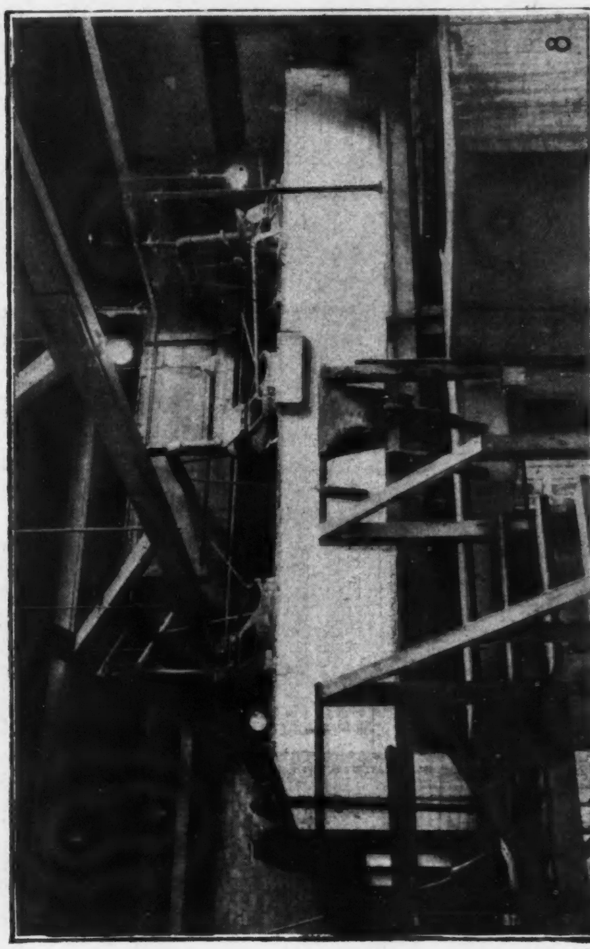
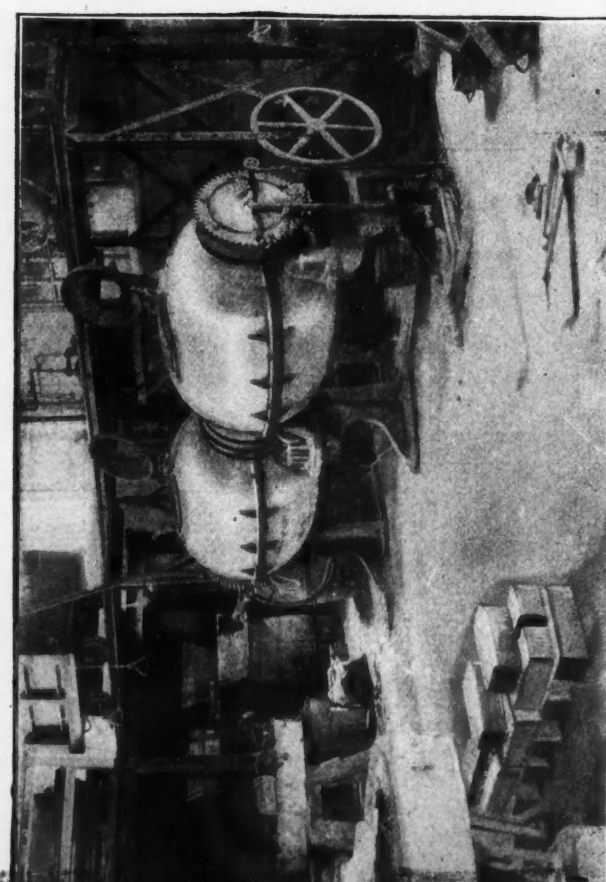
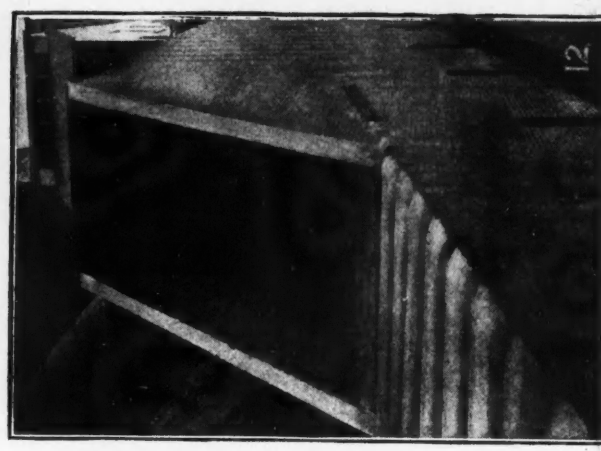


FIG. 5. TAPPING ZINC FROM FABER DU FAUR CONDENSER
FIG. 7. CUPEL FURNACE IN THE SILVER REFINERY

FIG. 6. FABER DU FAUR FURNACES IN THE REFINERY
FIG. 8. PARTING KETTLES IN THE SILVER REFINERY





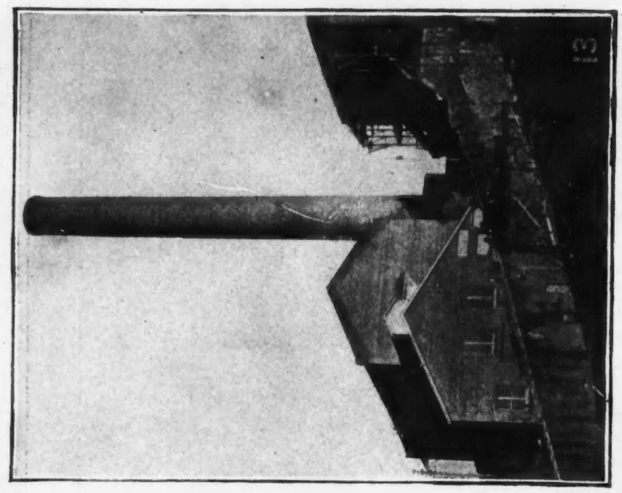


FIG. 9. LEAD-LINED PRECIPITATE VATS IN SILVER REFINERY
FIG. 11. DOUBLE MONARCH MELTING FURNACE IN SILVER REFINERY

FIG. 10. SILVER SLUDGE FILTER CAR
FIG. 12. MAIN FLUE UNDER ROASTER FLUE
FIG. 13. STACK, BAGHOUSE AND COTTRELL TREATER

the cupel furnace (Fig. 7) where the lead is oxidized, and the litharge tapped off as necessary, and returned to the softening furnaces for re-treatment.

After the lead has been removed, the doré metal is poured into flat bars. These bars are parted, by the sulphuric acid method, in iron kettles, shown in Fig. 8, 65° Bé. acid being used. The silver sulphate obtained is siphoned off and sent to the lead-lined precipitation tanks (Fig. 9). The gold sludge, after being collected and washed, is dried, charged into a graphite crucible, melted in an oil-fired furnace, and then poured into cast-iron molds. The lead-lined tanks contain copper bars, and the silver is obtained by boiling the sulphate solution and precipitating the silver on the copper as a sludge, which falls to the bottom of the tank. The copper-sulphate solution which results is piped to the sulphate plant, where the liquid is evaporated and the copper sulphate obtained by double crystallization in almost pure form. The mother liquor is then boiled to strength, and returned to the acid storage tank for re-use in the silver refinery.

The cement silver obtained by precipitation from the sulphate solution, after being washed, is filtered in a canvas bag in the car (Fig. 10), and then is charged into a double Monarch melting furnace (Fig. 11), where it is melted and poured into silver bars.

Details of Flue Construction

The gases from the blast furnaces are taken by downcomers to a brick flue which goes to the baghouse fans and the stack. To facilitate cleaning, this first brick flue is made with a hopper bottom. As the concrete retaining wall above the blast-furnace building is made to form one of the walls of the flue by lining it with four inches of brickwork, the hopper bottom slopes only toward the front, where gates are placed at frequent intervals. The main flue itself is rectangular in section and built with a flat bottom, as it is cleaned through manholes in the sides, with dry walls of brick that may be opened easily.

The feature of the brick flues at the Bunker Hill & Sullivan smeltery is that they are roofed over with transverse jack arches carried on I-beams. These jack arches are formed of special hollow radial tiling, capped with a layer of a cement grout from ¾ to 1 in. thick. The plant had been running nine months at the time the notes for this article were obtained, and the roof had stood admirably.

Gases from the balloon flue which serves the roaster building join the main flue that comes up from the blast-furnace flue and are led, in a brick flue placed on top of the main flue, to the Cottrell plant. Both flues are roofed over with hollow-tile transverse jack arches. At present the gases from the various refining furnaces are taken by a steel-pipe flue to the main brick duct leading up from the blast-furnace flue. But this will soon be changed so that the gases from the various refining furnaces and kettles are led by special duct to the flue that takes the roaster gases to the Cottrell treaters.

One of the features of this smeltery is the placing of the baghouse and the Cottrell plant near one another at the base of the stack (Fig. 13) so that both can be operated by two men, one in the power house and the other attending the bags. The gases from the blast furnaces go to the baghouse, as they vary too much in amount and composition to be handled efficiently by the Cottrell treaters. The Cottrell system requires constant temperature, velocity, and composition of the gases treated, in order that efficient recovery of fume and dust may be made.

The baghouse, which is 130 ft. long by 56 ft. wide and contains 1200 bags 18 in. in diameter and 30 ft. long, is divided into three main sections of 400 bags each. Under the nipple floor each of these main sections is divided into four smaller compartments to facilitate cleaning, an independent damper permitting each section to be shut off from the main flue while it is being cleaned. The gases are taken from the main flue and sent to the baghouse by one of two Buffalo Forge No. 19 special conoidal fans. Each fan is driven by its own 100-hp. motor and has a capacity of 160,000 cu.ft. per minute. The fans are placed in the same power house as the rectifiers of the Cottrell plant.

The bags are shaken mechanically by a system of levers from a line shaft driven by a 10-hp. motor and are hung in rows of 25. There are 16 rows of bags in each of the three sections into which the upper part of the baghouse is divided, and each of these sections is served by two shaker shafts which operate eight rows of 25 bags each. The bags are suspended by rods from I-beam carriers that run lengthwise over the rows, and the individual bags fasten into the bottom rings of these rods. The bags in each row are wired together at the carrier rings; and at the far end this wire fastens into a rod that passes through a stuffing box in the back wall of the baghouse. This stuffing box consists simply of a 2-in. pipe babbitted down so as to fit the rod snugly. On the outside of the wall, each of these shaker rods is fastened to a strong spring, so that the bags are shaken in tension. At the other end a similar stuffing box is used to carry the rod that connects with the eccentric rod on the shaft, and each shaker shaft is equipped with a clutch.

The cleaner sections below the thimble floor are 14½ ft. high, with a flat brick-paved floor. The dust caught is sintered and removed in cars. It is taken later by railroad car to one of the secondary bins to be returned to the blast furnaces. As this sintered material assays as high as 76% lead and is porous, it aids greatly in loosening the charge in the blast furnaces. About 125 tons of fine flue dust a month is caught at the baghouse. The gases are kept at a temperature of about 180° F. as they enter, and practically no trouble is experienced with burning of the bags. There is little arsenic in the ore; and whenever the temperature of the blast-furnace gases rises above 200° F., cold air is added at the intake flue.

Cottrell Treater Tubes

The treater house of the Cottrell plant is novel in construction, being made of bricks, kept low, and designed with down-draft flow of the gases. The stack draft pulls the gases up through a flue that runs longitudinally over the top of the treater house, and the gases are then sucked down through dampers into each of the four sections. In each unit are 64 treater pipes 12 in. in diameter, arranged in rows of eight each. These pipes are connected by plates in groups of four; and the shaking of the pipes is effected by hammers carried on a shaft running through the center of the section, and near the bottom. The dust which accumulates upon the pipes is removed where the hammers strike. In the center of each treater pipe is suspended a No. 10 jack chain with a 20-lb. weight at its bottom. The chains pass through a grid at the bottom, so as to keep them properly centered in the different precipitation pipes, to prevent their developing a swing after they have been shaken to remove dust, and to obviate oscillations due to other causes. The chains hang from bus bars that run longitudinally over the different rows of pipes in the upper header of

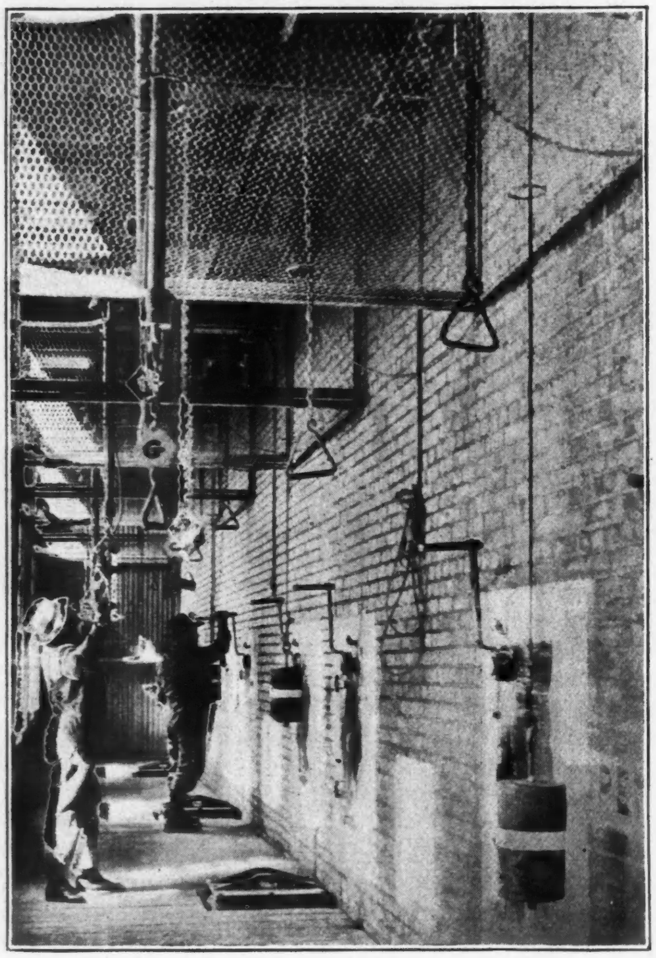


FIG. 14. OPERATING FLOOR—COTTRELL TREATER

the section, which connects through a damper with the main flue at the top of the treater building. These bus bars are carefully insulated from the building. The dust precipitated from the gases accumulates on the chains as well as on the inside of the pipes. A device that jars the chains is used to remove the dust. This is placed in the upper header of the section and arranged so that it can be operated from the outside of the building.

Temperature Uniformity Insured

In a treater in which discharge is by down-takes from the top of the section, the gases, as they issue from the different pipes, curl around and rise to the top under the pull of the stack draft. Consequently the air in the dust chamber below the pipes is clear and free from sulphur smoke, and the operation of the different pipes can be readily inspected. As the gases come in and go out at the top of each section (for the two down-takes lead off from the side immediately under the top header), the temperature is kept more uniform throughout the section than if the gases were drawn off directly at the bottom. The brick construction of the building also helps considerably in keeping an even temperature throughout the treater—an important aid to efficient operation. It was, however, not with this idea that brick was used, but because it was difficult at the time to get the steel needed for the construction of the treater building. By leading the gases off from the top of each section a better mechanical settling of the flue dust is obtained than if they were taken off at the bottom, for, in such a treater as this, nearly one-half of the fume recovered is due to mechanical settlement.

The dust-collecting chamber at the bottom of the treater is made of ample dimensions and has gates on one side for the removal of precipitated dust. Access to the treater sections is also provided through light steel explosion doors on the sides of the different sections. About 2½ tons of dust, assaying 60% lead, is caught in the treater each day.

Particular attention has been given, in designing this

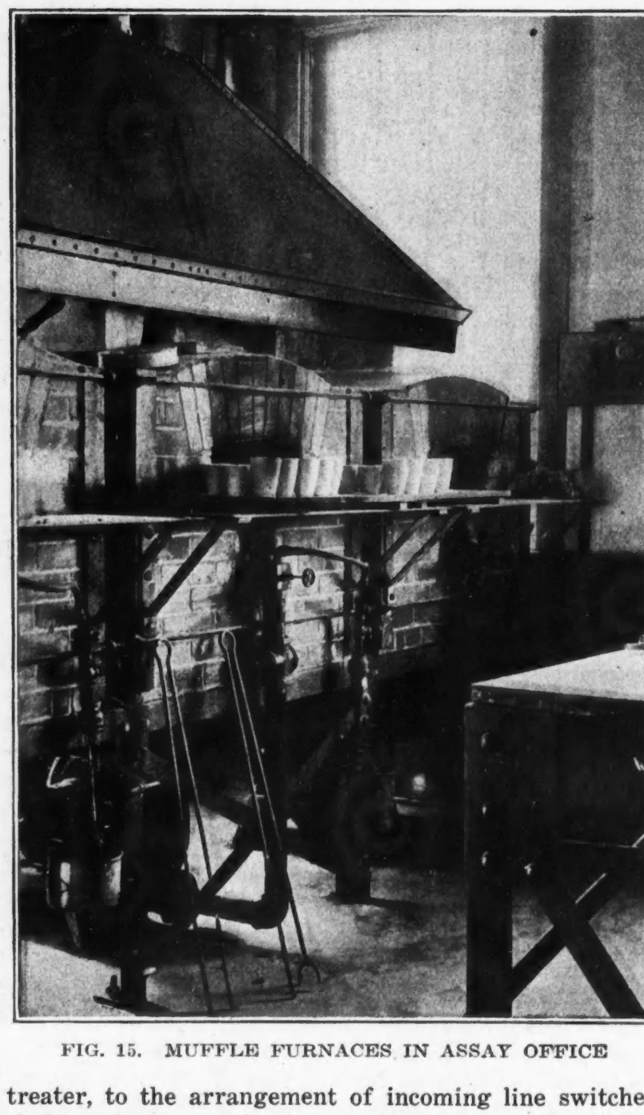


FIG. 15. MUFFLE FURNACES IN ASSAY OFFICE

treater, to the arrangement of incoming line switches, shaking devices, and other mechanisms, so that everything can be operated from one platform level, (Fig. 14). The incoming lines are carried on poles outside the treater house, and each section is fed directly from one of these poles to its switch, which is placed on the extreme outside of the operating platform. Consequently, by throwing the proper switch, each section can be cut out of electrical connection with the rest of the treater, and can be inspected from top to bottom without danger of coming in contact with high-tension current. Everything about the plant is grounded so as to prevent a short-circuiting in the event of faulty insulation; and three special "grounds" have been buried deep in moist soil to insure ample protection.

The power plant for the Cottrell treater is placed in the same building as the fans which feed the blast-furnace gases to the baghouse, making it possible for one man to attend to both installations. Three rectifier units are provided in the power house; but the foundations for two more are already constructed, so that additional equipment can be easily installed should it become desirable to increase the treater capacity. The mechanical rectifiers are of the Western Precipitation Co.'s K1 type. The 25-hp. 440-volt, 60-cycle induction motor of each rectifier unit drives a 15-kw. alternator at 1800 r.p.m., the current going to a transformer at 220 volts. At the transformer the pressure is boosted to a maximum of 100,000 volts (the voltage actually used depends upon treater conditions, being generally about 60,000), and

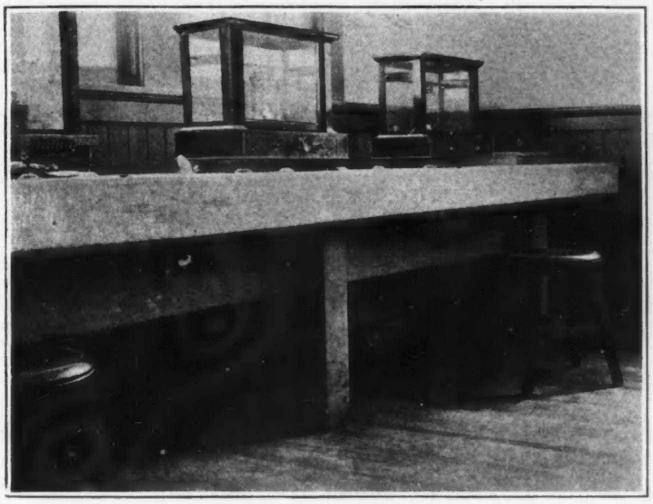


FIG. 16. CONCRETE ASSAY BALANCE TABLE

then goes to the rectifier of the unit. Only the positive waves go to the bus wires.

Five bus wires are carried at the top of the room, one for each rectifier unit; of which three are connected up to the three rectifiers at present installed. Two overhead switches are suspended below the bus wires, each switch consisting of a central knife surrounded with five poles. Each outside pole connects with a bus wire, and the central pole of each switch connects with the lead that goes to the feed wires of two treater sections. Thus, by moving the knife switch, any one of the rectifiers can be connected with either pair of treater sections, and a greater flexibility of operation is obtainable than in earlier Cottrell installations. At present only two rectifiers are in operation at a time, the third being an emergency machine.

Stack Design and Accessory Equipment

From the Cottrell treaters and the baghouse the gases go to a stack, 200 ft. high, with an inside diameter of 16 ft. at the bottom, and 15 ft. at the top, built by the Alphonse Custodis Chimney Construction Co., of New York. The bottom 30 ft. is lined with a radial-tile core wall, the remainder being unlined. The top of the stack is 315 ft. higher than the feeder floor of the blast furnaces and 239 ft. higher than the flues of the roaster building.

A commodious and well-arranged assay office is provided. The equipment includes oil-fired furnaces (Fig. 15) having special insulating construction to keep the muffles even in temperature, chemical balances with chain vernier riders, electric hot plates, the latest grinding equipment, and the best of gold and silver balances, carried on a concrete table (Fig. 16), on foundations independent of the building. A modern change house is equipped with showers and individual racks for the clothes of the men who see fit to change at the plant.

A fine office building provides ample accommodation for the engineering and office force of the smeltery; and nearby on the flat to the east of the town site, where excellent houses are provided for the employees. The town site has graded streets which are surfaced with rock and mill tailings; and a septic tank system of sewage disposal is provided. At present most of the employees live at Kellogg, 1½ miles away. Many, if not most of them, own their own homes.

Iron Manufacture in South Africa

The iron-smelting works which are being erected near Pretoria are nearing completion, and smelting operations will probably begin soon, states the *South African Journal of Industries*. The enterprise owes its inception to the commendable public spirit of the mayor and corporation of the capital, as they last year commissioned Professor Stanley, of the School of Mines and Technology, and Dr. Wagner, the well-known South African geologist, to report upon the feasibility of establishing smelting works in the locality, to treat local ores. The report of these experts being favorable, C. F. Delfos, who had previously obtained a concession from the municipality, formed a local company, the Pretoria Iron Mines, Ltd.; and manufacture of pig iron in Pretoria may be looked for in the near future. Great activity prevails at the new plant. The Railway Administration is constructing a branch line about 1¾ miles long from the Pretoria North line to the works. The earthworks are almost complete, and the rails will be laid to synchronize as nearly as possible with the beginning of operations. The equipment comprises a 50-foot blast furnace, lined with firebricks from the Olifantsfontein works, capable of producing between 10 and 15 tons of pig iron per diem; a substantial block of brick buildings, including engine house, storage bins for lime, coke, and graded ores; business offices, and a well-equipped laboratory. Quarrying has been in progress for some time, and a stack of ore of several thousand tons is already awaiting treatment.

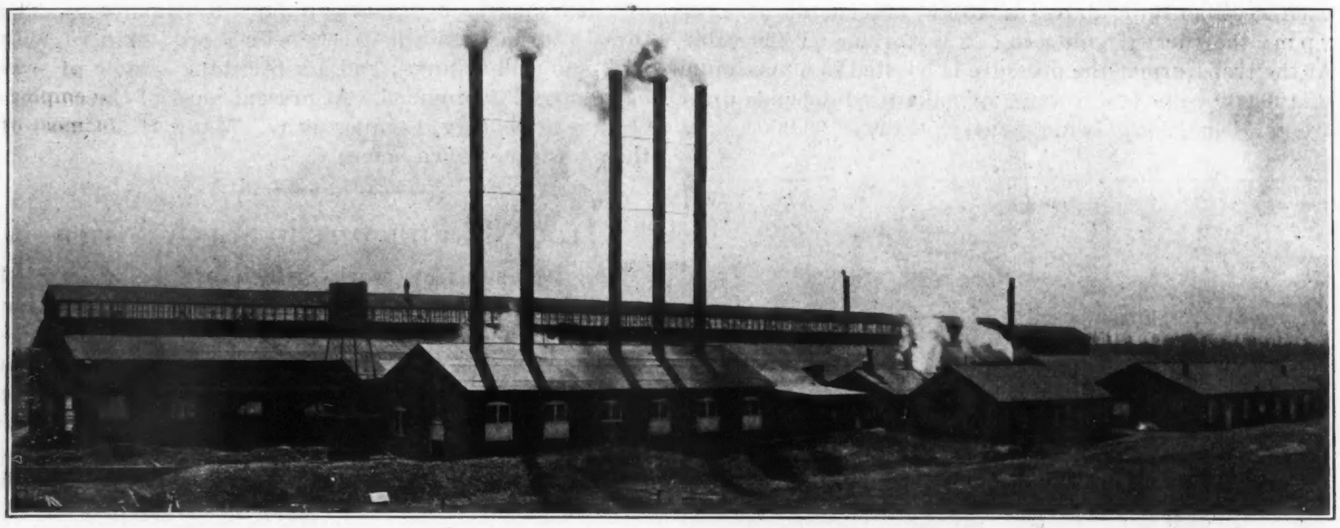
It may be of interest to state that the company purposes drawing its supplies of coke from Dundee (Natal); and limestone, for the present, will be obtained from the Zwaartkop farm, south of Pretoria. The material to be smelted will consist of a mixture of siliceous Time Ball Hill and clay-band ore occurring in the lower portion of the Pretoria series. The progress of the company will be watched with considerable interest, especially in the capital, and the enterprise is pregnant with important industrial possibilities.

American Zinc Products Co.'s Rolling Mill

BY J. H. DIETZ*

THE American Zinc Products Co. has completed a modern zinc-rolling mill at Greencastle, Ind., having a daily capacity of from 1000 to 1500 tons of zinc plates and sheets. The company is an Ohio corporation, capitalized at $1,000 000, D. W. Kerr, of Warren, Ohio, being president, and F. W. Stillwagon, of Warren, Ohio, vice president. The plant is situated on the Pennsylvania R.R., having shipping connections also with the main line of the Big Four and Monon railroads.

The equipment consists of furnace and mill building, power plant, storeroom, warehouse, blacksmith and machine shops, tin shop, carpenter shop and offices. The main building contains the refining furnace into which the spelter is charged. This furnace has a capacity of 100 tons of molten zinc and is heated by a coal furnace. The metal is melted by direct contact of the combustion flame on the surface. The furnace is provided with charging doors and provisions for skimming dross and tapping settled lead. The metal is dipped from this furnace and molded into flat slabs on a motor-driven revolving mold table.



ROLLING-MILL PLANT OF THE AMERICAN ZINC PRODUCTS CO. AT GREENCASTLE, INDIANA

The molded slabs are loaded on steel cars and stored in a reheating furnace, which is maintained at the constant temperature required for rolling. The slabs are removed from the discharge end of this furnace and go direct to the 24-in. roughing mills. The sheets from these mills are sheared to the exact weight required for the finished sheets to be rolled, and are stacked in packs on steel cars, which then go to the pack annealing furnaces. These furnaces are also maintained at the constant temperature required for finish rolling. All furnaces are equipped with recording pyrometers for the guidance of firemen.

The mill contains finishing mills, 24 x 72 in. in size, with automatic, motor-operated lifting tables. The packs from the pack-annealing furnace come to these mills on transfer cars and are rolled into finished sheets of any size and gage required. The finished sheets are trimmed in packs on rotary slitting shears; and, after sorting and inspection in the shipping department, are packed in standard steel drums ready for shipment. The shipping room contains several Kron automatic dial scales, and is served by two switch tracks in the building. Provision has been made for the subsequent addition of more finishing mills, the power plant and finishing roll engine installed being of sufficient capacity to handle the additional mills.

The finishing mills and the roughing mills are pulled by independent direct-geared Corliss engines, the roughers having sufficient capacity for the manufacture of heavy zinc plates up to 1 in. thick, in addition to supplying the roughed sheets for the finishing mills.

The entire main building and house track are served by a 10-ton electric crane, which is also used for returning scrap cars from all shears to the slab furnace. The blacksmith and machine shops are completely equipped for all repair work. The tin shop is used for the manufacture of the steel drums used in shipping. The carpenter shop is kept busy in making boxes for the shipment of the heavier gage sheets and plates.

The power plant equipment consists of ten 150-hp. high-pressure horizontal tubular boilers and two 150-kw. turbine generators. Either generator is capable of pulling the electric load. All the machinery except the rolls is driven by direct-connected motors. The mill is provided with an indirect blower system for heating, cooling, and ventilation. The ventilating system includes a large Sirocco fan and the usual steam coils heated by exhaust steam. Provision is made for recirculation in the winter and a by-pass for cold air from the outside in the summer.

The buildings are principally of brick and steel construction, with ample provision for lighting and ventilation. The interior of the main building is painted white. The floors are of 3-in. yellow pine, waterproofed and covered with hardwood matched flooring. The mill is equipped with circulating cold-water system and with sanitary drinking fountains, and has every conveni-

*Secretary, American Zinc Products Co., Greencastle, Indiana.

ence for the comfort of the employees. The plant has been in continuous operation 24 hours per day since the middle of May, and is operating close to capacity. Practically all the operators are being trained from workmen secured locally.

Tungsten in Manganese Ore

By William R. Jones*

Prof. Walter S. Palmer's interesting article entitled "The Occurrence of Tungsten in Manganese Ore," which appeared in the *Journal* of Apr. 27, 1918, page 780, has caused me to decide to submit the following notes, as they may give Professor Palmer a suggestion which may enable him to trace the source of the tungsten in the manganese ore analyzed by him.

In moist tropical countries such as lower Burma, Siam, and the Malay States, it is common to find wolframite so weathered that only deposits of the oxides and hydroxides of manganese and of iron, or of tungstic acid, remain. In some cases what it left after the weathering of the wolframite is almost a pure manganese mineral; in others it is limonite, and in still others no manganese or iron mineral is left, but only the greenish-yellow mineral tungstite, almost as pure as that obtained in the laboratory. Other products of the weathering of wolframite are also known.

Whether the wolframite is replaced by manganese minerals, by iron minerals, or by tungstite appears to depend on the following:

1. *The original composition of the wolframite.* The wolframite as found in the countries named is almost invariably composed of the hübnerite[1] and ferberite molecules mixed in varying proportions, and I do not know of any case where a variety of wolframite from these places has been found not to contain both manganese and iron.

2. *The composition of the water acting on the wolframite.* The water generally has an acid reaction due to decaying vegetation and the decomposition of unstable sulphides and arsenides. Occasionally it has an alkaline reaction from the alteration of feldspar. The presence of manganese or iron in solution in the water before it attacks the wolframite appears also to be of importance in determining how the wolframite will weather. The residue most commonly left by the weathering of wolframite in these countries is limonite, but lumps of manganite are also fairly common. The tungstite generally occurs as a bloom on the wolframite, and in cleavage planes and minute fractures.

So unstable is wolframite in these countries that at the foot of hills in which there are veins of that mineral which are being worked, it is the exception to find any wolframite in the alluvial deposits, although they are common in the detrital deposits. Careful prospecting in such places has shown that, although tin ore may be present in the alluvial deposits, and obviously derived from the lodes carrying wolframite and tin ore, the wolframite has been removed chemically owing to its good cleavage exposing new surfaces, and to its instability. This is strikingly shown in an alluvial deposit where tin ore is being recovered carrying less than 1% of wolframite in the concentrates, although occasionally rounded pebbles of quartz are found carrying wolframite protected from decomposition by a covering of silica.

In conclusion, there is given below the analysis of a manganese deposit taken by me from a wolframite lode occurring in decomposed phyllite. The manganese deposit occurred as a patch in the lode and gave place on both sides to slightly altered wolframite assaying over 70% WO_3. The analysis, made by H. R. Pepper, was as follows: MnO, 90.38; WO_3, 4.2; Al_2O_3, 4; and SiO_2, 1.80 per cent.

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[[1]Dana gives wolframite as $(FeMn)WO_4$; hübnerite as $MnWO_4$; and ferberite as $FeWO_4$. But it is not therefore to be assumed that wolframite is a mixture of hübnerite and ferberite —Editor.]

Wallaroo & Moonta Co.'s Report

The report of the Wallaroo & Moonta Mining and Smelting Co., Ltd., of South Australia, for the six months ended June 30, 1918, shows that the Wallaroo mines produced 29,586 tons of 8.69% copper ore, and the Moonta mines 4396 tons, carrying 13.91%, in addition to 404 tons of precipitate averaging 68.81%. Copper produced at the smelting works from ore and precipitate was 3804 tons, in addition to 864 tons recovered from Mount Cuthbert blister. The acid plant produced 3441 tons of sulphuric acid during the period. The cementation treatment of slime was continued for two shifts per day at the Moonta property, where tailing heaps are leached in rotation during night shifts and week-ends.

Owing to the difficulties encountered in an attempt to secure from Australian manufacturers the necessary electric motors, to drive the new installation of conveying machinery, the work was undertaken at the mine workshops. Fourteen high-efficiency motors, designed for a normal load varying from 5 to 25 hp., with all the necessary control apparatus, have been completed. A 40-kw. generator has also been constructed; and all the different machines have successfully passed the necessary tests.

The statement of assets over liabilities shows a balance of £390,860, in connection with which no provision has been made with respect to future liability under the Wartime Profits Tax. This liability is indefinite, and the 1915-1916 profits were taxed to the extent of £37,-936 10s. 8d., an amount which was considered excessive and in connection with which an objection was lodged.

Iron Ore in Brazil

An outlet for the iron-ore region around Itabira, Brazil, will be afforded by the Victoria & Minas Ry., when complete, according to the Bureau of Foreign and Domestic Commerce at Washington. This road runs inland from the port of Victoria across the State of Espírito Santo and to Cachoeira Escura, in the State of Minas Geraes. The line is being built and operated under Federal concessions by an English concern, which also owns iron-ore deposits at Itabira. The gage of the road is one meter, and 366 miles were open and 115.5 miles under construction in December, 1913.

Today is an opportune time to send a check for the Comfort Fund of the 27th Engineers.

The Porphyry Coppers, Part I—Resources And Achievements

By L. H. Goodwin*

The relatively rapid rise of a group of mines generally designated as "porphyry coppers" to a position of dominating importance in the copper industry of this country may be accepted as the forerunner of parallel development where similar deposits are found, as it is probable that the future world supply of the metal will come largely from such low-grade producers. A résumé of the commercial results achieved by this group of mines, considered from the investor's point of view, should be of present interest because of the unprecedented demand for copper.

SIX large porphyry mines have been brought up to capacity in this country. Half of these are steam-shovel operations, and the remainder underground mines. The Utah Copper mine, at Bingham Canyon, Utah, the pioneer of development among the "porphyries," was originally planned to be worked by underground methods, and considerable development, beginning in 1903, was done preparatory to the introduction of the caving system; but, as a result of further prospecting, it was decided that the orebody could be more economically handled by steam-shovel operation. Stripping of overburden was begun in 1906, and, after that, no underground work was done except incidentally as a means of keeping the concentrators at capacity until they could be supplied by the shovels alone. Milling was begun at the large plant at Garfield in September, 1906. The Nevada Consolidated mine, at Ely, Nev., was developed soon after the Utah property, and milling was begun in 1908. Ore is still being mined mostly by steam shovels, but underground work has always furnished a small proportion of the total production. The Chino deposit at Santa Rita, N. M., was the last of the steam-shovel porphyries to be developed, and milling began late in 1911.

Work on the two older underground porphyry mines, both in Arizona—the Miami, near Globe, and Ray Consolidated, about 20 miles south at Ray—was begun in 1907, and the mills of both companies began operations in April, 1911. A somewhat longer period was required to bring these mines to the producing stage, because of slower underground development. The Inspiration mine, which is adjacent to the Miami, was the last to be developed; its mill was started in July, 1915.

A factor of the greatest importance to investors is the extent to which these mines permit a reliable estimate of the tonnage and grade of ore reserves which may be thoroughly prospected by drilling, thus eliminating one of the greatest hazards of mining practice. This feature has led many to refer to this type of mine as a "manufacturing proposition," which is an apt analogy, because such mines are engaged in producing a commodity under stable conditions of supply of raw material and demand for their product. The fact that a mine is a wasting asset, whereas the manufacturing business is one in which every successful transaction is of benefit in establishing prestige and good-will, which brings new business, makes it necessary for the investor to differentiate between the two industries. The term "manufacturing proposition" appears to have a valid significance when used to distinguish between two mines which have their reserves blocked out, one, say, for two years and the other for a generation in advance.

In order to present the data of ore reserves as concisely as possible, Table I has been prepared to show

TABLE I. ORE ACCOUNTS AND INDICATED LIFE OF OPERATIONS

	Utah Copper		Nevada Consolidated		Chino		Miami		Ray Consolidated		Inspiration	
	Tonnage	Grade	Tonnage	Grade	Tonnage	Grade	Tonnage	Grade	Tonnage	Grade	Tonnage	Grade
Recoverable ore developed before mill started	120,000,000	1.77	30,073,000	1.99	54,970,646	2.34	18,232,000	2.58	75,096,000	2.17	74,950,000	1.70
Further ore developed to Dec. 31, 1917	318,972,700	1.26	65,793,377	1.40	54,718,717	1.03	4,999,542	1.38	31,499,122	1.57	....	....
Total recoverable ore developed to Dec. 31, 1917	438,972,700	1.40	95,866,377	1.60	109,689,363	1.68	23,231,542	2.34	106,595,122	1.99	74,950,000	1.70
Ore mined to Dec. 31, 1917	67,220,700	1.43	25,841,055	1.63	15,198,427	1.90	8,471,542	2.19	16,782,600	1.68	9,268,622	1.48
Recoverable developed ore remaining	371,752,000	1.39	70,025,322	1.58	94,490,936	1.65	14,760,000	2.40	89,812,522	2.05	65,681,378	1.73
Developed ore unrecoverable by present mining or milling equipment:												
In detached orebodies	....	....	864,199	2.41	....	....	....	....	....	....	....	....
Carbonate ore used as flux	....	....	174,648	2.50	....	....	....	....	....	....	....	....
Mixed carbonate and sulphide ore	....	....	....	....	1,064,907	1.81	....	....	....	....	....	....
Low-grade sulphide ore	....	....	....	....	....	....	28,000,000	1.06	....	....	....	....
Mixed oxide-sulphide ore	....	....	....	....	....	....	6,000,000	2.00	....	....	4,732,700	1.31
Oxide ore	....	....	....	....	....	....	....	....	....	....	17,460,300	1.31
Total developed ore of all classes remaining	371,752,000	1.39	71,064,169	1.67	95,555,843	1.66	48,760,000	1.55	89,812,522	2.05	87,874,378	1.63
Ore milled during 1917, tons	12,542,000	....	4,064,095	....	3,608,100	....	1,640,206	....	3,560,900	....	5,316,350(a)	....
	Years		Years		Years		Years		Years		Years	
Life of mine as indicated by applying the 1917 rate of mining to:												
Recoverable developed ore remaining	30		17		26		9		25		12	
Total developed ore of all classes remaining	30		18		27		30		25		16	

(a) Ore milled during 1916.

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the tonnage in reserve at various stages of each mine's history, as presented in the annual reports, from which the indicated life of each property is estimated. In all cases the total reserves are given, and the distinction between fully or partly developed ore is not indicated. It will be seen that all the mines have sufficient reserves to last several years, and that the more fortunate are assured a long life. It is probable, moreover, that not one of them has fully exhausted the possibilities of further development.

A satisfactory review of the financial condition of these mines is possible because the directorates of all of them have been frank with their stockholders, and have submitted excellent reports. This matter cannot be judged solely by a consideration of the money that was originally invested in the mines, as compared with that which has been taken from them in the form of dividends. A considerable proportion of earnings has been invested in plant extensions, which will not only increase the annual earning capacity of the mine, but also, theoretically at least, increase its total recoverable value as a result of quicker redemption. Broadly speaking, the gross earnings of a mining company are usually subject to only two charges—operating and overhead expenses. The item of fixed charges does not, as a rule, amount to an appreciable expense in the accounts of successful mining companies. After the deduction of these charges, the net income is distributable in three channels, namely, as dividends to the stockholders, as expenditures on new plant and equipment to extend the operations of the company, and, lastly, as new construction to replace depreciated plant, or as depreciation reserves for such purposes.

To summarize the factors involved in a presentation of the financial status of these mines, Tables II and III have been compiled. Table II indicates the total amount of capital which was originally invested in the enterprises, the net earnings and other credits making up the totals available for distribution, and then the division of the amounts in dividends, depreciation, and earned surplus. The figures include data with reference to all operations for each mine from the year in which the mill was started to Dec. 31, 1917, and are based upon figures given in the reports of the various companies in what is generally called the combined balance sheet, that is, for the combined operation, including railroad and smelter, if they are operated by the company, as well as for the mine and concentrating plant. The figures of this table will not be found to agree exactly in all cases with those of the respective reports, but this is due to bookkeeping changes in accounts. They are, however, essentially correct.

As regards the actual amount of money invested, it is the custom with most companies in the field under review to carry, as a liability, a surplus account, which represents the profits realized from the sale of capital stock at a figure above its par value, and from the conversion of bonds into stock at a figure above par. The sum of the liabilities carried as capital stock, bonds, and surplus should give the amount actually invested in the property by the stockholders. It would appear to be a simpler method, and just as satisfactory, to carry the item of surplus for sale of securities as one account with the capital stock—a system which will perhaps be adopted when the practice of issuing securities without a par value has become more general.

TABLE II. SUMMARY OF EARNINGS ON THE PAID-IN CAPITAL AND THEIR DISPOSAL TO DEC. 31, 1917

	Utah Copper	Nevada Cons.	Chino	Miami	Ray Cons.	Inspiration
Actual paid-in capital:						
Number of shares outstanding	1,624,490	1,999,457	869,980	747,114	1,577,179	1,181,967
Par value of shares	$10	$5	$5	$5	$10	$20
Total par value outstanding	$16,244,900	$9,997,285	$4,349,900	$3,735,570	$15,771,790	$23,639,340
Surplus from sale of securities	8,290,620	7,071,850	2,995,253	1,995,412(e)	1,506,646	....
Totals	$24,535,520	$17,069,135	$7,345,153	$5,730,982	$17,278,436	$23,639,340
Milling operations began	June, 1907	October, 1908	November, 1911	April, 1911	April, 1911	July, 1915
Amount of earnings available for distribution:						
Total net profit before depreciation (a)	$129,652,482	$56,448,305	$38,646,186	$22,476,073	$34,388,803	$33,810,284
Previous surplus	588,261	2,084,409	165,974	38,920	....	....
Miscellaneous credits or debits to surplus	252,902(b)	568,813(c)	179,000(d)	....	....	....
Totals	$130,493,645	$59,101,527	$38,991,160	$22,514,993	$34,388,803	$33,810,284
Disposal of that amount:						
Dividends	75,770,883	35,771,603	22,488,132	16,226,633	15,555,252	18,299,279
Reserves for depreciation, depletion, etc	3,676,332	9,455,096	1,350,981	1,657,834(f)	1,942,883	1,500,000
Written off prepaid stripping expense	2,500,000	....	288,121	....	....	....
Earned surplus	48,546,430	13,874,828	14,863,926	4,630,526	16,890,668	14,011,005
Totals	$130,493,645	$59,101,527	$38,991,160	$22,514,993	$34,388,803	$33,810,284
Ratios in per cent. of the following items to the actual paid-in capital:						
Dividends	308.8	209.6	306.2	283.2	90.0	77.4
Depreciation	15.0	55.4	18.4	28.9	11.2	6.3
Earned surplus	197.8	81.3	202.4	80.8	97.8	59.3
Total available for distribution	521.6	346.3	527.0	392.9	199.0	143.0

(a) From year in which the mill started to Dec. 31, 1917. (b) Credit by railroad earnings. (c) Credit by railroad surplus less debit by shortage in inventory. (d) Credits accrued from investments. (e) As of Dec. 31, 1916. (f) Does not include charges of $3,655,101 made in 1917 for mine depletion in 1916 and 1917.

TABLE III. CONDENSED FINANCIAL STATEMENTS AS OF DEC. 31, 1917

	Utah Copper	Nevada Consolidated	Chino	Miami	Ray Consolidated	Inspiration
Total cost of property, development and equipment less depreciation or depletion	$28,935,700	$10,986,337	$10,027,587	$22,065,508 (a)	$22,691,558	$23,167,399
Investments	5,604,002	....	442,040	1,929,354	310,329	....
Deferred charges to operations	8,300,040	5,454,520	2,910,197	....	....	....
Current assets less current liabilities	30,242,207	14,503,106	8,829,255	3,123,907	11,167,218	14,482,946
Total assets	$73,081,949	$30,943,963	$22,209,079	$27,118,769	$34,169,105	$37,650,345
Total paid-in capital	$24,535,520	$17,069,135	$7,345,153	$22,407,774 (a)	$17,278,436	$23,639,340
Earned surplus	48,546,429	13,874,828	14,863,926	4,710,994	16,890,669	14,011,005
Total liabilities	$73,081,949	$30,943,963	$22,209,079	$27,118,768	$34,169,105	$37,650,345

(a) Contains excess in valuation of mine in accordance with Government regulations, and is not comparable with the other mines' figure for this item.

In the matter of total dividends paid, it would seem fair to include the interest on bonds in this amount, especially as the bond issues are usually convertible, but as generally reported this is not segregated from interest on cash advances, and its exact amount is consequently not shown. It is a comparatively small matter, however, and would make little difference in the result indicated.

The manner in which the amounts of paid-in capital and the earnings after dividends have been employed is shown in the condensed financial statements summarized in Table III. The total amounts spent for the mining and milling property—its development and equipment to the end of 1917—are shown in a lump sum. In the reports of Utah, Nevada Consolidated, and Ray, this item includes the cost of a railroad; and in the record of operations of Nevada Consolidated, the cost of a smeltery.

Remarkable Exhibition of Earning Power

The financial success attending the exploitation of these mines must be considered satisfactory. Both Utah and Chino have already returned to their owners dividends aggregating over 300% of the actual paid-in capital. Chino required only about six years to achieve this result, earning about 50% per year. Inspiration's performance is also noteworthy, thanks in large measure, of course, to its fortuitous beginning at a time of high metal prices. Although it had operated only two and one-half years, the net result during that short period was to return to the stockholders in dividends over 77% of their investment, and, in addition, to accumulate an earned surplus, which, it may be noted, is accurately represented by the excess of quick assets over quick liabilities, amounting to another 60% of that investment. The results of the other underground properties are not so remarkable, but none can be considered poor.

The financial report on Utah Copper denotes that a sum considerably larger than the actual paid-in capital is represented by the total cost of the properties. Nearly one-third of the entire property and plant investment is represented by the cost of the railroad; which illustrates the importance of a subsidiary enterprise which is external to the actual mine operations. Utah's investments are large, and appear to be conservatively carried, consisting, as they do, mostly of 1,000,500 shares of the capital stock of the Nevada Consolidated company, which has always sold at a much higher figure in the open market. It should be noted that the Nevada Consolidated mine has helped the Utah to make its good showing, because nearly all of the $23,480,489 reported as dividends received on investments came from this source.

Nevada Consolidated's results might be expected to be better than Utah's, because the grade of its ore is considerably higher, but even after allowance has been made for the dividends paid by the former to the latter, its exhibit is not as good. This may be partly explained by the following facts: The cost of the Nevada's railroad was relatively higher than Utah's in proportion to the size of the operation, and the amortization of a smelting plant has been a drawback. Nevada's depreciation policy has been more conservative; and the property was considerably slower than Utah in reaching full production. Nevada's conservatism in the matter of depreciation charges has presumably been prompted by the comparatively short indicated life of its mine. The fact that such charges include amortization of its orebody makes the total for depreciation of reserves out of proportion to totals for the other mines.

Chino has been able to outstrip its big rival, Utah, in the matter of quick return of capital, because of its higher grade of ore. Referring to the percentage ratios of dividends and earned surplus to paid-in capital in Table II, it will be noted that in its six years' operation it has accomplished practically the same result that Utah has required ten years to achieve, owing mostly to the magic difference between 1.90% and 1.43% copper. Chino's advantage in this matter is really not fully shown by these figures, for the reason that Utah has been aided by dividends from Nevada Consolidated, as noted in the preceding paragraph.

The attainments of the underground mines cannot be expected to be as spectacular as those of the open-pit properties, owing to larger initial outlay per unit of capacity and to shorter periods of operation. Miami's comparatively high-grade ore has enabled it to make an excellent showing.

Methods of Electric Welding

There are two kinds of electric welding, known respectively as carbon electric welding and metal electrode welding, states the *Railway Mechanical Engineer*. In the former, an arc is drawn between a carbon electrode and the piece to be welded. The metal to be added is fed into the arc. In the metal electrode process a metal electrode is used, the arc being drawn between the electrode and the piece being welded. The heat of the arc melts simultaneously the metal of the piece and the metal of the electrode. As the metal of the electrode melts, it is drawn across the arc, and a complete and homogeneous union is formed with the molten metal of the piece. With the exception of work with certain electrodes (manganese steel and slag-covered electrodes) the electrode is always made the cathode or negative, i.e., the current flows from the piece being welded to the metal electrode. The voltage required for metal electrode welding is about 20, direct current.

Mining Equipment as Realty Fixtures

By A. L. H. Street*

According to a recent decision of the Colorado Supreme Court, mining, milling and concentrating machinery, implements and tools, belting, attachments, and similar apparatus, placed on mining property by a lessee of the land, for the special purpose of developing the mines, extracting ores and treating the same, are trade fixtures, and may be removed by him at any time during the term of the lease or within a reasonable time after its expiration. Such equipment does not become a part of the real estate, nor the property of the lessor, in the absence of agreement to the contrary, and hence is subject to attachment to satisfy claims of third persons against the lessee. (Foote *vs.* Campbell, *170 Pacific Reporter, 954.*)

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Dust Abatement in Mines*

BY W. O. BORCHERDT

The composition of dust in mines and the effect of inhalation on the health of employees are discussed, and attention is drawn to the necessity for safety work to protect the lives and well-being of miners. The author of the paper characterizes as ridiculous the contention that dust, of whatever character, is not injurious. Attention is drawn to the stringent laws in force in Australia and South Africa which were framed to combat the dust menace. A considerable amount of valuable data was obtained by the author by means of a questionnaire; and the information, classified, is here presented in tabular form.

DUST in mine air is dangerous and objectionable more or less in proportion to its silica content; and the well-known diseases phthisis and silicosis commonly result from the continued inhalation of dust high in silica. It is not generally recognized that all dust is injurious, and that it should be the business of mine operators to suppress dust of any character, and to employ the same perseverence and intelligence which are, or should be, applied to the more obvious dangers due to faulty sanitation or unsafe practices. It is sometimes assumed that because high silica dusts are the most injurious, other dusts, unless present in quantities offensive to the senses, may be ignored. Figures have been advanced showing that the incidence of tuberculosis among coal miners is no greater than among surface workers in the same locality, and it has even been stated that the inhalation of coal dust is supposed to confer a partial immunity to tuberculosis.

Those who are operating mines in which the rock dust is not siliceous, or in which it is siliceous to only a slight degree, have, of course, a less serious problem to face than those whose work is carried on in the highly siliceous rocks; but the dust problem exists none the less, and it behooves operators to recognize and solve it promptly and voluntarily, in order to make unnecessary eventual interference and regulation by the state.

NATURE AND EXTENT OF DUST EVIL

So far as I am aware, there has not been in this country any legislation directed at the dust evil which is as drastic as that of South Africa; but that conditions have existed, in certain parts at least, which paralleled those in the African gold mines is shown by the admirable work in the Joplin district.

Respirators do not, in general, present any hope of a solution, because they are objectionable to the miners, are partly effective only when properly cared for, hamper respiration, and will, therefore, be worn by only exceptional men or under conditions where unusually strict discipline can be maintained. To make such a provision effective it would be necessary for nearly all underground men to wear them. Moreover, ordinary respirators do not remove from the air dust particles less than five microns in diameter, and much of the dust which has been shown to be harmful is less than three microns in diameter.

Water sprays directed into the dust as delivered from the drill hole, and dust-collecting bags intended to catch the dust and prevent its distribution through the mine atmosphere, have been constructed in many forms. It is my conclusion that none of these methods is effective on a practical scale. Elsewhere the opinion has been expressed that the best hope for a practical solution of the problem lay in the use of drills employing hollow steel, through which water is injected into the hole. This would appear to be the ideal method, because, as frequently pointed out, this type of drill not only allays dust, but gives a higher drilling speed. In some mines the conditions resulting from the operation of such drills have been entirely satisfactory, from both a hygienic and mining point of view. In others, however, especially in those in which conditions demand overhand stoping and a large amount of raising in dry ground, the water-feed drills have not been a success, partly because of mechanical imperfections, and largely owing to the attitude of the miners, who generally insist that they would rather breathe dust than get wet.

As the general features of this problem and the most practical methods for its solution have been covered in other papers and in the official reports of the South African and Australian Dust Commissions, it occurred to me that the best hope of contributing something of real value lay in the direction of determining the actual practical operating results with the various types of water-feed drills in different mines under diverse conditions. For the purpose of securing this information I sent a questionnaire to 47 representative mines in the United States and Canada, to which 26 have made reply.

In the accompanying table the information has been arranged in a convenient form; and, although it was necessary to use symbols and a key, it will be found easy to understand. A summary of this table shows 11 instances of the use of respirators, only five of which were considered successful; four cases refer to raising, and one case refers to overhand stoping.

One operator suggests that improvements in respirators could be made by following the design of military gas masks; and, although it seems probable that a respirator could be developed along these lines which would be highly effective in stopping dust of even a few microns' diameter, the difficulty of getting men to use such respirators would be greater than is the case with the existing types, which, though less effective, are also lighter and not so objectionable.

A man cannot chew or smoke while wearing a respirator; and I think no one familiar with the actual problem of protecting men from themselves and others will fail to agree with the statement that even men of more than average intelligence will not voluntarily and consistently use safety guards or precautions if these interfere with their comfort, convenience and

*Excerpted from a paper presented at the seventh annual congress of the National Safety Council.

fixed habits. This is unfortunate, but it is a fact, nevertheless. In practice it is not sufficient to point out the existence of a danger and the means by which it may be guarded against, but the men must be continuously and intensively educated in order to secure their coöperation in self-protection; and no amount of education will insure the adoption of a safety device which results in discomfort or inconvenience to the wearer. A sidelight on this problem is obtainable from the sand-blast art, where, originally, various types of masks and respirators were used, but in which present practice provides that the operator work on the outside of the chamber in which the sand blast is being used.

Construction of Respirators

I have experimented in the construction of respirators containing a filtering element or cartridge which would be inexpensive, readily inserted and removed, and would have a filtering surface of such dimensions as to render violent exertion possible without distress. I believe that considerable progress is possible along these lines, and that, by the addition of an arrangement for humidification, it might be possible to stop even the finest dust. At best, however, I believe that the field of respirators is limited.

The use of dust-collecting bags is reported in three instances, which were unsuccessful, because all appliances so far produced have been a nuisance. The failure of water sprays is shown by the fact that, though reported in 29 instances, only one successful result is claimed—in connection with drifting, where the dripping of the water on the operator is naturally not as extensive as in overhand stoping and raising. Water-feed hand drills—unmounted machines of the Jackhamer type—are extensively used. In drifting, four instances are given, three of which were successful; the other case was unsuccessful, because, as stated, the men prefer inhaling dust to getting wet, and because of mechanical imperfections in the machine. In underhand stoping, three instances are given, all successful, although objection was recorded in one instance on the ground that the safety precaution involved too much inconvenience. For sinking, nine instances are given, eight of which were successful. In the one unsuccessful instance the objections were that the steel sticks, that the machine cannot be rotated by hand, and that no dust is produced by dry sinking, anyhow. Evidently, because my questionnaire was not well worded, I failed to elicit any information either for this type of drill, or for others used in block holing. This I regret, because, in many mines, blockholing undoubtedly contributes materially to the dust in circulation, as it is carried all over the stopes and often into the chutes, during shift; and, indirectly, because boulders are frequently blasted during the shift, with the consequent spreading of dust.

Experience With Drills

The water-feed stoping drill is a machine of comparatively recent development. Mechanically it leaves more to be desired than any of the other modern hammer drills. It has great inherent possibilities; and to many operators it has seemed that designers and manufacturers have not fully recognized the extent of these possibilities, and have not given the question of the development of this type of machine the attention which it deserves.

In drifting, five instances are shown, of which four were successful. In overhand stoping, which would appear to be an ideal field for this machine, five instances are recorded, three unsuccessful, resulting in the comment that the men prefer dust to getting wet. Workers will not employ a safety device which causes discomfort or inconvenience, and no one should expect them to do so.

In raising, in 11 instances of the use of this type of machine three were successful. One of the successful cases is qualified by the familiar objection that the men prefer dust to getting wet, and that the machine has not been perfected mechanically; another comment was that the men will use the wet stoper if the wages paid are high enough, even if they do get wet. Of the eight unsuccessful instances, six were based on the grounds that the men prefer the dust to the water; another agrees to this and mentions the disadvantage of high maintenance cost; and still another supplements the same objection by referring to the frequency of the steel sticking, making rotation by hand impossible.

Two operators report the use of dry drills with auger steel for drifting or undercutting in soft ground. This type of equipment is recommended for these conditions by three operators, as being substantially dustless; and it is possible that this combination has not received the attention that it deserves, although it can be employed only under favorable conditions.

That the water-feed mounted drill is now the standard machine in most mines is clearly indicated in the table. In drifting, 22 instances, all successful, are shown, although in the case of one of these the machine is used in wet ground, and dust allaying is not considered one of its functions. In overhand stoping, of 11 instances nine were successful and two unsuccessful, the latter being due to mechanical imperfections and the fact that the men prefer dust to water. In underhand stoping, eight applications, all successful, are shown. In raising, nine instances are given, of which seven were successful, although one is qualified as partly successful, and one refers to use of the machine only if the ground is dry, but says that "the men prefer the dust to getting wet." In the two instances of failure this same familiar reason is given. In sinking, 12 instances, all successful, are quoted, one operator saying that the machines are used occasionally, but are not usually necessary; and another, that the water feature is not employed to allay dust.

Use of the Water-Feed Mounted Drill

To the man interested in safety alone, an examination of the accompanying tabulation would lead to one conclusion—that the water-feed mounted drill should be employed universally for drifting, overhand and underhand stoping, raising and sinking. Fortunately in some mines—instances of which are shown in the table—the dictates of mining economics appear to agree with those of safety. The water-feed mounted drill has been adopted for all purposes, and it is reported throughout as a successful machine. To what extent this conclusion represents the results of actual comparison I am, of course, not informed, but my own experience leads me to believe that in overhand stoping and raising, particularly in the latter, a properly designed water-feed self-rotating stoper would insure faster and cheaper progress than could be obtained with any mounted drill. In many overhand stopes the same would be true; and, even in drifting, the water-feed hand-rotated stoper is a much more formidable competitor, as compared with the mounted water-feed drill, than is generally supposed. There is reason to hope that, with the development of the former, much more effective work may be done in drifting than is now possible. It is these considerations which suggest that the manufacturers of rock drills should devote more attention to the development of this machine.

ANALYSIS OF QUESTIONNAIRE ON DUST-ALLAYING METHODS

Kind of Mine	Location	Rock Dust Problem	Experience With Various Dust-Allaying Appliances in— Drifting	Overhand Stoping	Underhand Stoping	Raising	Sinking	Blockholing	Suggestions for Improvement
Zinc and lead	Va.	Moderate	R-Ub SM-Ub WFMD-S WFSD-Sf	R-Ub SM-Uab WFSD-Ua	R-Ub	R-Ub SM-Uab WFSD-Ua	R-Ub	R-Ub	WFSD-g h
Copper	Ariz.	Moderate, worse in siliceous rock	SM-Uab WFMD-S	SM-Uab WFMD-S WFSD-Sld	WFMD-S	SM-Uab WFMD-Sk WFSD-Sad			m
Zinc	Mont.	None o	SS-Uab V WFMD-S	SS-Uab		SS-Uab WFMD-Sea WFSD-Sac	WFMD-Sp WFHD-Sp		g q
	N. J.	None							
Iron	N. J.	r							
Zinc and manganese		Moderate, drifting and raising only	SM-Uab WFMD-S WFSD-Ud DCB-Ub	WFMD-Ud		SM-Uab WFSD-Uaf DCB-Ub			
Iron	Mich.	None o s	DDAS-S WFMD-S WFHD-S	WFMD-S	WFMD-S WFHD-S	R-S WFMD-Ua	WFMD-S WFHD-S		DDAS in soft ground
Copper	Mich.	None	WFMD-S WFSD-S	WFMD-S WFSD-S	WFMD-S	WFMD-S WFSD-S	WFMD-S		
Nickel and copper	Ont. Can.	Slight	SM-Uab WFMD-S	SM-Uab WFMD-S		SM-Uab WFMD-S	WFMD-S		
Gold	Cal.	None	SM-Uab WFMD-S	SM-Uab WFMD-S	WFMD-S	SM-Uab WFMD-S WFSD-Uat	WFMD-S WFHD-Utu		
Zinc, lead iron	Colo.	In stoping	WFMD-S	WFMD-Ua WFSD-Ua	WFMD-S WFHD-S	WFSD-Ua	WFMD-S WFHD-S		DDAS in soft ground
Manganese iron	Minn.	None r							
Gold silver	Colo.	In some parts of mine	SM-Uab WFMD-S			WFSD-Ua			Rv
Copper	Ariz.	Yes	R-Ub SM-Uab SS-Ub WFMD-S WFHD-Uad	SM-Uab SS-Ub WFMD-S WFMD-w	WFMD-w	SM-Uab SS-Ub WFSD-Ua WFMD-w	WFMD-S		x
Copper, Zinc, Silver, Gold	Mont.	In stoping	SM-Ua WFMD-S WFSD-Sa WFHD-S				WFHD-S		
Silver	Ont. Can.	None	SM-Uabd DCB-U						
Zinc	Wis.	None r							
Iron	Mich.	Only in rock raises	WFMD-Sn r			R-S	WFMD-Sn r		
Zinc	N. M.	Drifting and blockholing	WFMD-S	R-S V-S					
Copper	Nev.	None r	WFMD-S	Undercut'g DDAS-S			WFMD-S WFHD-S		DDAS in soft ground
Au-Ag-Pb-Zn-Cu	Utah	Yes, in stoping	SM-Uabd WFMD-S	WFMD-Sb	WFHD-Sb	WFSD-Ua	WFHD-Sb		
Lead Silver	Utah	Moderate	WFMD-S			Re-S	WFMD-S WFHD-S		Ra
Zinc	Tenn.	None	SM-Uab WFMD-S WFSD-S	WFMD-S WFSD-Ua	WFMD-S	WFMD-Ua WFSD-Ua	WFHD-S		x Vj
Copper	Tenn.	Only in raising	SM-Uab WFMD-S			Re-S			
Zinc and lead	Okla.	In drifting	SM-S WFMD-S						
Copper	Mich.	None	WFMD-S	WFMD-S	WFMD-S	WFMD-S	WFMD-S		y
Zinc and lead	Mo.	None	SM-bd WFMD-S	WFMD-S	WFMD-S	WFMD-S	WFMD-S		z

KEY

R	Respirators.
DCB	Dust-collecting bags.
SM	Spray, mounted on drill.
SS	Spray, separate mounted.
V	Ventilation.
WFHD	Water-feed hand drill.
WFMD	Water-feed mounted drill.
WFSD	Water-feed stoping drill.
DDAS	Dry drill with auger steel.
S	Successful.
U	Unsuccessful.
a	Men prefer dust to getting wet.
b	Too much trouble to use.
c	Men will use if wages high enough.
d	Not perfected mechanically.
e	If in dry ground.
f	Maintenance high.
g	Perfection of self-rotating stoper.
h	Ventilation by suction from working face.
j	Better ventilation.

KEY

k	Partially—hard to use in style of raise driven.
l	Difficult to place holes accurately.
m	Perfection of water-feed stoper.
n	Not used in order to allay dust.
o	Except in raises in gangue rock.
p	Occasionally—not usually necessary.
q	Reduce indiscriminate outflow of water on men in overhand stoping and raising.
r	Have not attempted to allay dust in mine, as ground is damp enough so that dust problem is not serious.
s	Use spray to wet down dirt piles on account of gas.
t	Steel sticks, cannot rotate by hand.
u	No dust in sinking dry.
v	Respirator construction might be improved by study of military gas masks.
w	Intend to use.
x	To use water-feed drills for all work.
y	No phthisis problem. Men are as healthy as any other class of labor.
z	Most dust at present comes from squibbing holes and popping boulders. Discontinue shooting of any kind on shift and use water-type drills.

Some of the drills now available are convenient, light, and extremely powerful, but their maintenance cost is high, and they contain details of design borrowed from machines intended for other purposes, which, under new conditions, cause difficulty and delay. In overhand stoping and raising, about the only advantage discernible, from the point of view of the operator, in the use of the mounted water-feed drill, as against the stoper, is that the mounted machine is self-rotating, and it is not necessary for the operator to stand so close to the drill barrel; therefore, he does not get so wet as with the other machine. The operator of the hand-rotated water-feed stoper, owing to the necessity for hand rotation, has to stand close up, where he receives all the drip and spatter. With an automatically rotated stoper, this proximity to the machine would not be necessary.

Improvements in Drills

So far as mechanical troubles which result from water and drill sludge running down the steel and into the working parts of the machine are concerned, there is no apparent reason why the same improvements in construction would not eliminate these difficulties also. That this is the thought of other operators is evidenced by the response to the request for suggestions for improvements. Three of these refer to the development of a perfected self-rotating water-feed stoper, and one refers to means for the reduction in the indiscriminate use of water in the machines engaged in overhand stoping and raising. A certain amount of water is required to allay the dust effectively. In many cases the design of the machine is such that much more water is discharged through the steel than is necessary, or water is released at other points, with the result that the operator is constantly sprayed, and the machine is condemned.

Suction Ventilation Impracticable

Ventilation by suction from the working faces would prevent the distribution of any quantity of dust through the mine atmosphere; but would be more expensive and difficult to apply. The problem of the ventilation of metal mines, comparatively speaking, is in its infancy; and many projects which might now be condemned as impracticable or too expensive will later become customary, as advanced practice or legislation suggests their adoption.

Machine Must Be as Nearly as Possible "Fool Proof"

At present, conditions, rather than theories, must be faced. Mines must be made safe, regardless of whether the motive for doing so is lofty, or simply that of making a virtue of necessity. Few metal mines would show an atmosphere conforming, for example, to the South African regulations; and, as it is idle to talk longer of disciplining labor or of making the men do this or do that, it is obvious that the only solution possible is the use of drilling apparatus which will be inherently non-dust producing, and at the same time not be objected to by the men. In order to combine with these qualifications a drilling rate which will make it possible for the mine to operate, the machine must operate successfully, must be light, simple, durable, powerful, and, at the same time, as nearly as may be, "fool proof."

Manufacture of Mine Disinfectant*

Locally manufactured hypochlorite is now used at the Falcon mine, in Rhodesia, for treating wounds, washing out buckets, and for like purposes.

In the process of manufacture a continuous current is passed through a salt solution; and among the several chemical reactions that take place as the result of the electrolysis of the salt and water is the production of sodium hypochlorite, NaOCl.

The electrolytic cell consists of a wooden watertight box, the internal dimensions of which are 12 x 12 x 4½ in. wide, the last dimension being determined by the size of the carbon plate obtainable. The cell contains 12 carbon plates—six anodes and six cathodes.

The plates should be as close together as possible, as this assists the formation of sodium hypochlorite, and tends to prevent loss of chlorine gas. The plates are separated by thin wooden strips fixed down the sides of the box.

The six anodes should be raised 1 in. off the bottom of the box; and, by making them a tight fit against the sides, the solution, as it flows through the box, is forced to travel up and down between the plates, thus insuring good circulation, which aids production.

Owing to the corrosive action of the solution, and also to prevent impurities from getting in, thin carbon rods should be embedded in the carbon plates, and taken up 4 or 5 in. clear of the top of the cell, the copper conductor being soldered to a tight-fitting metal cap, attached to the top of the carbon rod. The cell can be made water-tight by painting over with hot bitumen.

The carbon plates are a somewhat expensive item, the 12 costing £8 ($38). These plates are of the best quality "Morganite" carbon. At first the carbon plates from old Leclanche porous pots were tried, but these were found to disintegrate rapidly, and by the end of a week or ten days the anodes or + plates were almost destroyed. The cathodes are not attacked, and therefore a cheaper quality carbon can be used for them.

After passing through the cell, the solution is clarified in a sand filter and passes thence to earthenware jars, ready for use. Continuous current is essential for the process. The source of supply at the Falcon mine is a small motor-generator, converting from 550 volts 3-phase alternating current to 3—6 volts continuous current. In cases where a motor-generator is not available, the small current required could generally be obtained from the "exciter" attached to all alternating-current generators. An "exciter" usually generates a current at a pressure varying from 60 to 100 volts. By inserting a "bank" of a few carbon-filament lamps as a resistance, a current of 5 to 10 amperes can be obtained at the required 3 to 5 volts.

The above notes are not published with the intention of recommending the general use of sodium hypochlorite. In many cases, however, war conditions have brought about a serious shortage of suitable disinfectants, and in instances where large consumers have suitable electric current and apparatus available, the information concerning the production and use of hypochlorite may be of assistance.

*Abstract from report of the 1918 Rhodesia Munitions and Resources Committee.

The Ferro-Alloys*

By J. W. RICHARDS†

The ferro-alloys have become of great importance in manufacturing and in construction. With the exception of ferromanganese and spiegel, little attention up to within a few years ago had been given to the manufacture of ferro-alloys in the United States, but it is now an important industry. The paper that follows is of value to engineers, for it gives a condensed description of the method of manufacture, properties and many of the more important uses of the alloys of iron.

A LARGE industry has grown up within the last fifty years, most of it within the last twenty-five years, which furnishes to steel makers alloys of iron with some of the rarer metals, in order to introduce these rare metals into steel. Such alloys are known as ferro-alloys, because they all contain iron (ferrum); some of them, however, contain more of the rare metal than iron. They were originally made in crucibles, cupolas or blast furnaces, but are now made principally in electric furnaces, and their manufacture is one of the principal electric-furnace industries.

They are of great importance to the steel industry. The steel maker uses them for one of two purposes: (1) As reagents to take oxygen out of melted steel and thus insure sound solid casting (ferromanganese, ferrosilicon, ferro-aluminum); or (2) to put into the steel a small or large percentage of the rare metal (ferromanganese, ferrochromium, ferrotungsten, ferromolybdenum, ferrovanadium, ferrotitanium, ferro-uranium, ferroboron).

These two uses may be discussed briefly. Melted steel, just before taking from the furnace, always contains some oxygen dissolved in it (like the gas in charged soda water). If this is not removed, the casting made is more or less unsound from cavities or blowholes. The addition of a small amount of a metal with a high affinity for oxygen removes this element and makes the casting sound. Manganese (1% or less) is the cheapest ana and most generally used reagent for accomplishing this; silicon (½% or less) is more powerful but also more expensive, and is often used to supplement the action of manganese; aluminum (0.1% or less) is still more powerful and still more expensive, and is used in small quantities as a final addition to complete the action of the manganese and silicon. All steel makers use one, two, or all three of these reagents; manganese and silicon in the form of ferro-alloys, aluminum more often as the pure metal, but ferro-aluminum is sometimes used.

The second use is to make special steels, that is, steels containing such quantities of the rare metal as give to them properties different from plain carbon steels deoxidized by manganese, silicon or aluminum. Thus we may make manganese steel by putting in 12 to 14% of manganese, making a very tough, hard steel such as is used in mining and grinding machinery, burglar-proof vaults, etc.; chromium (2 to 4%) makes a very hard tool steel; tungsten (15 to 25%) makes high-speed tool steel, which cuts iron while red hot; molybdenum (6 to 1%) has powers similar to tungsten, and is also used in steel for lining large guns. Vanadium ($\frac{1}{10}$ to ½%) makes a strong steel which resists shock extremely well, as when used for automobile axles; titanium, uranium and boron impart valuable properties not so easily described. Every one of these materials is used for producing some specific result which is not produced by any other; sometimes combinations of two, three, or four are used in one steel, producing a particular combination of special properties for some special purpose. Some of these materials cost $5 per pound, and the special steels produced cost up to $2.50 per pound, but their particularly valuable properties justify the expense. The value of these special steels to the industries, and particularly for military purposes, is very great, so great that the supply of ferro-alloys for their manufacture is an important factor in winning the war.

FERROMANGANESE

This is the oldest of the ferro-alloys. Its manufacture was begun about fifty years ago. First made in crucibles, it has for a long time been made in blast furnaces, but is now being produced in many places in electric furnaces. It is made with 30 to 85% manganese, 3 to 5% carbon, a little silicon and the rest iron. The rich grades, 75 to 85%, are preferred by the steel maker, but they require rich manganese ores for their manufacture. The United States has very little rich manganese ore, but has quantities of low-grade ores. One of the present burdens of the steel maker is to use low-grade ferromanganese, in order that we may not have to use ships for importing the high-grade ores from Brazil.

The usual manufacture in blast furnaces is wasteful of both fuel and manganese; the furnace must be run hot and slowly, with hot blast, in order to reduce the manganese oxide ore as completely as possible and not waste manganese in the slag. Yet, in spite of all efforts, from 15 to 25% of the manganese going into the furnace escapes reduction and is lost in the slag. This waste of fuel and manganese has led to the use of the electric furnace, in which fuel is required only as a chemical reagent and not to produce heat, thus saving about two-thirds the fuel requirements of the blast furnace, while the higher temperature available causes the extraction of manganese to reach 90%, i.e., slag losses to be down to 10% or less. Against these economies must be set the considerable expense for electric power and the smaller scale on which the furnaces run. At the present high prices of coke and manganese ore, and in view of the scarcity of manganese and the high price of ferromanganese, the electric ferromanganese industry is able to exist and make large profits. Whether it can do so when normal conditions return, after the

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war, is questionable; it is to be hoped that it will be able to do so, because of the economy which it undoubtedly possesses in regard to fuel and manganese.

Steel producers use ferromanganese particularly for making the low carbon or soft steels, because they can thus introduce the required manganese for deoxidation without putting in considerable carbon. For higher carbon steels spiegeleisen (15 to 20% manganese), a cheap blast-furnace alloy, can be used, and is being used at present wherever practicable, in order to save ferromanganese. The best practice with either spiegeleisen or ferromanganese is to melt them in a small electric furnace, and tap from it the required weight to be added to the heat of steel. The melted alloy mixes quicker with and reacts more actively upon the melted steel, while less of it is necessary because less is oxidized by the furnace gases. The saving in manganese by the use of the electrically melted ferro is alone sufficient to justify the expense of melting it in an electric furnace, while better and more homogeneous steel is produced.

Ferrosilicon

This alloy may run 15 to 90% silicon, but the most commonly used is the 50% grade. It is made from ordinary silica (quartz or sand), reduced by carbon in the presence of iron ore or scrap iron. The blast furnace is able to make only the lowest (15%) grade, because silica is exceptionally difficult to reduce, and under conditions which would reduce 99% of the iron ore in a furnace, or 75% of the manganese ore, only 15 to 20% of the silica present can be reduced, and only a low-grade silicon alloy produced. The higher grades must all be produced in the electric furnace.

The raw materials are ordinary silica, the most abundant metallic oxide on the earth's surface; iron ore or scrap iron (iron or steel turnings or punchings), and coke. Electric furnaces up to 10,000 hp. have been operated on ferrosilicon (50% grade). At the high temperature required, a not inconsiderable proportion of the reduced silicon vaporizes, and burns outside the furnace to a white silica smoke. This can be largely prevented by skillful furnace supervision. In normal times, the 50% alloy sells at $45 to $50 per ton, which is a low price for an alloy so difficult to produce.

Steel producers use ferrosilicon principally for the great activity with which the silicon removes dissolved oxygen from the steel. It is about four times as active as manganese in thus reducing blowholes and producing sound castings. It is usual, however, to use manganese first, to do the bulk of the deoxidation, and silicon afterwards to finish up the reaction more completely. It is particularly useful in making sound steel castings which are cast into their ultimate form and do not have to be worked into shape, because a slight excess of silicon may make the steel hard to forge or roll, whereas an excess of manganese does not have so bad an effect on the working qualities. A particular kind of steel called silicon steel carries 1 to 2% of silicon and yet forges well; this would be classed as a special steel.

The ferrosilicon industry has attained large proportions in countries where electric power is cheap, particularly therefore in Switzerland, the French Alps, Norway, Canada, and parts of the United States. Under present conditions it is even profitably run where electric power is relatively dear, as at Anniston, Ala., and Baltimore, Md. It is a large, interesting, and rapidly growing industry.

Ferro-Aluminum

This alloy, with 10 to 20% of aluminum, was made in the electric furnace and used in considerable quantity in steel about 1885-88, but was displaced by pure aluminum as the latter became cheaper. Aluminum is about seven times as powerful as silicon and twenty-eight times as strong as manganese in acting upon the oxygen dissolved in steel; therefore only minute quantities are necessary, say 1 oz. up to a maximum of 1 lb. of aluminum per ton of steel. Its use gives the finishing touch to the deoxidation of the steel.

About 1885 the Cowles brothers, operating the first large electrical furnaces run in America, at Lockport, N. Y., made and sold considerable quantities of ferro-aluminum, selling the aluminum in it at the rate of about $2 per pound, while the pure metal was then costing $5. When, a few years later, pure aluminum sold for 50c. per pound, the steel makers turned to using the pure metal instead of ferro-aluminum, and at the present time aluminum is so used in practically every steel works in the world.

There seems to me a distinct opportunity for makers of ferro-alloys to revive the manufacture and sale of ferro-aluminum. Such great advances have been made in the construction and operation of large electric furnaces since 1890, and so much experience has been had in reducing the difficult oxides to ferro-alloys, that the production of 50% ferro-aluminum at say $100 per ton may be a distinct electric-furnace possibility. That would furnish the contained aluminum at about 10c. per pound, as against 30c. for the commercial aluminum now used. The alloy should be broken to small pieces before using, and thrown in the runner or on the bottom of the ladle, in order that the melted steel may quickly dissolve it as it runs into the ladle.

Such ferro-aluminum would require bauxite with iron ore or scrap iron, for its manufacture, but there are large deposits of low-grade bauxite rich in iron, in Southern France, which could be reduced directly to the alloy without any additions, and thus furnish very cheap raw material for the operation.

In conclusion, ferro-aluminum is not now being made, but its electric-furnace production is a real possibility.

Ferrochromium

Ferrochromium is used for making what is familiarly but erroneously called "chrome steel." It makes steel exceedingly hard. Very hard cutting tools, and armor plates to resist projectiles, are made of it. Only 2 to 4% of chromium may be used.

Several grades are made in the electric furnace, depending on the percentage of chromium (25 to 75), and the content of carbon (2 to 8%). This alloy takes up carbon so actively in the furnace that it has to be treated subsequently to remove the carbon down to what can be endured by the steel into which it is introduced.

The raw material for its manufacture is chromite, an oxide ore of both chromium and iron. If this is mixed with carbon and smelted in the electric furnace it reduces directly to ferrochromium alloy (often misnamed "ferrochrome"), and highly saturated with carbon (6 to 10%). Steel makers want lower carbon than this, so the alloy is re-melted with more chromite in another furnace, and the excess of carbon oxidized out. The low-carbon alloy sells for two to three times the price of the high-carbon crude material.

The cutting off of importations of high-grade chromite ore from Asia Minor has led to considerable prospecting in the United States. Fair material has been found in many places, and at present our country is nearly independent of foreign sources of the ore.

Ferrotungsten

Tungsten (also called wolfram) imparts curious and valuable properties to steel. A small amount (2 to 5%) has been used for half a century or more, to make the steel self-hardening; that is, a tool of this steel need only be allowed to cool in the air, and it becomes hard without the ordinary quenching or chilling operation. Larger proportions (10 to 25%) make a steel which stays hard even when red hot. A tool of this material can be run so fast on a lathe, for instance, that it gets red hot from the friction and work, yet keeps hard and keeps on cutting. It is called high-speed tool steel, and its use alone has more than doubled the output capacity of the machine shops of the world.

The ore used is either wolframite or scheelite—found in considerable quantities in Colorado and some other Western states, and imports of this ore have not been necessary during the war. In this respect we are much more favorably situated than the European nations. A plentiful supply of tungsten ore may indeed be regarded as a large factor in the production of cannon and firearms and all kinds of machinery, and therefore a considerable factor in winning the war.

Ferromolybdenum

Molybdenum has only recently come into large use in steel. Its action being somewhat similar to that of tungsten, scarcity of the latter metal, particularly in Europe, has led to the manufacture of ferromolybdenum on a comparatively large scale.

The ores are widely distributed but not very plentiful. Molybdenum sulphide, molybdenite, looks almost exactly like shiny graphite, but it is a shade lighter in color and nearly twice as heavy. It occurs usually as flakes in granite rock and might easily be mistaken for graphite. Lead molybdate, wulfenite, is a compound of lead and molybdenum oxides, a prettily crystallized yellow-to-red mineral, in thin square plates. It occurs abundantly in a few lead mines in the West. It is usually first treated to extract its lead, and the residue then worked for molybdenum. The sulphide used to be roasted to molybdenum oxides, and this reduced by carbon in the presence of iron ore or scrap iron in an electric furnace. It is now smelted directly in the electric furnace with carbon and a large excess of lime along with iron ore or scrap iron. Ferro with 50 to 60% of molybdenum is tapped from the furnace like other ferro-alloys, but with molybdenum up to 80% the alloy has such a high melting point that it cannot be tapped out without freezing; it is necessary to make a furnace full of this alloy and then let the furnace cool down and take it apart, taking out a large mass of solidified alloy; the furnace is then rebuilt.

The large use of molybdenum in steel has been so recent that not much has been made public about it Rumor says that the large German guns which bombarded Liége (the "Black Berthas") were lined with molybdenum steel (6 to 7%) to increase their resistance to erosion. It seems certain that Germany drew considerable supplies of molybdenite from Norway to compensate for shortage of tungsten for high-speed tool steel. Parts of guns, gun carriages, motors, automobiles, have also been made of molybdenum steel of most excellent quality. Canada has been especially active in the manufacture of ferromolybdenum steel, most of which is exported to Europe. This alloy is therefore another valuable war material that has established itself in manufacturing.

Ferrovanadium

Without vanadium the modern automobile or autotruck would be a much weaker machine. When steel is desired to withstand the heaviest shocks and vibration, nothing is quite so effective as adding vanadium. This is another comparatively rare metal, found principally in the radium ores of Colorado and as a black sulphide on the highlands of Peru. The canary yellow Colorado ore is treated for radium, and the residue for vanadium and uranium. The U. S. Government (Bureau of Mines) operated this process for the radium supply. The black ore of Peru is rich and unusual; it is a sulphide with some asphaltic matter, and it is roasted to the condition of iron-vanadium oxide before reduction. The oxides are best reduced by metallic aluminum. This is the well-known thermit (Goldschmidt) method of reduction. Electric-furnace reduction by carbon is not advantageous because of the large amount of carbon taken up by the alloy; powdered silicon is therefore put into the charge as the reducing agent, together with iron, lime and fluorspar, and then a 30 to 40% vanadium alloy is obtained with seldom over 1% of carbon, a very desirable composition. (R. M. Keeney).

Only small amounts of vanadium are necessary to improve steel; 0.1 to 0.4% are the usual quantities. This is fortunate because the vanadium costs $5 per pound and over. Metallurgists suspect that part of the improvement of the steel may be due to the vanadium combining with an removing nitrogen dissolved in the melted steel. This is probably true, yet some advantage undoubtedly must be ascribed to the final vanadium content in the steel; both avenues of improvement function. Steels thus treated are unusually resistant to shock and alternate stresses, making them very useful for axles, cranks, piston-rods, and such severe service.

Ferrotitanium

Titanium is an abundant element in nature. It occurs in immense amounts as a double oxide of titanium and iron, known as ilmenite, or titanic iron ore. This ore can be reduced directly by carbon in electric furnaces to ferrotitanium. The reduction proceeds easier if some aluminum is put in as a reducing agent, but this is expensive and unnecessary. The alloy running 15 to 25% titanium is sold for use in steel as a refining agent to remove oxygen and nitrogen. Thousands of tons of steed for rails has been thus treated, the tests showing considerable improvement in the mechanical properties by the use of quite small amounts (0.10 to 0.20%) of titanium.

Ferroboron

This is another alloy whose valuable qualities have not yet been entirely determined. Boron is the metallic base of borax, which is a sodiumboron oxide. Borax is very difficult to reduce to the metallic state. Another raw material, not so abundant, is colemanite, containing lime and boron oxide. Many attempts have been made, none very successfully, to reduce this with iron oxide to ferroboron. The American Borax Co. offered a prize, for several years, for a process which would accomplish this. Boron oxide occurs rarely in nature, but it can also be manufactured from borax and colemanite. When the oxide is obtained, this can be combined with iron oxide and the resultant boron-iron compound reduced by carbon in the electric furnace to ferroboron. Small quantities of this alloy have thus been manufactured.

Experiments on steel have shown that ferroboron acts somewhat similarly to ferrovanadium. Experiments in France showed remarkably strong and tough steels were thus made, using 0.5 to 2% of boron. The results have not been properly followed up, partly on account of the difficulty in getting ferroboron. No one, as yet, has taken up its regular manufacture, and steel makers can hardly be blamed in these stirring times for not having thoroughly explored its possibilities as an addition to steel.

Ferro-Uranium

This is the latest of the ferro-alloys to enter the lists. Uranium is a very heavy and, chemically, very active element. It is found very scarcely as a black oxide, the mineral pitchblende—the mineral in which radium was first discovered. It is found more abundantly in the Colorado radium ore, a bright-yellow oxide and silicate of vanadium, uranium and lime. After extracting the radium and vanadium, the uranium remains in the residue as a byproduct, usually as a soda uranium compound. This is treated so that uranium oxide is obtained, and this can be reduced by carbon in an electric furnace in the presence of iron ore or scrap iron, to ferro-uranium (30 to 60%). The recovery of uranium is not high (50 to 70%), the rest being lost in the slag. Mr. R. M. Keeney has recently described these processes in detail, for the first time in the August *Bulletin* of the American Institute of Mining Engineers.

The results of tests showing the influence of uranium on steel are not yet completely known. Some firms have claimed for it wonderful strengthening power and resistance to shock. The subject is still receiving expert attention from steel makers, and valuable results are confidently expected.

Conclusion

The ferro-alloys are exceedingly important materials to the steel maker, either in the making of ordinary steel or for producing special alloy steels. They are indispensable to the steel industry. They are important factors in producing both ordinary and fine steels, and therefore in winning the war. The country well supplied with them has a great advantage over the country in which they are scarce. They are deserving of all the expert attention which they are receiving from the War Industries Board, the steel makers, and the economists. The possession by the United States of large supplies and resources in the ferro-alloy line, may be one of the important factors in determining the quick ending of the war.

Electrical Ground Connections*

By Orville S. Peters

Water pipes offer by far the most desirable means of making ground connections, but where it is necessary to resort to other means, such as driven pipes or plates, an appreciable degree of protection can in some places be obtained at reasonable expense. In a great many cases, however, grounds of the latter type will be found unsatisfactory. If a common ground wire is used, a good degree of protection can be had, but the expense may be considerable, and the result not equal to that obtainable from water pipes, unless the common ground wire is connected to a water pipe.

The resistance of water-pipe ground connections, where there are no high-resistance areas near by, averages about 0.25 ohm, which is sufficiently low for practical purposes in any case that is likely to arise. The resistance of driven pipe and plate grounds, however, is much higher than that of water-pipe grounds. A series of measurements on ground connections made with driven pipes, plates, coils of wire and patented devices showed results as given in the accompanying table. These ground connections were found in service in a number of cities situated in different parts of the United States between the Atlantic Coast and the Rocky Mountains.

RESISTANCE BY KINDS OF SOIL

Number of grounds tested	Soil	Average Resist.	Minimum Resist.	Maximum Resist.
24	Fills, and ground containing more or less refuse, such as ashes, cinders, and brine waste	14	3.5	41
205	Clay, shale, adobe, gumbo, loam, and slightly sandy loam with no stones or gravel	24	2.0	98
237	Clay, adobe, gumbo, and loam mixed with varying proportions of sand, gravel and stones	93	6	800
72	Gravel, sand and stones with little or no clay or loam	554	35	2700

From these measurements, it is readily seen that, except in certain localities where natural conditions are particularly favorable toward making ground connections with driven pipes or plates, to obtain a degree of safety equal to that obtained with water pipes would entail an expense that would be almost prohibitive. It is possible, of course, to obtain an appreciable degree of protection with driven pipes in nearly all places, but the comparative advantages in connecting to water pipes are so great that the latter should be used wherever they are available. There is no possibility of damage to the pipes from currents flowing in them, nor of danger to employees of the pipe-owning company, if simple precautions are observed in regard to the use of the pipes for the purpose of grounding.

*Excerpt from Technologic Paper 108, United States Bureau of Standards.

Dutch View of German Potash

It is pointed out in Dutch journals, says *Commerce Reports*, that the German potash industry, heretofore almost a monopoly, may have to face severe competition after the war. Potash deposits have been discovered in Catalonia; potash will probably be mined in the Netherlands (in the concession field of Winterswijk); and the United States may develop a potash industry. Under the stress of competition the German mines would doubtless combine, so that only one out of four or five mines would remain in operation, but the closed mines would still require considerable sums for the upkeep of buildings and machinery; and water must be pumped out to keep the mines dry, as it might otherwise flood the neighboring mines. The earnings of one mine would be distributed among the owners of four or five mines, and, if prices should fall, the shareholders would have to be contented with meager dividends. The German mines charge their foreign customers higher prices than the domestic consumers pay, and, owing to the enormous sums invested, high prices of potash are a vital condition for the existence of German potash industry. Hence the German interests are bound to keep the prices high and will not lower them save in case of extreme necessity.

Sliding Scale of Prices for Joplin Zinc Ore

The following documents are self-explanatory:

At the suggestion of Mr. Pope Yeatman, of the War Industries Board, a committee of the Joplin ore producers met with the Zinc Producers' Committee (which committee was appointed last year to represent the zinc smelting and mining industry of the country in its relations with the Government), for the purpose of arriving at a plan by which the long-existing differences between the Joplin ore producers and the smelters might be adjusted.

At this meeting the enclosed "Plan Governing the Purchase and the Sale of Joplin Blende Ore" was devised and received the unanimous approval of the representatives of both the mining and the smelting interests present.

In order to make this plan a success, it is necessary that practically all of the smelters using Joplin ores should acquiesce. Already smelters representing approximately 55% of the zinc-smelting capacity of the United States have agreed to adopt the plan if acquiesced in by a sufficiently large proportion of the smelters.

It is not contemplated under the proposed plan that the relations between smelters and individual producers shall be interfered with. Orders will be placed direct by the buyers, as heretofore.

That this plan may become effective as of Nov. 1, you are requested immediately to signify your approval on the enclosed form and return it to Stephen S. Tuthill, Acting Secretary, American Zinc Institute, 27 Cedar St., New York.

It is sincerely hoped that all the zinc-smelting interests of the country will adopt this plan. It is designed to bring about closer coöperation between the zinc-ore producers and the zinc smelters and a stabilization of the zinc industry, which is a matter of national importance.

EDGAR PALMER,
Chairman Zinc Producers' Committee.

Oct. 21, 1918.

PLAN GOVERNING THE PURCHASE AND THE SALE OF JOPLIN BLENDE ORE, ADOPTED AT A CONFERENCE BETWEEN THE ZINC PRODUCERS' COMMITTEE AND THE JOPLIN ORE PRODUCERS ON OCT. 18, 1918.

1. That the smelters will specify the quantity of ore that they will obligate themselves to take in approximately equal weekly quantities during the period ending Jan. 1, 1919, and that the ore producers will furnish such tonnage, both subject to fires, strikes, accidents, or other causes beyond the control of either party, interrupting, curtailing or suspending operations at smelteries or mines, and neither party shall be liable for damages due to such interruption, curtailment, or suspension.

2. That the ratio shown in the following table shall be the basis of the settlement for 60% zinc Joplin mill concentrates, subject to the variation of $1 for each unit above or below 60% zinc contents, and subject to the customary lime and iron penalties of $1 for each unit of these ingredients in excess of 1%. Sludge material running not below 57½% zinc shall be penalized $2.50 per ton; sludge material assaying less than 57½% zinc and all flotation material shall be penalized $5 per ton. This schedule shall not apply to any ores below 50% Zn.

BASIS OF SETTLEMENT OF 60% ZINC JOPLIN MILL CONCENTRATES

Spelter Market (In Cents)	Ratio	Price 60% Joplin Ore at Mines	Spelter Market (In Cents)	Ratio	Price 60% Joplin Ore at Mines
6.0	6.8 to 1	$40.80	10.6	6.34 to 1	$67.204
6.1	6.79 to 1	41.419	10.7	6.33 to 1	67.731
6.2	6.78 to 1	42.036	10.8	6.32 to 1	68.256
6.3	6.77 to 1	42.651	10.9	6.31 to 1	68.779
6.4	6.76 to 1	43.264	11.0	6.30 to 1	$69.30
6.5	6.75 to 1	43.875	11.1	6.29 to 1	69.819
6.6	6.74 to 1	44.484	11.2	6.28 to 1	70.336
6.7	6.73 to 1	45.091	11.3	6.27 to 1	70.851
6.8	6.72 to 1	45.696	11.4	6.26 to 1	71.364
6.9	6.71 to 1	46.299	11.5	6.25 to 1	71.875
7.0	6.70 to 1	$46.90	11.6	6.24 to 1	72.384
7.1	6.69 to 1	47.499	11.7	6.23 to 1	72.891
7.2	6.68 to 1	48.096	11.8	6.22 to 1	73.396
7.3	6.67 to 1	48.691	11.9	6.21 to 1	73.899
7.4	6.66 to 1	49.284	12.0	6.20 to 1	$74.40
7.5	6.65 to 1	49.875	12.1	6.19 to 1	74.899
7.6	6.64 to 1	50.464	12.2	6.18 to 1	75.396
7.7	6.63 to 1	51.051	12.3	6.17 to 1	75.891
7.8	6.62 to 1	51.636	12.4	6.16 to 1	76.384
7.9	6.61 to 1	52.219	12.5	6.15 to 1	76.875
8.0	6.60 to 1	$52.80	12.6	6.14 to 1	77.364
8.1	6.59 to 1	53.379	12.7	6.13 to 1	77.851
8.2	6.58 to 1	53 956	12.8	6.12 to 1	78.336
8.3	6.57 to 1	54.531	12.9	6.11 to 1	78.819
8.4	6.56 to 1	55.104	13.0	6.10 to 1	$79.30
8.5	6.55 to 1	55.675	13.1	6.09 to 1	79.779
8.6	6.54 to 1	56.244	13.2	6.08 to 1	80.256
8.7	6.53 to 1	56.811	13.3	6.07 to 1	80.731
8.8	6.52 to 1	57.376	13.4	6.06 to 1	81.204
8.9	6.51 to 1	57.939	13.5	6.05 to 1	81.675
9.0	6.50 to 1	$58.50	13.6	6.04 to 1	82.144
9.1	6.49 to 1	59.059	13.7	6.03 to 1	82.611
9.2	6.48 to 1	59.616	13.8	6.02 to 1	83.076
9.3	6.47 to 1	60.171	13.9	6.01 to 1	83.539
9.4	6.46 to 1	60.724	14.0	6.00 to 1	$84.00
9.5	6.45 to 1	61.275	14.1	5.99 to 1	84,459
9.6	6.44 to 1	61.824	14.2	5.98 to 1	84 916
9.7	6.43 to 1	62 371	14.3	5.97 to 1	85.371
9.8	6.42 to 1	62.916	14.4	5.96 to 1	85.824
9.9	6.41 to 1	63.459	14.5	5.95 to 1	86.275
10.0	6.40 to 1	$64.00	14.6	5.94 to 1	86 724
10.1	6.39 to 1	64.539	14.7	5.93 to 1	87.171
10.2	6.38 to 1	65.076	14.8	5.92 to 1	87.616
10.3	6.37 to 1	65.611	14.9	5.91 to 1	88.059
10.4	6.36 to 1	66.144	15.0	5.90 to 1	88.50
10.5	6.35 to 1	66.675			

3. The market price of spelter governing settlements will be posted by the Joplin Ore Producers' Association each Friday, and shall govern for one week. The quotation to be posted by the Joplin Ore Producers' Association shall be the average of the daily quotations for Prime Western spelter at St. Louis as given in the *Engineering and Mining Journal* for the week ending the Wednesday previous to the Friday of the week in which the quotation is posted.

4. Should this arrangement prove satisfactory, it will be continued from quarter year to quarter year, with such modifications as may be found necessary.

Smelters are now being asked to sign a certificate saying that they will be governed in the purchase of their Joplin blende by the plan governing the purchase and the sale of Joplin blende adopted at a conference between the Zinc Producers' Committee and the Joplin ore producers on Oct. 18, 1918.

Salt From Sea Water

Experiments in Norway with a view to extracting salt from ocean water by means of electricity have been successful, and two salt factories will be started for this purpose in the near future, by the name of De Norske Saltvertker, according to the *Bulletin* of the Canadian Department of Trade and Commerce. One is to be in western and the other in northern Norway, as these districts, on account of the fisheries, are the best home markets. It has been estimated that each factory will produce 50,000 tons of salt per year for a start, but the works will be so built that the production can be brought up to double the quantity, if necessary. Besides the salt, different byproducts will be made. The capital for the two factories is said to be 20,000,000 crowns ($5,360,000). Each establishment will require about 6500 horsepower for the normal production.

During the war it has been difficult to get salt from abroad, and sometimes it has been impossible to salt down the fish. The new salt works should greatly improve the situation.

Operations at the Trail Smeltery*

The Consolidated Mining and Smelting Co. of Canada, Ltd., Trail, B. C., is now producing on a commercial scale at the Trail plant five refined metals—gold, silver, copper, zinc, and lead—as well as bluestone, sulphuric acid, and hydrofluosilicic acid. During the last year the zinc plant has been completed. It has a capacity of from 60 to 70 tons of spelter a day, working on high-grade zinc ores. The ores treated, however, are, in the main, low in zinc, and the capacity of the plant is thereby reduced, the best record up to the present being 62 tons a day.

The zinc plant contains two driers; three 18 x 5-ft. ball mills; thirteen seven-deck 25-ft. Wedge roasters; a large leaching building, where the ores are leached by counter-current continuous process in Pachuca tanks and thickened in Dorr thickeners, purified in Pachuca tanks, and filtered with Kelly and Oliver filters; electrolyzing-tank rooms, where the solutions are electrolyzed in concrete electrolytic tanks; thirteen 1000-kw. motor-generator sets; the necessary transformer plant to reduce the 60,000-volt current with which the plant is supplied; and a melting plant with two reverberatory furnaces for melting the cathode zinc.

The copper plant is, primarily, a gold-copper plant for the treatment of Rossland ores. The copper tonnage is small. The copper smeltery consists of the necessary ore bins, two 35-ft. and two 25-ft. furnaces, and two 12-ft. Great Falls type converters. The refinery was originally built to refine 10 tons of copper a day. It was found necessary during the year to double this capacity.

Owing mainly to increased production of customs lead ore, the roasting capacity in the lead smeltery has been increased. This equipment now consists of three seven-hearth 25-ft. Wedge roasters, five single-hearth Godfrey roasters, 32 Huntington-Heberlein converters, and three Dwight & Lloyd sintering machines.

The lead smeltery consists of the necessary ore and roast bins, four blast furnaces, drossing kettles, and an anode casting machine. The lead refinery, which is an electrolytic Betts process plant, has a capacity of approximately 100 tons of pig lead a day. During the year a concentrator with daily capacity of 400 tons has been built. This mill is equipped with a 6 x 6-ft. ball mill, a standard 24-in. 17-cell Minerals Separation machine, concentrating tables, filters, thickeners, and complementary appliances. The mill has been working on the concentration of the low-grade zinc-lead ores from the Sullivan mine.

Since 1894, when the company took over the plant, 5,179,307 tons of all classes of ores has been treated, with a gross value of $94,315,754, and yielding 1,778,921 oz. gold, 27,500,350 oz. silver, 458,236,524 lb. lead, 75,047,410 lb. copper, and 23,056,996 lb. zinc.

During the fiscal year 10,000 tons of zinc was produced, representing a value of $3,000,000, marking an epoch in the metallurgical history of Canada. The production of lead amounted to 22,000 tons, exceeding that of last year by 2000 tons. The year's output of sulphuric acid reached 2878.7 tons of 100% product. The capacity has been doubled and a daily output of 30 tons established. Hydrofluosilicic acid was produced to the extent of 196 tons, and an installation of new retorts designed to double this capacity is being made.

*Excerpt from the annual report (1917) of the Minister of Mines of British Columbia.

Amalgamation Practice Economies*

By S. A. Pearce

The chief losses of mercury are caused by the attrition of the ore particles passing over the amalgamated plates. Beyond a certain limit, it is found that coarse pulp will strip mercury and amalgam off the plates entirely. Losses may also occur from other causes, which include:

1. Impure mill water, or insufficient lime to correct acidity in the ore.
2. Inadequacy of traps, and too long intervals between cleaning them out.
3. Too generous use of mercury at dressing. This includes carelessness in using the mercury bottle and spraying elsewhere than on the plate.
4. Too great a velocity of pulp, which may be due either to too high a ratio of water to ore crushed, or too much fall on the plates.

Another item which I think worthy of mention refers to the grinding of amalgam and black sand. Individual practice in the treatment of the "scrape and plate dressings" differs considerably.

My own experience, after trying various methods, is that a minimum of loss of mercury is involved by the old-fashioned method of cleaning up the "scrape" in a Batea pan and subsequently grinding the "black sand" in a barrel for about 20 hours, adding the necessary mercury only about two hours before finishing. When I had 100 stamps out of 300 hung up, and the quantity of scrape and black sand was correspondingly low, it was found that the size of the barrel charge had a substantial bearing on the amount of mercury floured in the operation; and, after experimenting, the following conditions to insure a minimum loss have been adopted:

Speed.—A 24-in. internal diameter barrel should run at 16 revolutions.

Load.—Barrel should be at least three-quarters full.

Consistence of charge should not be more than sloppy, with no excess of water.

As much as 100 oz. of mercury can be floured by not attending to these conditions. A liberal use of lime in the charge, to prevent acidity, is essential.

I deprecate the use of cyanide when dressing plates. An attempt was made to recover mercury in the traps by using a number of rusty iron nails therein. The iron retained both mercury and amalgam.

Liberty Loan Subscriptions placed through the special Mining Committee reached a total of $59,122,900, instead of $58,926,350, already reported in the *Journal*, the increase being due to belated reports.

*Excerpt from the *Journal* of the Chem. Met. and Min. Soc. of South Africa.

Assayer and Chemist

Zirconium Content in Ores and Alloys

By J. D. Ferguson*

For the determination of zirconium in ores, or in ferrozirconium, take a ½-gm. sample of finely ground material and fuse well with 5 gm. of sodium carbonate in a platinum crucible. Dissolve the fusion from the crucible, neutralize with HCl, then add 20 c.c. of HCl in excess, and boil to dryness. From this point the method is the same as for zirconium in steel, as given below, after the evaporation to dryness.

Zirconium in Steel

Place 3 gm. of steel in a 250 c.c. beaker. Add 15 c.c. of hot water and 15 c.c. of concentrated HCl, followed by several additions of 1 c.c. of concentrated HNO_3 at short intervals till the sample is in solution. This takes only a few minutes. Now introduce 6 c.c. of concentrated H_2SO_4 from a burette under the cover glass of the beaker. Place on the hot plate and evaporate to dryness. Cool. Add 30 to 50 c.c. of hot water and 1 c.c. of concentrated H_2SO_4, and heat till all soluble salts are in solution. Now filter, using suction, and wash the silica well with hot water, then with hot 1 to 1 HCl solution, followed by hot water, taking care to remove all iron in the washing. Transfer the filtrate from the filter flask to a 500-c.c. beaker.

Ignite the filter containing the silica in a platinum crucible. When thoroughly ignited, cool, add sufficient concentrated H_2SO_4 to cover the silica (not less than 2 c.c.), then add HF, a little at a time, till all effervescence ceases, and then another 2 c.c. in excess. Place the crucible on a hot plate and evaporate just to white fumes of sulphuric anhydride. Cool, dilute with water, and add to the main filtrate from the silica.

Now nearly neutralize the combined filtrate with NH_4OH, leaving it only slightly acid. Then add, with vigorous stirring, 6 c.c. of ammonium bisulphite solution (made by passing SO_2 gas into concentrated NH_4OH to saturation), place on the cooler part of the hot plate and slowly heat to boiling. The ammonium bisulphite solution should completely reduce the iron, leaving it a very pale green color, except where nickel or chromium is present, when, of course, the color is deeper.

Remove from the hot plate and cool to room temperature. Now add 1 to 1 ammonia, with constant stirring, till the precipitate formed redissolves with difficulty, then 3 drops of methyl orange solution, and continue adding dilute NH_4OH, drop by drop, till the color changes from pink to yellow and a slight permanent precipitate begins to form. Immediately add 10 drops of concentrated HCl if it be the purpose to precipitate by phenylhydrazine (or 2 c.c. concentrated H_2SO_4 if the purpose is to precipitate zirconium as phosphate); see Note 1. Dilute to about 400 c.c. with hot water and heat to boiling. At this point if it be suspected that the solution is not perfectly reduced, add another c.c. of ammonium bisulphite.

When the solution boils, remove from the hot plate and add, with vigorous stirring, 1 c.c. of phenylhydrazine for every 100 c.c. of solution. This will precipitate both zirconium and aluminum as hydroxides, together with a little iron. Replace and boil for a few minutes. Remove and allow to stand for half an hour in a warm place; then filter and wash several times with hot water. Redissolve this precipitate with hot dilute HCl and H_2SO_4; reprecipitate after reducing (use only 1 c.c. of bisulphite this time), and neutralizing and proceed as before. Wash well with hot water. This should free the aluminum and zirconium hydroxides from iron. Ignite and weigh the combined oxides (or as an alternative the precipitate may be redissolved in 40 c.c. of hot 1 to 1 HCl, and the zirconium separated from the aluminum by cupferon; see note).

Fuse the combined oxides with a large excess of Na_2CO_3. Dissolve the fusion in hot water. Add a little NaOH solution, and filter. Wash well with hot water. Aluminum passes into the filtrate, and the zirconium remains on the filter as insoluble sodium zirconate. Ignite the filter containing the sodium zirconate, and fuse the residue at a low red heat for 15 min. with potassium pyrosulphate. Cool and dissolve the fusion in hot water. The zirconium may now be precipitated as hydroxide by ammonia; or, if it is suspected that iron is present, by phenylhydrazine, as before. Ignite the precipitate to ZrO_2 containing 73.90% Zr (or multiply by 0.7390 factor).

Note 1—Zirconium may also be determined as the phosphate after the reduction and neutralization, as given in the above method, by immediately adding 2 c.c. of concentrated H_2SO_4, diluting to 400 c.c. This makes the solution about 1% acid with H_2SO_4, which is the necessary condition to prevent the precipitation of aluminum. The mixture is then heated to boiling and 1 gm. of Na_2HPO_4, dissolved in a little hot water, added, with vigorous stirring. The zirconium, if present, precipitates as a whitish gelatinous substance. Boil for a few minutes, and allow to stand for a couple of hours. Hillebrand states that if the zirconium is present in small amount, 24 hours may be necessary. Filter, wash with hot 1% H_2SO_4 and hot water, without suction, till free from impurities. Dry the filter, separate the precipitate and burn separately; combine, ignite for 10 min. on the blast lamp, and weigh as zirconium phosphate containing 38.28% zirconium.

Note 2—The combined aluminum and zirconium hydroxides from the second phenylhydrazine precipitation may be dissolved in 40 c.c. of hot 1 to 1 HCl, and the solution diluted to 100 c.c. and cooled.

*374 Cortland Ave., Detroit, Michigan.

A 6% solution of cupferron in water is then added, with stirring, till the zirconium is precipitated, and further additions precipitate the crystals of the reagent. Now add an excess of cupferron solution equal to 1/5 the volume of the solution being precipitated. Allow to stand for 15 min., then filter, and wash first with cold dilute HCl solution (20 c.c. concentrated HCl to 100 c.c. H_2O), then with water, followed by NH_4OH solution, and again several times with water. The precipitate is now ignited and weighed as ZrO_2, containing 73.90% zirconium.

Note 3—There is still another method of determining zirconium in steel which I shall mention briefly. Use the Stead or the Carnot method for determining aluminum steel. Zirconium precipitates with aluminum in the precipitation with phosphate. This precipitation, repeated several times, will free the zirconium and aluminum from iron. They may then be separated by methods already mentioned.

Note 4—It will be found that the results obtained from the precipitation of zirconium by phosphate and phenylhydrazine methods will agree closely. I have carried out a number of determinations for my own satisfaction, and seldom got a variation of 0.05% in result. More frequently the variation was only 0.01 or 0.02%. The phenylhydrazine method may, of course, be used to determine aluminum in iron and other ores.

Colorimetric Assay for Tungsten*

By W. R. Schoeller and A. R. Powell

The gravimetric method does not provide a satisfactory solution of the problem of the assay of low-grade tungstic material. The characteristic property of tungsten is, that the yellow modification of tungstic acid is practically insoluble in dilute mineral acids, and soluble in ammonia or caustic alkali. The assay of high-grade ores and concentrates is based on those facts. With low-grade and impure material, however, the precipitation of tungstic acid by evaporation of the acid solution is incomplete, because the change to the yellow compound does not take place below a certain concentration, and tungstic acid has a pronounced tendency to form stable soluble complexes with a number of elements—a characteristic which is exerted more strongly when the liquid is evaporated to dryness. Hence, with such material, recourse must be had to precipitation by means of reagents such as mercurous nitrate, benzidine, cinchonine and the like, which, however, precipitate other acid radicles as well. Hence, the precipitate obtained is contaminated to a greater or lesser extent, and its further treatment for purposes of purification renders the process too tedious for routine work. Nor has a satisfactory volumetric method yet been evolved to replace the gravimetric. Under the circumstances a colorimetric process, based on the reduction of tungstic acid to the blue oxide, will probably overcome the difficulties attaching to the estimation of small percentages of tungsten. The following directions indicate the lines along which the test would proceed:

A suitable quantity of ore (e.g., 3.125 gm.), ground to pass 90 or 100 mesh, is fused with sodium bisulphate in a silica crucible. The cold melt is dissolved in hot 5% tartaric acid, and the solution filtered from silica and unattacked gangue into a graduated 250 c.c. flask. The filtrate is made ammoniacal, warmed, and saturated with hydrogen sulphide; all the iron, manganese, and metals of the copper group are thus precipitated. When cold, the liquid is made up to bulk, and 200 c.c. (= 2.5 gm.) filtered off. The filtrate is slightly acidified with hydrochloric acid, and warmed so as to coagulate the precipitate, consisting of sulphides of molybdenum, arsenic, antimony, tin, or vanadium. The volume is again adjusted to 250 c.c., and an aliquot part, corresponding to 0.5 or 1 gm., filtered off. This filtrate, which contains all the tungsten, together with alumina, titanium, phosphoric acid, and lime, is now ready for the colorimetric process, after addition of a suitable reducing agent, stannous chloride or zinc, preferably the former.

[The suggestions with regard to the new colorimetric method are made by the authors without opportunity for experimental verification, and were submitted with an explanation to this effect.—Editor.]

*Excerpt from a recent bulletin of the Inst. of Min. and Met.

Solution of Tin-Antimony-Lead Alloys*

By Louis E. Eckelmann

The dissolving of alloys containing tin, antimony and lead has always been accompanied by considerable uncertainty, especially with regard to the time required. The usual method of heating the finely divided metal with aqua regia, or concentrated HCl and $KClO_3$, takes a considerable amount of time; and I have found that most of the trouble experienced in bringing alloys of this type into solution is caused by the application of excess heat, and consequent expulsion of the nascent chlorine, before enough of the latter is present to act upon the dissolving metal. By the use of the following method 2 gm. of the alloy may be dissolved in less than 12 minutes:

To the finely divided alloy (1 gm.) add 60 c.c. of concentrated HCl and 2 c.c. of concentrated HNO_3. Heat to violent ebullition over a Bunsen flame. Lower the flame and continue heating, adding small portions of sodium or potassium chlorate until the alloy is dissolved. Enough chlorate must be added to permit the more or less permanent formation of the yellow supernatant foam, which is an indication of the amount of chlorine in solution. The rapidity with which this foam will disappear is an indication of the correct temperature. Too high a temperature does not allow the foam to form at all, and too low is shown by the amount of gas evolved by the dissolving metal. After solution the excess chlorine is boiled off.

Vacation Leave on Pay for Mine Employees on a daily wage has been granted by the gold-mine companies of the Transvaal since 1915. A recent amendment to this regulation has been adopted by the Chamber of Mines, by which the leave given to surface employees is increased from 10 to 12 working days, after one year's service, thus permitting three week ends in the holiday. It is claimed that in no other industry have employees paid by the day been granted privileges of this nature.

*Excerpt from *Chemist-Analyst*.

Events and Economics of the War

Following close upon Berlin's reply to the last note of the President, stating that Germany was awaiting proposals for an armistice, came word on Oct. 29 that Austria-Hungary sought an immediate and separate peace. Later dispatches proclaimed that a faction in Hungary, lead by Karolyi, had declared for an independent state. While the Dual Monarchy's internal affairs were thus in such difficulties, an offensive was suddenly opened in Italy between the Brenta and the Piave rivers against the Austrian positions, with immediate results; the enemy's lines were pierced on a 37-mile front, and the Piave was crossed, many thousands of prisoners being taken.

In France, the Allies drew nearer to Valenciennes; further south, the French overcame the German resistance in the Oise-Serre salient and resumed their advance, which had been delayed; and the Americans pushed ahead on both sides of the Meuse. In Palestine, General Allenby captured Aleppo, rendering the Turkish situation desperate; the Turks are said to be seeking a separate peace.

In the United States, on Oct. 24, the Interstate Commerce Commission, in ruling on a Washington case, asserted its authority to alter the freight rates fixed by the Railroad Administration. The Military Deficiency Bill was passed by the Senate and placed in the President's hands. In accordance with the terms of the Daylight-Saving Law, clocks were set back an hour on Oct. 27.

Anthracite Miners' Wages Raised

After negotiations with the U. S. Fuel Administration lasting from the end of July until the middle of October, the anthracite miners are to be granted a wage increase. The higher scale paid in the bituminous fields, where the men ordinarily work much less regularly than they do in the anthracite region, was a source of dissatisfaction to the anthracite workers, probably because at present there is little difference in the regularity of employment in the two industries.

Following the increase of 35c. per ton added to the price of anthracite at the mines by President Wilson on Dec. 1, 1917, the anthracite workers had received an advance in wages. The wage agreement then consummated, however, proved ineffectual, and recently the representatives of the miners informed Dr. Garfield that they had exhausted their resources in holding the men at work; that the lure of higher wages elsewhere was drawing them away. Finally, after a long discussion, during which the cost of living was considered, a wage scale was agreed upon by representatives of the various Governmental agencies dealing with labor problems. The General Reviewing Board sanctioned this increase, and submitted its finding to the Fuel Administrator.

The increase to be granted amounts to 12% in the case of contract hand and machine miners. Contract miners' laborers will receive an increase of $1 or more per day; outside company men and monthly men getting $2.54 or less per day, 90c. per day; breaker boys, 60c. per day; inside engineers and pumpers, $1.10 per day; and all other mine workers, $1 per day.

Thus wages in the anthracite region are to be raised because of the higher scale prevailing in the bituminous fields. But the bituminous leaders immediately sought to bring about an advance in the bituminous scale on the basis of the new anthracite wage. However, Dr. Garfield ruled on Oct. 25 that the situation did not warrant this, although he left the way open for the introduction of further evidence.

More Potash Needed

Every effort should be made by the Government to encourage production of potash and nitrates, Bernard M. Baruch, chairman of the War Industries Board, told the Senate Finance Committee on Oct. 24. The potash situation has been calling for special attention on the part of the various Government agencies during the last few weeks. William W. Mein, assistant to the Secretary of Agriculture, urges that additional potash be secured from blast furnaces, cement mills, greensand, certain shales, the brine of certain lakes, and from kelp. An estimate by A. W. Stockett, of the U. S. Bureau of Mines, places the domestic production of potash for the next 12 months at 60,000 tons. As this is only 25% of pre-war consumption, extraordinary efforts must at once be made to increase production.

Steps Toward Reconstruction

Though the problem of economic reconstruction after the war has received far less recognition in this country than abroad, much has nevertheless been done that will prove of great assistance in the post-bellum period. Burwell S. Cutler, chief of the Bureau of Foreign and Domestic Commerce, discusses the future trade plans of the European belligerents in a report referred to in the last issue of the *Journal*. In a letter submitting this report, he outlines the work accomplished by the various Government offices at home.

This Government's greatest preparation for future trade, according to Mr. Cutler, is the building up of a merchant marine backed by ample shipyards and drydocks. The Webb-Pomerene Bill has been passed, permitting our exporters to combine for foreign-trade purposes. The Federal Reserve Board and banking system have wide leeway in foreign-trade banking matters and are meeting such needs as develop. The Federal Board for Vocational Education, and the War Department, in its attention to the welfare of crippled soldiers, are looking to the future. The work of the Department of Labor, in its efforts to create a mobile labor supply more respondent to industrial needs, will doubtless continue after the war. Steps in preparation for the future have also been taken in the Department of Agriculture, the Bureau of Mines, the Geological Survey, as well as in the Bureau of Standards and the Bureau of Foreign and Domestic Commerce.

The last-named bureau now has far better information service as to materials, markets, legislation, and economic conditions in foreign countries than ever before, states Mr. Cutler. Its foreign commercial staff has been greatly expanded, and the amount of research work done has correspondingly increased. Statistical work of similar kind has been done by the Shipping Board, the War Trade Board, and the War Industries Board, with reference to commodities for war purposes, but which will be useful in organizing an after-the-war program. The State Department has long been engaged in drafting commercial treaties, and the Tariff Commission is surveying American industries to ascertain their tariff needs. To formulate complete and binding policies as to the future would be a waste of effort at this time, but facts should be, and are being, assembled, upon which action can be based later.

Larger Coal Stocks Authorized

All classes of industries consuming bituminous coal, except Class 1, as defined by the War Industies Board, were authorized by the U. S. Fuel Administration on Oct. 16 to increase their reserve stocks of coal. Those heretofore not on Preference List No. 2 were authorized to lay in additional reserve supplies. Consumers in Class 2 may store their coal up to the limits previously imposed on Class 1. Consumers heretofore in Class 3 will receive the facilities heretofore accorded to Class 2, and consumers in Class 4 have been allotted the opportunities heretofore reserved for Class 3. Consumers not on the preference list have been allowed the stocks formerly permitted Class 4 concerns. Preference List No. 2, as it affects mining and metallurgical companies, was printed in the *Journal* of Sept. 14, page 499.

The regulations, it was announced, will stand until further notice, and it was stated that, under them, an opportunity is afforded every industrial consumer for laying in at this time some reserve supply of bituminous coal. The order affects only those consumers in states east of the Mississippi, with the exception of Alabama, Tennessee, Mississippi, Indiana, Illinois, Wisconsin, and northern Michigan.

German Potash in War Time*

To justify a bill increasing the prices of potash, the German government has submitted to the Reichstag a long report on the potash industry in war time. Sales outside of Germany in 1917, as given in this report, were 143,948 tons (2000 lb.) of K_2O, compared with 557,318 tons in 1913. Sales in Germany in 1917 were 963,075 tons, against 666,537 tons in 1913. Total sales in 1917 were therefore 116,832 tons less than in 1913. Of the total output in 1917, 95.7% was consumed in agriculture, against 90.4% in 1913.

The gradual consolidation of potash mines, begun in peace time, became all the more urgent in war time, as the number of mines in operation had increased from 191 on Aug. 1, 1914, to 209 on Jan. 1, 1918. Under this policy 99 mines have been shut down. The number of operatives decreased from 34,316 on July 1, 1914, to 31,740 on Jan. 1, 1918, the latter number including 11,361 prisoners of war and 2336 women. The general average wage in the fourth quarter of 1917 was 6.20 marks, as against 4.37 marks in 1914, 4.30 marks in 1915, and 4.83 marks in 1916. The par value of the mark is $0.238.

The condition of equipment and repairs is declared to be altogether unsatisfactory. Only mines with preliminary assignments of production quotas did any installation and equipment work during the war, and that ended when the scarcity of labor and fuel compelled the government to assign war prisoners and fuel to the principal working mines. As a rule, the mines did only such repair work as was found to be absolutely necessary.

*Frankfurter Zeitung, July 10; Commerce Reports, Oct. 9.

Metal Accumulated in Russia

During the navigation period of 1917 about 80,000 tons of metal was imported into Russia through Archangel, says the *Ironmonger* of Sept. 21, 1918. When the revolution broke out, in November, 1917, the further transport of the metal into Russia was made difficult, and at the end of the year 32,000 tons of various metals had accumulated at the port. In the spring of the present year a beginning was made in sending this accumulation south, and by the end of June, 22,114 tons had been forwarded to Vologda, consisting of 10,299 tons of copper, 1565 tons of brass, 3454 tons of iron and steel alloys, 2267 tons of lead, 1991 tons of antimony, 1770 tons of aluminum, 551 tons of tin, 167 tons of steel, and 50 tons of spelter. As a result of newly arrived consignments, the stock of metals at Vologda is now said to have again increased to about 24,000 tons.

Research Laboratory Needs Data

The Engineering Foundation and the National Research Council are coöperating in compiling information about the research laboratories of the country and in promoting industrial research. They request all laboratories who have not yet done so to send to the New York office a brief statement covering the following matters:

Equipment—not a detailed list, but a summary indicating kinds and capacities in a general way and mentioning apparatus of unusual character or size; research work—general kinds, with reference, if permissible, to special problems which would indicate the scope of the work which the laboratory can undertake; staff—classes, such as chemists, physicists, engineers, assistants, together with the number of each, the name of the person in charge, and approximate time spent on research.

A committee consisting of Grant Hamilton, representing the Department of Labor; George J. Salmon, U. S. Bureau of Mines, and S. A Taylor, representing the Fuel Administration, has been formed to investigate mechanical labor-saving devices relating to mining.

Industrial News from Washington

By Paul Wooton, Special Correspondent

Report on Gold Situation Soon

The committee appointed by the Secretary of the Interior to study the gold situation expects to submit its report before the middle of November, practically all those having replied to whom questionnaires had been sent. In compiling its report, the committee had before it yearly statements of operations of all gold properties in the United States from 1913 to this time. It also had the opinions of all operators as to the effect of a continuation of present conditions on their production. None of the deductions of the committee is to be given out in advance of the complete report. The committee consists of Hennen Jennings, J. H. Mackenzie, Charles Janin, H. D. McCaskey, and F. L. Ransome.

Revenue Bill Covers Depletion

An addition to the War Revenue Bill to read as follows has been adopted by the Senate Committee on Finance:

In the case of mines, oil and gas wells, other natural deposits, and timber, a reasonable allowance for depletion, and depreciation of improvements, according to the peculiar conditions in each case, based upon cost, including cost of development not otherwise deducted: Provided, That in the case of such properties acquired prior to Mar. 1, 1913, the fair market value of the property (or the taxpayer's interest therein) on that date shall be taken in lieu of cost up to that date: And provided further, That in the case of mines, oil and gas wells, discovered by the taxpayer and not acquired as the result of purchase of a proven tract or lease, where the fair market value of the property is materially disproportionate to the cost, the depletion allowance shall be based upon the fair market value of the property at the date of the discovery, or within 12 months thereafter, such reasonable allowance in all the above cases to be made under rules and regulations to be prescribed by the commissioner with the approval of the secretary. In the case of leases the deductions allowed by this paragraph shall be equitably apportioned between the lessor and lessee. In the case of a foreign corporation, the deductions under this paragraph shall be allowed only as to property within the United States.

Pyrite Development Checked

Further development of domestic pyrite deposits is being discouraged by the Government. This condition has been brought about not only by the actual development of pyrite properties but by the unexpected growth in sulphur production in Louisiana and Texas. When the imports of Spanish pyrite first were curtailed, it was feared that it would be impossible to produce the necessary sulphur materials in this country to take the place of the normally heavy imports of the Spanish product. The point now has been reached, however, where there is danger of a domestic overproduction.

Negotiations are now in progress between certain pyrite producers and the War Industries Board as to the marketing of their product. On account of their high costs, many producers are not willing to sell on a parity with sulphur. Plants in the vicinity of pyrite mines are now required to use that material instead of sulphur, so long as the pyrite is offered on a parity with the sulphur price. Whether a higher price may be charged and the plants still required to use that material will be decided at the conferences now in progress. The opinion is expressed that the negotiations will result in a satisfactory agreement.

Lead-Silver Volatilization Tests

Reporting on experimental work being done in lead-silver volatilization, the acting superintendent of the Salt Lake City station of the U. S. Bureau of Mines states:

In the lead-silver volatilization work, tests have been conducted on pure minerals in a small electrical furnace with the object of discovering the factors that interfere with and assist in the recovery of silver. Exceptionally high recoveries of oxide copper were made. In order to determine just what results could be obtained on oxide copper ores, a series of experiments has been made, on both a large and a small scale. In practically every test, better than 95% of the copper has been obtained, and as high as 85% of the silver on a 15-oz. ore. The fume has varied from 36 to 40% copper, with high silver and gold content. The fume is easy to reduce by means of powdered coke and limestone.

No loss of chlorine was encountered in the various steps, so far as could be ascertained.

Chromite Import Limit Exceeded

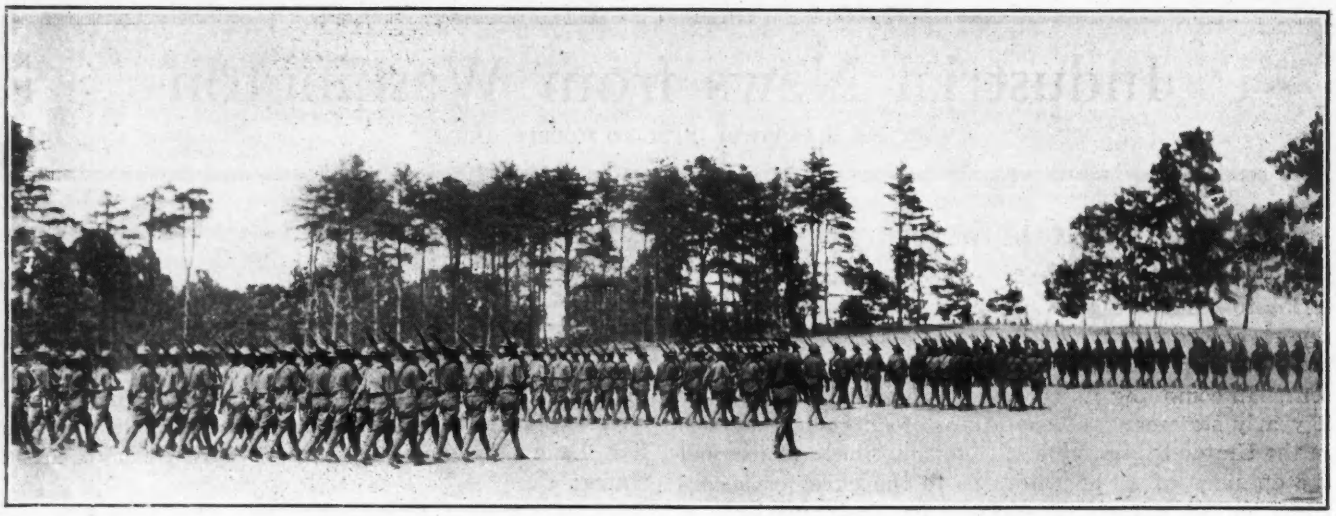
Immediate suspension of all shipments of chromite from overseas and revocation of all outstanding licenses therefor have been recommended by advisers to the War Industries Board and to the U. S. Shipping Board. An investigation of the chromite situation has developed that imports of that material have been much greater than the limits set by the restricting orders. This has been made possible by the loophole in the original order which permitted the use of chromite as ballast. The proposed change in the regulations would bar the importation of chromite, even as ballast.

New Engineer Chief Appointed

A new chief for the engineering division of the Ordnance Department, in the person of Brig.-Gen. G. W. Burr, has been chosen. General Burr succeeds Brig.-Gen. John H. Rice, now in France on active duty. The former is at present the representative of the Ordnance Department in England. Prior to that assignment he was in command at the Rock Island Arsenal. For many years he was in charge of ordnance matters in the Philippine Islands. Col. J. B. Dillard is acting chief of the engineering division.

Milling of Graphite Ore Improves

Decided improvement in the practice at graphite mills in Alabama is reported to the U. S. Bureau of Mines by one of its engineers, who is studying graphite conditions in that state. Though he finds widespread inefficiency on the part of the labor employed, and some inefficiency on the part of its supervision, a marked improvement has been made. No difficulty is being experienced in raising No. 1 flake to 88%, with good recovery.



A DETACHMENT OF THE 27TH ENGINEERS, PHOTOGRAPHED WHILE STILL ON THIS SIDE

Let the Comfort Fund Do Your Work

The things we would like to do for the men of the mining regiment which circumstances prevent can be done through the Comfort Fund. Hundreds of mining men have used this medium for showing their feeling toward the 27th Engineers, and it gets results.

It will be remembered that the last detachment of the regiment to go across was furnished a band through the Fund. It also carried a supply of smokes and considerable athletic equipment. Those who gave toward these things will therefore be interested to hear what Captain Balch, who commanded the unit on its trip over, has recently written from the other side. He says:

On disembarking we had to march through the town to the railroad station. The band covered itself with glory, and the whole battalion received an ovation. The Scottish people are certainly very hospitable at times.

After our Channel trip and arrival in France, we had a strenuous journey to our station, but are now comfortably located in billets in an old French town. We opened the boxes and distributed the tobacco to the men today, and they were very glad to receive it.

We are well equipped in the line of athletic supplies as compared with some of the other units near here, and the men appreciate it very much. Have a game scheduled for next Sunday with another regiment.

We lost four men coming over, who were sick and had to be transferred to the hospital, which was a very good record, considering the number of men. Our men are all in good health now, and we expect to get in some good hard training and hope to join the rest of the regiment soon.

Join the rest in maintaining the Comfort Fund. The mining regiment is your regiment and deserves your consideration.

HOW THE COMFORT FUND STANDS

Previously Acknowledged	$18,492.77
C. M. Eye	10.00
C. A. Burdick	5.00
Mining and Metals Section, National Safety Council	125.00
John Herman	10.00
Lane Pearl	5.00
W. L. Gibson	5.00
C. M. Fenton	10.00
Charles Le Vasseur, monthly	5.00
B. N. Jackson	10.00
H. A. Johann	10.00
Mrs. A. B. Emery, Messina, Transvaal	10.50
A. C. Stoddard	5.00
Robert E. Tally	25.00
Total	$18,727.77

Make your checks payable to W. R. Ingalls, treasurer of the Association of the 27th Engineers. Because of the work involved in administering the Comfort Fund contributions are acknowledged only by publication in the *Journal*.

The Situation in the Brass Business

Despite the drastic curtailment of the use of brass by all non-war consumers, there still is an important shortage in making up actual war needs. Chairman Baruch of the War Industries Board says that production now is running 40% below the demand.

On Aug. 29, 1918, according to figures compiled by Everett Morss, chief of the non-ferrous tubing section of the War Industries Board, the situation stood thus:

THE DAILY REQUIREMENTS IN SHEET AND ROD BRASS

SHEET BRASS, LB.	
Requirements for ordnance ammunition, etc.	2,220,000
Incidental requirements	1,000,000
Total demands	3,220,000
Actual production	1,800,000
Shortage	1,420,000

ROD BRASS, LB.	
Requirements for ordnance, ammunition, etc.	840,000
Incidental requirements	300,000
Total demands	1,140,000
Actual production	1,000,000
Shortage	140,000

Since Aug. 29, because of the widespread effect of the influenza epidemic among employees of the brass mills, as elsewhere, the situation has grown materially worse, and, in fact, may be said to have reached a crisis.

Three measures of relief, in the opinion of the chief of the non-ferrous tubing section of the War Industries Board, appear to be immediately demanded. They are:

1. For the Government to release soldiers from the camps and assign them to the brass mills in sufficient number to make up lost production due to the shortage of labor.

2. For the War and Navy departments to eliminate to the utmost possible extent the use of brass in various accoutrements and equipment for the Army and Navy. Major General Goethals, chief of the division of purchase and supplies of the War Department and a member of the War Industries Board, has already been advised by Mr. Morss that the use of brass buttons on uniforms must be discontinued, as there is not enough of the metal available for this purpose.

3. A more vigorous pruning by the Government of its demands for other uses, and the employment of sharper restrictions to prevent the various departments from demanding more than their actual needs. Specifications must be revised.

October Mining Dividends

Dividends disbursed in October, 1918, by 29 United States mining and metallurgical companies making public reports amounted to $5,658,584, as compared with $9,778,910 paid by 48 companies in October, 1917. Holding companies paid $348,139 in October, 1917, but nothing in October, 1918. Canadian, Mexican and

MINING DIVIDENDS

United States Mining and Metallurgical Companies	Situation	Per Share	Total
Am. Smelters, pfd. A	U. S.-Mex.	$1.50	$148,013
Am. Smelters, pfd. B	U. S.-Mex.	1.25	44,242
Arizona Commercial, c	Ariz.	.50	132,500
Bingham Mines, c	Utah	.50	(a) 75,000
Caledonia, l.s	Ida.	.03	78,150
Cardiff, l.z	Utah	.20	100,000
Cons. Interstate-Callahan, l.z	Ida.	.75	348,742
Cresson Cons., g	Colo.	.10	122,000
Dragon Con., l.s	Utah	.01	18,750
Golden Cycle, g	Colo.	.03	45,000
Grand Central, l.s	Utah	.04	24,000
Homestake, g	S. D.	.50	125,580
Inspiration, c	Ariz.	2.00	2,363,934
Iron Blossom, l.s	Utah	.02½	25,000
Iron Cap, c	Ariz.	.25	36,203
Judge Min. and Sm., l.z.s	Utah	.12½	60,000
Nevada Packard, g.s	Nev.	.02½	29,122
New Idria, q	Calif.	.50	50,000
North Butte, c	Mont.	.25	107,500
Ontario, s	Utah	.50	75,000
Portland, g	Colo.	.02	60,000
Richmond, l.s	Ida.	.01	8,400
Rochester Mines, g	Nev.	.02	40,000
Shattuck Arizona, c	Ariz.	.50	175,000
Tonopah Min., s	Nev.	.15	150,000
United Eastern, g	Ariz.	.05	68,150
U. S. Smelting, com	U. S.-Mex.	1.25	438,894
U. S. Smelting, pfd	U. S.-Mex.	.87½	425,555
Vindicator, g	Colo.	.03	45,000
West End, g.s	Nev.	.10	178,849
Wolverine, c	Mich.	1.00	60,000

Canadian, Mexican and Central American Companies	Situation	Per Share	Total
Cons. Min. & Sm. Co., c.z	B. C.	$0.62½	$261,936
El Oro Min. and Ry., g.s	Mex.	.24	57,375
Hollinger, g	Ont.	.05	246,000
Howe Sound, c	B. C.	.05	99,208
McKinley-Darragh-Savage, s	Ont.	.03	67,431
N. Y. & Hond. Rosario	C. A.	.50	100,000
Nipissing, s	Ont.	.25	300,000

(a) Payable in Liberty Bonds.

Central American companies paid $1,131,950, as compared with $1,287,137 in October, 1917.

The totals for the first ten months of the year are as follows: Mining and metallurgical companies, $135,187,192; holding companies, $1,728,438; Canadian, Central American, South American and Mexican mines, $19,618,740.

Imports of Ores and Metals

Imports of antimony, pyrites and manganese, as reported by the U. S. Department of Commerce for August, 1918, and the figures for August, 1917, as finally revised, are as follows:

	August, 1917	August, 1918
Antinony ore, contents, lb	1,457,798	18,951
Antimony matte, regulus or metal, lb	6,414,175	2,886,926
Pyrites, long tons	118,575	57,420
Imported from:		
Spain, long tons	69,674	15,364
Canada, long tons	48,901	41,469
Manganese ore, long tons	87,650	33,975
Imported from (in part):		
Cuba	4,860	972
Brazil	79,511	25,520
British India	1,500	1,650

American Smelting and Refining Co.

In its twentieth semi-annual report, covering the period ended June 30, 1918, the American Smelting and Refining Co. refers to the difficulties which have arisen because of the increase in operating costs, coupled with a stationary income on account of fixed contract charges. Many of the company's establishments were operating at a loss. The matter was discussed with the various companies with whom the A. S. and R. Co. had entered into long-term contracts, with the result that an agreement has been reached. This factor, coupled with the results arising from the improved situation in Mexico, permits the company to report earnings sufficient for the usual dividend requirements.

Net income amounted to $9,745,525.77, and permitted dividend disbursements of $3,954,949; surplus account was credited with $113,872.08. The net amount credited to property account during the period was $2,891,635.35; and the total charge to property account amounted, on June 30, 1918, to $133,905,840.87, or a reduction during the 12 months of $4,850,703.67.

Manganese in Wyoming

Few deposits of manganese ore are known in Wyoming. A deposit in the northern part of Albany County was examined by E. L. Jones, Jr., of the U. S. Geological Survey, in October, 1917. It was being exploited by the Wyoming Manganese Co., of Laramie. At the time the deposit was visited no ore had been shipped, although about 200 tons of ore containing 40% Mn was on the dumps. Later in 1917 about 30 tons of high-grade ore was shipped to a mill at Boulder, Colo., for experimental purposes. The development work consisted of 200 ft. of tunneling connecting with a shaft 25 ft. deep.

Tin Mining in Federated Malay States

The *British Board of Trade Journal* for Aug. 22 contains the following report on the tin-mining industry of the Federated Malay States:

British territory produces by far the largest share of the world's supply of tin, and the Malay States for many years have been the chief source of the metal. Last year's export from the Federated Malay States amounted to 39,833 tons, as compared with 43,870 tons in 1916, but the value of the exports rose from £7,526,566 in 1916 to £8,489,610 in 1917.

The average sterling value per ton in Singapore in 1917 was £213 2s. 7.3d. (a new record), compared with £171 11s. 2.1d. in 1916, and £153 4s. 3.1d. in 1915. In no previous year has the London market been subjected to such abnormal pulsations as in 1917, the lowest cash price quoted being £180 15s., on Jan. 1, and the highest £309 per ton, on Dec. 21—a fluctuation of £128 5s.

The output and value of the metal from the four states is compared in the following table:

TONNAGE AND VALUE OF TIN PRODUCED IN FEDERATED MALAY STATES

	1916		1917	
States	Tons.	Value.	Tons.	Value.
Perak	27,242	£4,675,379	24,643	£5,264,215
Selangor	12,241	2,099,072	10,960	2,323,541
Negri Sembilan	907	155,887	734	157,346
Pahang	3,480	596,228	3,496	744,508
Totals	43,870	£7,526,566	39,833	£8,489,610

The total of the Fourth Liberty Loan is now estimated to be $6,500,000,000. Oversubscription in every Federal Reserve district is indicated. This is a fitting commentary on the efforts of the energetic workers who have made the loan successful. More than that, it shows the unity and purpose of the citizenry of our country.

Editorials

Let There Be No Relaxation

ONE of the leading German newspapers is reputed to have made the remark that "If the Kaiser really has any arrangement with Gott, now is the time when he needs the benefit of it."

In former times military supremacy has been determined by the number of men on the opposing sides, but the comparison has not always been numerical. When the arms and equipment and the directing genius were equal, two opposing armies came to a deadlock. Indeed, a defense of inferior numbers could produce that result, the offense needing always to have a certain superiority.

When, however, an army provided with firearms marched against an army of bowmen and axmen, a numerically inferior force could overwhelm, for one man with a musket was superior to many men armed only with axes.

In the present war the opposing armies were for a long time nearly equal in striking power, but during the last six months the Allies have acquired a distinct superiority, and that superiority is increasing every day, owing to America's exertion of mechanical power. Owing to the latter, each million of Germans in the field may be opposed by a million of Allies multiplied by 3, 5, 10, or some other factor which represents their enginery. The men who are producing the engines in the shops at home are therefore fighting just as much as the men who are using them in the field.

The time is therefore coming, if it has not already come, when the Allies will possess such superior power, through their guns, gas shells, tanks, aëroplanes, motor trucks, etc., that the Germans cannot withstand them at all. Probably the Germans see this, and, being unable to create an equivalent mechanical power, owing to deficiency of material, men, etc., are interested in talking about peace in order to stave off the inevitable and irresistible invasion of Germany.

The job is going to be done, but until it is finished we must not relax one ounce in our efforts. Relaxation is the one thing for which the Germans are praying. Therefore we must be careful not to play into their hands.

Germany's Economic Position

WHEN the war began, the wealth of the German Empire was estimated to be $80,000,000,000. This has now been reduced to about $50,000,000,000, it is said, while the national debt has been increased to about $58,000,000,000; wherefore the statement is made that "Germany's debts now exceed her assets."

We do not know whether the above figures be approximately correct or not, but we do know that the deduction is incorrect. Germany's debt is mainly internal, i.e. the German people as a whole owe it to those Germans who are bondholders. This is a matter of internal distribution of wealth, which may be arbitrarily readjusted. It has nothing to do with the national wealth. Germany possesses the same land, forests, mines, factories, houses, railways, municipal improvements, etc., that she did before the war. She has lost nothing of her material resources and property, except to the extent that her metals, chemicals, etc., have been discharged on the battlefields, or have been supplied to her allies, whose notes are probably no longer good; and to the extent that the fertility of her lands have been robbed and her railways and machinery have been impaired by wear. All of this may be loss enough, but it is a long way from spelling bankruptcy, for if there were really the latter the people would not be able to exist at all.

On the other hand, Germany still possesses the machinery and treasures that she has looted from Belgium, Northern France, and Russia, estimated by M. Cheradame in the billions, which, of course, she will be required to return. It is not unlikely that the financial arrangements of the great settlement will compel the Germans to cancel their indebtedness among themselves and put everything in a common pool to pay up the foreign indemnities for restoration; but pay up they will in the course of time.

In this connection, some of our own people will have to revise their economic ideas. Already there is agitation for protective duties to support some of our producers who have sprung into being during the stimulus of war prices and now foresee extinction unless aid be extended to them. The advocates of a protective tariff are "barking up the wrong tree," as one of our friends has aptly put it.

The war has made us a creditor nation. Now, how are our debtors abroad going to pay their interest and principal unless we buy things from them, and what should we buy unless we take those things that they can supply cheaper than we? How is Germany going to pay her foreign debt? She will have very little to sell except her work. The only way the rest of the world can get advantage of her work is to buy from her. The United States may not have to buy directly from Germany, although of course we will buy some things, such as potash, from her. We may sell to her largely of copper and other things. She will sell goods to China and other countries, and we shall have to buy from them. The bankers will settle the triangular, quintangular, or multi-angular accounts, and this is the only way we can collect our foreign credits.

Coal From Lens

PERHAPS it would be better to say that there is no coal in Lens. Probably more suffering is borne throughout France for lack of coal than for the lack of any other one commodity. Frenchmen have generally felt that if their armies could only recapture Lens a great part of the suffering, which their fellow country-men have borne uncomplainingly, might be largely or totally eliminated. Lens has been taken, but a dispatch from Paris informs us that the methodical Germans have, as usual, completed their task of destruction in the vicinity of Lens in a thorough and businesslike manner, and that the work of restoration, no matter how actively pushed, will not permit of any coal being mined this winter. A period of reconstruction of a year or two must precede production. To civilians this is a hard blow, but the engineers who know the mines of that district are not in the least surprised.

A French civilian, speaking recently of the fuel situation in France, remarked: "Our soldiers have no fear of German shot and shell. They feel that in some way their women at home will get food; but they know that their children are cold and will be so until after peace is declared. That thing which spurs them to the utmost endeavor is also the thing that may weaken them most."

Some of us were a little inconvenienced last winter for a few days, and thought disagreeable things if we did not say them.

During the coming winter we may have a few more such days, but before complaining let us recall that those who have been holding the front line for us have had four years of coalless winters and are now facing another with so little of complaint that many of us had not heard that they were even short of coal.

Dust Abatement in Mines

IN THE current issue we publish an excerpt from a paper on "Dust Abatement in Mines," presented by Mr. W. O. Borcherdt at the recent annual congress of the National Safety Council. We are glad to note that Mr. Borcherdt takes the position that dust of all kinds is injurious if it is in the air that is regularly breathed by miners or others. Attention has been directed mainly to finely divided siliceous dust, for the injurious effects of this dust have been investigated with a considerable degree of thoroughness in Western Australia, South Africa, and in our own country.

The statement is often made that certain kinds of dust, such as coal dust and non-siliceous dusts, are not harmful, but we think that any dust taken into the lungs in sufficient quantity to overcome the natural rate of elimination must accumulate, and though it may not in every instance do injury to the lung tissue, it at least interferes with the efficiency of the lung cells in performing their function.

The solution of the dust problem, reduced to its simplest form, necessitates the prevention of dust entering the lungs. The problem has been attacked from several different directions. First, an attempt was made to induce the miners to use respirators, but these did not receive ready acceptance. Next, efforts were made to prevent dust from getting into the air. Drilling, blasting, and the shoveling, loading and unloading of ore and waste are the principal causes of dust-charged air. Dust-catching bags were used with certain types of drills, hollow steel and water sprays with others, and outside sprays with still others. The hollow-steel drill with internal spray is without doubt the most practicable arrangement yet devised for the elimination of dust caused by drilling. The result of Mr. Borcherdt's questionnaire bears this out and agrees with our opinion.

Elimination of dust resulting from blasting operations has not been so easily accomplished. The first attempt was to reduce the amount of dust from this source through confining blasting operations to the end of a shift and allowing a sufficient time interval for the dust to settle. This was only a partial remedy. The next step was to increase the quantity of air in circulation so as to dilute the dust in suspension to a relatively small amount per unit of air volume. There are limits to the amount of air in circulation, and, if these are exceeded, dust is picked up and brought into circulation, defeating to a considerable extend the desired end. A great increase in volume of air also operates to dry out the mine and, if anything, to increase the dust nuisance. Ventilation will, however, always be an important factor in dust control.

In handling dry, dusty ore, the most effective preventive seems to be the general spraying of ore piles with water. By wetting the ore sufficiently—and this is not always easy to do—much dust can be eliminated.

We are inclined not fully to agree with Mr. Borcherdt's view that dust respirators do not, in general, present any hope of a solution, although we appreciate the reasons that he presents. Our own experience with different types of respirators inclines to the belief that much can be done to improve them. At the Chemical Exposition, held recently in New York, we had an opportunity to examine closely a new type of respirator, and found that some of the objectionable features of the older types had been removed. This respirator is light, convenient, and as comfortable as such devices can be. The filtering area is large. The filter disk is light, porous and an effective dust-stop.

The development of gas masks may help materially in the perfection of a satisfactory respirator. It is obvious that an efficient respirator with ample filtering surface will meet the primary requirement of preventing dust from entering the lungs, and it is this important fact that leads us to take the position that as much or more attention should be directed to the development of a respirator as to the perfection of the oxygen apparatus. We do not advocate the universal use of respirators, but rather a limited use, particularly in ore shoveling and chute loading.

Dust prevention may properly be considered as much a part of the duties of a mining engineer as mine surveying. The mine office should be equipped with dust-sampling apparatus, and regular surveys of dust conditions should be a part of the routine work of a mine where there is a conspicuous or dangerous amount of dust. There is no panacea for dust, but by intelligent application of the various methods of prevention that mining practice has evolved, its pernicious effects may be greatly lessened, if not eliminated.

In the midst of the war news, the wreck of the "Sophia," in Lyn Canal, with the loss of both passengers and crew, draws attention to far-off Alaska. This is the time of year that miners who have completed their season's work leave for their homes in the States. Doubtless many of them were on board. Our hearts go out in sympathy for those who lost their lives in this accident.

BY THE WAY

A well-known mining man writes us from Africa, his letter being, of course, a long time in coming, as follows: "I see that Hoover is to be the guest of the British nation shortly. If we cannot have him for the House of Lords, we want him for Westminster Abbey, when you have finished with him." Our correspondent, by the way, is an Englishman.

Among the most audacious gold thieves who flourished on the Westralian fields in the boom days was a German mine-manager who worked in with another German, the owner of a treatment plant, and stole amalgam and zinc-box slimes wholesale, writes "Oof Bird" in the *Bulletin*. Both grew very wealthy, and when the Chamber of Mines detective force began to get around they hurriedly left the country. Another was an assayer with a small reduction plant, who had a baker as a partner. The baker collected telluride ore specimens on his rounds and secreted them in the loaves which he delivered to the assayer. A lucrative business was done in this way. A third, head of a syndicate of three, was metallurgist at one of the big mines. A barmaid received the stolen stuff from him and passed it to the owner of an alleged gold-producing show, for treatment. All three shared alike and made a lot of money. Scores got nice-sized parcels of gold together and then went out into the bush and made "new finds." The papers raved about the prospects of these for a little while, and then the announcement of "a return" enabled the finders to lodge their gold in the bank without questions being asked. Nowadays the bank officials are more inquisitive and the police more watchful.

At that time [early in 1859] Comstock, whose name is now heard in all parts of the world in connection with the great silver lode bearing his name, was familiarly known to the miners as "Old Pancake," wrote Dan De Quille in "The Big Bonanza." Some ladies from Genoa visited the mine, attracted by the reports of its great richness which had reached the town. Comstock was delighted, showed them everything, and gallantly offered each lady a pan of dirt, a piece of politeness customary in California in the early days when ladies visited a mine. "Old Pancake" was anxious that each of his visitors should get something worth carrying home, and, by means of sly nods and winks, gave one of the workmen to understand that he was to fill the pans from the richest spot.

One of the ladies was young and very pretty. Although each of the other ladies had obtained from $150 to $200 in her pan, Comstock was determined that something still handsomer should be done for this visitor. When her pan of dirt was being handed up out of the cut (that is, the open cut run into the lead), he stepped forward to receive it, and, as he did so, slyly slipped into it a large handful of gold which he had taken out of his private purse. The result was a pan that went over $300, and "Old Pancake" was happy all the rest of the day.

The Eleventh Engineers

Thomas M. Johnson, staff correspondent of the *Evening Sun*, cabled the following under date of Oct. 13:

While the New York infantry has swept the Germans from the Argonne forest and the New York artillery has blasted them from their trenches along the Meuse, the New York railroad engineers (the Eleventh Engineers) have been behind them bringing up the rations and the shells that feed the men and guns.

The troops commanded by Col. William Barclay Parsons, who were among the first American units to arrive in Europe nearly a year and a half ago, laid much of the standard-gage railroad track behind the lines that was needed for the transportation of supplies for the St. Mihiel attack. So these men helped in the first American offensive.

They are now laying track and running trains with engines made in the United States, marked "U. S. A.," on the famous Verdun battlefield, hauling monster shells for the heavy guns that are blasting the trenches of the Kriemhilde Stellung.

These famous troops, who jumped into the first Cambrai battle one year ago and fought beside the British, are now so expert that they can lay broad-gage track faster than the infantry can advance.

Maj. Walter T. Chevalieri's battalion broke the record at St. Mihiel. This was the result of experience gained with the British and on American lines of communication, where these engineers spent several months prior to the St. Mihiel attack.

These New Yorkers show long training and experience in every action. Lean, sunburned, husky, they're tremendous workers and have been of inestimable value to the First Army in its two attacks.

The Eleventh Engineers is the regiment in which Dwight and Stehli are officers, and in which, also, was the lamented Irving.

Trust tha Pumps

By D. E. Charlton

I 'as 'eard of pumps gert, I 'as 'eard of pumps small,
I 'as 'andled them many a year,
An' I naws all about 'em an' naws 'ow they act
An' I'll tell 'e, there's nothin' to fear
If there's plenty of steam an' tha gaskets 'old tight,
An' tha win'bore is clear in tha sump.
If it's sinkin' or minin' an water shows h'up,
Don't thee worry or fret—trust tha pump.

W'en I think o' tha minin' I 'as done back long we
An' tha minin' I's done over 'ere,
I can truthfully say that tha troubles I've 'ad
Are a 'eap, but tha one's I 'old dear
Ain't tha troubles with pumps, for I naws bloody well,
That each time there wuz water to face,
I 'as banked on m' pumps an' they hasn't lost yet,
An' they always come firs' in tha race.

I ain't sayin' as 'ow, if tha water's too much,
That there's no chance to drown' h'out tha mine,
But jus' crowd in tha pumps, an' soon thee will see
That tha bailin's a matter o' time.
Thee can fill h'up tha drif' with a bulk'ead an' such,
But w'en water starts in pourin' through,
There's but one way to stop un an' that is, m'son,
To start up tha pumps—see thee do.

'Andlin' water s'like minin', its in all nawin' 'ow,
So jus' take this 'ere bit from me—
Make sure w'en tha driftin' is like to be wet
That tha pumps is all 'andy, an' see
That there's plenty o' gaskets an' pipe lyin' round—
No tellin' 'ow fas' thee mus' jump
W'en tha water starts comin', it's 'urry, m'son—
But thee's safe enough then, trust tha pump.

The Mining Index

This index is a convenient reference to the current literature of mining and metallurgy published in all of the important periodicals of the world. We will furnish a copy of any article (if in print) in the original language for the price quoted. Where no price is quoted the cost is unknown. Inasmuch as the papers must be ordered from the publishers, there will be some delay for the foreign papers. Remittance must be sent with order. Coupons are furnished at the following prices: 20c. each, six for $1, 33 for $5, and 100 for $15. When remittance are made in even dollars, we will return the excess over an order in coupons if so requested.

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10062—SURVEYING—Common Methods of Determining Latitude and Azimuth Useful to Engineers and Surveyors. Compiled by Harry J. Wolf. (Quart. Colo. School of Mines, July, 1918; 11 pp.)

10063—TIMBERING—A Reenforced Drift Set. James E. Harding. (Eng. and Min. Journ., Oct. 19, 1918; 1 p., illus.) 20c.

10064—VENTILATION—Practice of Mine Ventilation. Chas. A. Mitke. (Paper before National Safety Council, Sept., 1918; 5 pp.)

FLOTATION

(See also "Lead and Zinc")

10065—COLLOIDS in Flotation. Jackson A. Pearce. (Min. and Sci. Press, Oct. 12, 1918; 2½ pp., illus.) 20c.

10066—FLOW-SHEETS—Flotation Flow-Sheets. Algernon Del Mar. (Min. and Sci. Press, Sept. 7, 1918; 1⅜ pp., illus.) 20c.

10067—LITIGATION—Similarities in the Legal Aspects of Some Flotation, Cyanidation and Filtration Litigation. R. C. Canby. (Bull. Can. Min. Inst., Sept. 1918; 10½ pp.)

ORE DRESSING—GENERAL

10068—MILLING—The Morale of Mill Crews. Paul T. Bruhl. (Eng. and Min. Journ., Oct. 12, 1918; 2 pp.) 20c.

10069—SAFETY—Hazards and Safeguards in Ore-Dressing Plants. John Stuart McKaig. (Paper before National Safety Council, Sept., 1918; 7½ pp., illus.)

10070—SCREENING—Mechanical Screening of Wet Pulp. H. A. Megraw. (Eng. and Min. Journ., Sept. 21, 1918; 2 pp.) 20c.

METALLURGY—GENERAL

10071—ALLOYS—The Pyrophoric Alloy Industry. Alcan Hirsch. (Journ. Ind. and Eng. Chem., Oct., 1918; 2½ pp.) Paper before Fourth National Exposition of Chemical Industries, Sept. 27, 1918.

10072—BRASS MELTING—The Present Status of Electric Brass Melting. H. M. St. John. (Chem. and Met. Eng., Sept. 15, 1918; 8 pp., illus.)

10073—ELECTROCHEMISTRY and National Economy. Colin G. Fink. (Advance copy, Am. Electrochem., Soc., Apr., 1918; 6 pp.)

10074—EXPANSION OF METALS by Heat. John Roger. (Min. and Sci. Press, July 27, 1918; ⅜ p.) 20c.

10075—MELTING FURNACE—Electric Furnace for Melting Alloys. Wm. H. Easton. (Elec. Wld., Aug. 17, 1918; 2 pp., illus.) Describes furnace in operation at plant of Driver-Harris Co. 20c.

10076—METALLOGRAPHY AND HEAT TREATMENT of Metals Used in Aëroplane Construction. F. Grotts. (Chem. and Met. Eng., Sept. 15, 1918; 4½ pp., illus.) Fourth article of series.

10077—REFRACTORIES—Carborundum Refractories. S. C. Linbarger. (Journ. Ind. and Eng. Chem., Oct., 1918; 2½ pp., illus.)

10078—REFRACTORIES—Recent Developments in Ceramics. A. V. Bleininger. (Journ. Ind. and Eng. Chem., Oct., 1918; 2½ pp.) Paper before Fourth National Exposition of Chemical Industries, Sept. 26, 1918.

10079—REFRACTORIES—The Manufacture of Ceramic Wares in the Union of South Africa. John Adams. (So. Afr. Journ. of Industries, May, 1918; 12½ pp.)

10080—REFRACTORY MATERIALS—Relative Volatilities of Refractory Materials. Wm. Roy Mott. (Advance copy, Am. Electrochem. Soc., Sept.-Oct., 1918; 34 pp., illus.)

10081—REFRACTORY MATERIALS—The Standardization of Tests for Refractory Materials. Communicated, with introduction by Cosmo Johns. (Advance copy, Iron and Steel Inst., Sept., 1918; 32 pp., illus.)

10082—ROASTING—New Merton Roasting Furnace for Blende. (Eng. and Min. Journ., Sept. 28, 1918; 1 p., illus.) 20c.

10083—SAFETY and Health in Hydrometallurgical Plants. A. W. Allen. (Eng. and Min. Journ., Sept. 14, 1918; 1⅜ pp.) 20c.

10084—STELLITE Developed by Arc Furnace. Elwood Haynes. (Iron Tr. Rev., Oct. 17, 1918; 2 pp., illus.) 20c.

10085—STELLITE—Quelques Observations sur "Le Stellite." L. Guillet and H. Godfroid. (Rev. d. Met., July-Aug., 1918; 8 pp., illus.)

SAMPLING AND ASSAYING

10086—BARIUM—Separating Barium from Strontium. John Waddell. (Min. and Sci. Press, Oct. 12, 1918; 1½ pp.) 20c.

10087—SULPHUR DIOXIDE—Simple Method for Determining Sulphur Dioxide. G. W. Jones, J. H. Capps and S. H. Katz. (Min. and Sci. Press, Sept. 28, 1918; 4 pp., illus.) 20c

FUELS

(See also "Petroleum and Natural Gas.")

10088—CANADA—The Fuels of Canada: Methods for More Efficiently Utilizing Our Fuels. B. F. Haanel. (Gen. Elec. Rev., Oct., 1918; 9½ pp., illus.) Read before the annual meeting of the Can. Soc. of Civ. Eng.

10089—COAL in 1916. C. E. Lesher. (Mineral Resources of the U. S., 1916—Part II.; 91 pp.)

10090—COKE—Development of the Coke Industry in Colorado, Utah and New Mexico. F. C. Miller. (Bull. A.I.M.E., Aug., 1918; 4 pp.) 40c.

10091—CONSERVATION—Methods for More Efficiently Utilizing Our Fuel Resources, Part XX: Is Our Fuel Supply Nearing Exhaustion? R. H. Fernald. (Gen. Elec. Rev., Aug., 1918; 13½ pp., illus.)

10092—FUEL OIL—Home Sources of Fuel Oil. (Iron and Coal Tr. Rev., Aug. 9, 1918; 1½ pp.) Official report of committee appointed to deal with the subject by Ministry of Munitions of War; also Interim Report of Committee of Petroleum Technologists. 40c.

10093—PEAT—The Utilization of the Peat Resources of Canada. B. F. Haanel. (Journ. Soc. Chem. Ind., Aug. 15, 1918; 3½ pp.)

10094—POWDERED COAL—A Diversified Application of Powdered Coal. Chas. Longnecker. (Iron Age, Sept. 12, 1918; 4½ pp., illus.) The pulverized fuel is distributed by compressed air to sub-stations and used in open-hearth, annealing and other furnaces. 20c.

10095—STORAGE—Coal Storage in Large Quantities: Methods, Equipment and Typical Installations Henry J. Edsall. (Industrial Management, Sept. 1918; 8 pp., illus.) 40c.

10096—WASTE HEAT—The Utilization of Waste Heat from Open-Hearth Furnaces for the Generation of Steam. Thos. B. MacKenzie. (Advance copy, Iron and Steel Inst., Sept., 1918; 24 pp., illus.)

MINING AND METALLURGICAL MACHINERY

10097—AIR-COMPRESSORS—Modern Air-Compressors. David Penman. (Min. Mag., July, 1918; 9 pp., illus.) Conclusion of article previously indexed.

10098—CRANES—Safety Code for Electric Cranes. (Iron Tr. Rev., Sept. 12, 1918; 1½ pp.) 20c.

10099——ELECTRIC FURNACE—Northrup-Ajax High-Frequency Induction Furnace. (Chem and Met. Eng., Aug. 1, 1918; 1⅜ pp., illus.)

10100—LOCOMOTIVES—A New Type of Mine Locomotive Controller. L. W. Webb. (Gen. Elec. Rev., Sept., 1918; 3 pp., illus. Aug. 17, 1918; 1½ pp., illus.) 20c.

10101—MOTORS—Electric Motor Faults. J. Humphrey. (Iron and Coal Tr. Rev., Aug. 2, 1918; 1½ pp.)

10103—WELDING—Bibliography of Electric Welding. 1918-1914. Wm. F. Jacob. (Gen. Elec. Rev., Sept., 1918; 6 pp.) 20c.

10104—WELDING—Electric Welds. Ernest Edgar Thum. (Chem. and Met. Eng., Sept. 15, 1918; 7½ pp., illus.)

INDUSTRIAL CHEMISTRY

10105—POTASH from Searles Lake. Alfred De Ropp, Jr. (Jour. Ind. and Eng. Chem., Oct., 1918; 4⅜ pp., illus.)

10106—POTASH—Recovery of Potash from Iron Blast Furnaces and Cement Kilns by Electrical Precipitation. Linn Bradley. (Journ. Ind. and Eng. Chem., Oct., 1918; 3⅜ pp.)

10107—POTASH—Recovery of Potash from Kelp. C. A. Higgins. (Journ. Ind. and Eng. Chem., Oct., 1918; 2 pp., illus.) Paper before Fourth National Exposition of Chemical Industries, Sept. 25, 1918.

10108—POTASH—The Prospects of Founding a Potash Industry in this Country. Kenneth M. Chance. (Journ. Soc. of Chem. Ind., July 31, 1918; 7⅜ pp.)

10109—POTASH—The Recovery of Potash as a By-Product in the Manufacture of Portland Cement. John J. Porter. (Chem. Engr., July, 1918; 4½ pp.

Personals

The paragraph in this column of our last issue, reporting changes in the management and staffs of the Nevada Consolidated Copper Co. and Chile Copper Co., was incorrect, except that portion of it which said that C. V. Jenkins, of the Nevada Consolidated, had been transferred to New York. The paragraph came from our Ely correspondent, and was supposed by us to be reliable, until it was repudiated by several of the persons mentioned and officially from the Nevada Consolidated office. We regret the error and make haste to substitute this correction.

Morton Webber was in Salt Lake City last week.

Fred G. Farish is examining mining property in Nevada.

Robert E. Cranston, mining engineer of San Francisco, has joined the Food Administration.

Harry Urban has been appointed general manager of the Woodward Iron Co., of Alabama. **E. J. Best** has been made chief engineer.

Frank W. McLean, superintendent of the Morenci, Ariz., branch of the Phelps Dodge Corporation, is recovering from a serious illness.

R. R. Leslie has been appointed general superintendent of the Cubo Mining and Milling Co.'s property at Guanajuato, Gto., Mexico.

Thomas Chalmers has been appointed superintendent of the Fairfield byproduct coke plant of the Tennessee Coal, Iron and Railroad Company.

Anthony Jenkin has resigned as mining engineer for the Seneca Mining Co., Calumet, Mich., and has joined the staff of the Utah Consolidated Mining Co., Bingham, Utah.

D. J. Parker, of Pittsburgh, Penn., mine safety engineer of the U. S. Bureau of Mines, has been in Butte, Mont., arranging to establish a fourth mine-safety district in the West.

Dr. M. Y. Williams, Canadian government geologist, and **H. F. Slater,** general manager of the Rockwood Oil and Gas Co., are making an inspection of the Mosa Township, Ontario.

Charles M. Campbell, superintendent of the Granby Consolidated Mining, Smelting and Power Co.'s mines at Phoenix, B. C., has been examining copper properties in northern Manitoba, Canada.

Frederic Keffer, mining engineer of Spokane, Wash., who has been examining claims at Ainsworth, B. C., in the West Kootenay district, has gone to Lewiston, Idaho, to inspect properties there.

W. V. De Camp has resigned as superintendent of the Consolidated Arizona Smelting Co.'s Blue Bell mine, having been commissioned a first lieutenant of engineers, and has gone to Camp Cody, Deming, N. M., for training.

William H. Hampton has been placed in charge of miscellaneous gas-defense apparatus at the Long Island laboratory, gas-defense division of the Chemical Warfare Service. He is stationed at Long Island City, New York.

H. C. Thomas, formerly chief chemist for the Illinois Steel Co. at Gary, Ind., has been appointed assistant general superintendent of the United Alloy Steel Corporation, of Canton, Ohio, with which company he has been affiliated since June 1.

Prof. Edward E. Bugbee, of the mining department of the Massachusetts Institute of Technology, has been granted a leave of absence to become assistant director of education for the students' Army training camps in five Southern states, with headquarters at Raleigh, North Carolina.

Francis N. Flynn has been appointed assistant general superintendent of the Balbach Smelting and Refining Co. at Newark, N. J. Mr. Flynn was until recently in charge of the smelting and refining departments of the Consolidated Mining and Smelting Co. of Canada.

S. S. Arentz is a captain in the U. S. Army. Other Utah engineers in the service include Capt. E. P. Kipp, Capt. Stanley C. Sears, Capt. A. D. Knowlton, Capt. R. M. Croker, Capt. James W. Wade and Capt. C. H. Jones; and First Lieutenants George P. Greenman, Paul R. Arentz, Leland Kimball and H. A. Kleinschmidt.

James Colquohoun, formerly manager of the Arizona Copper Co. of Clifton, Ariz., who was thought to have been lost in Russia, is reported to have arrived in England. He managed to make his way from southeastern Russia into Siberia and eventually reached Archangel, where he secured passage to Norway and thence to England.

Herbert C. Hoover, chairman of the Commission for Relief in Belgium, received on Oct. 24 this cablegram from the King of the Belgians, dated Oct. 22: "On this, the fourth anniversary of the foundation of the Commission for Relief in Belgium, my heart prompts me to thank you once more in the name of all my compatriots for having during four years saved the Belgian nation from starvation.—Albert."

Obituary

W. H. Woodson, a pioneer miner of the Globe-Miami district, in Arizona, died recently in Los Angeles, California.

William Main, a chemist and formerly interested in mining and metallurgical work in the West, died at Piermont, N. Y., on Oct. 18, aged 74 years.

A. B. Clabon, president of the Vancouver Chamber of Mines, Vancouver, B. C., was killed on Oct. 16 by falling over a precipice at Silver Creek, B. C., during a visit to the Wolsely claims, located there.

Stanley C. Way, superintendent of the Coates & Tweed properties of the Mesabi Range, with headquarters at Virginia, Minn., was killed by gas in a test pit, which the company was sinking, near Biwabik, Minnesota.

Branch E. Russell, captain of the San Francisco mine of the Morocochа Mining Co., at Tuctu, Morococha, Peru, was murdered on Sept. 18 by a disgruntled employee of the company. He had been in Peru about nine months, having gone there from Arizona.

Eugene N. Engelhardt, superintendent of the Selby Smelting and Lead Co., at Selby, Calif., for the last 11 years, died by his own hand on Oct. 13 at Oakland, Calif. He was a graduate of the Columbia School of Mines, 1885, and a member of the American Institute of Mining Engineers.

William D. Stevens, a mining engineer and a graduate of the Michigan College of Mines, died of pneumonia on Oct. 13 at Aberdeen Proving Grounds, in Maryland, aged 29 years. He was a son of the late Horace J. Stevens, publisher of the "Copper Handbook," and, previous to enlisting in the Army, had been in the employ of the Bethlehem Steel Co. He was buried at Houghton, Michigan.

Harry T. Binder, assistant superintendent of the electrolytic refinery of the Raritan Copper Works, Anaconda Copper Mining Co., Perth Amboy, N. J., died Oct. 24, 1918, in Perth Amboy of heart failure, following an attack of Spanish influenza. He was 36 years old, and for the last 17 years had been in the employ of the company at Perth Amboy. Mr. Binder was well versed in all matters pertaining to selenium and tellurium, and had charge of the production of these elements.

Trade Catalogs

Giant Trucks. Chicago Pneumatic Tool Co., Chicago. Catalog No. 344; Aug. 1, 1918; 9½ x 12½; pp. 32; illustrated. Descriptive of trucks burning low-grade fuels.

Rotary Dump. Wood Equipment Co., Chicago, Ill. Bulletin No. 180; 8½ x 11; pp. 12; illustrated. Descriptive of a pneumatic rotary dump for unloading mine cars.

"Gone Again." Crescent Belt Fastener Co., 381 Fourth Av., New York. Pamphlet; 5¼ x 7½; pp. 24; illustrated. Pictures in humorous vein the use of Crescent belt fasteners, rivets and plates.

Remco Redwood Pipe. Redwood Manufacturers' Co., San Francisco, Calif. Catalog No. 8; 6 x 9; pp. 112; illustrated. A catalog of redwood piping and flumes with data to guide purchaser in selecting and installing.

Mining Tanks. Pacific Tank and Pipe Co., 318 Market St., San Francisco, Calif. Catalog No. 12; 6 x 9; pp. 128; illustrated. A catalog of mining tanks and cyanide-plant equipment. Much information and data of value to the metallurgical engineer are in this book. Copy free on request.

Remco Redwood Tanks. Redwood Manufacturers' Co., San Francisco, Calif. Price List No. 14; 4¾ x 9½; pp. 36; illustrated. A catalog and price list of redwood water and oil tanks, gravity sprinkler tanks, tank covers, troughs and like devices. A discussion of essentials that insure good installation and instructions for erecting, together with data to guide the purchaser.

Jeffrey Belt Conveyors. Jeffrey Manufacturing Co., Columbus, Ohio, Catalog 175; 6 x 9; pp. 80; illustrated. This catalog is rightfully termed by its publishers a textbook upon the belt conveyor. Primarily it is a price list and catalog of Jeffrey products. In addition, voluminous information and data regarding the best in conveyor practice are placed at the disposal of the conveyor user, both present and prospective.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 15c. each. British patents are supplied at 40c. each.

Alloy of Iron with Ni, Cu and a small proportion of Mn. Henry K. Sandell, Chicago, Ill., assignor to Herbert S. Mills, Chicago, Ill. (U. S. No. 1,279,448; Sept. 17, 1918.)

Copper Ores, Lixiviation of. Niels C. Christensen, Salt Lake City, Utah, assignor of one-half to J. E. Barlow, Havana, Cuba, and one-half to Big Indian Copper Co., of Utah. (U. S. No. 1,278,854; Sept. 17, 1918.)

Flotation Method and Apparatus. Carl C. Thomas, Baltimore, Md. (U. S. 1,279,-040; Sept. 17, 1918.)

Furnace, Electrical Heating. Herman V. Finnie, St. Catherines, Ont., Can., assignor to the Canadian Crocker Wheeler Co., Ltd., St. Catherines, Ont., Can. (U. S. No. 1,279,-313; Sept. 17, 1918.)

Furnace, Electric. Samuel Peacock, Philadelphia, Penn., assignor to Haslup & Peacock, Inc., New York, N. Y. (U. S. No. 1,279,146; Sept. 17, 1918.)

Furnace. Richard Ziesing, Cleveland, Ohio. (U. S. No. 1,279,486; Sept. 17, 1918.)

Manganese from Lean Ores, Process of Leaching. Edward W. Haslup, Bronxville, N. Y., and Benjamin A. Peacock, Philadelphia, Penn., said Peacock assignor to said Haslup. (U. S. No. 1,279,108-10; Sept. 17, 1918.)

Metallurgy—Method and Apparatus for Subliming and Sintering Ores. William D. Kilbourn, Pueblo, Colo., assignor to United States Smelting, Refining and Mining Co. (U. S. No. 1,278,166; Sept. 10, 1918.)

Mine Cage, Safety Device for. Louis Pichler, Fort Wayne, Ind. (U. S. No. 1,278,742; Sept. 10, 1918.)

Mine Cars, Coupling for. Hopkin J. Williams, Nanticoke, Penn. (U. S. No. 1,278,-541; Sept. 10, 1918.)

Mine Car and Tipple. David Scott Allison, Salt Lake City, Utah. (U. S. No. 1,278,551; Sept. 10, 1918.)

Monazite, Extraction of Cerium Group from. Wallace S. Chase, Lakewood, Ohio, assignor, by mesne assignments, to National Carbon Co., Inc. (U. S. No. 1,279,257; Sept. 17, 1918.)

Nickel-Copper Matte or Nickel Matte, Method of Treating. Otto Lellep, New York, N. Y. (U. S. No. 1,278,176; Sept. 10, 1918.)

Ore Dressing—Conical Mill. Harry W. Hardinge, New York, N. Y. (U. S. No. 1,279,335; Sept. 17, 1918.)

Potash—Process of Obtaining Potassium Sulphate. Benjamin A. Peacock, Philadelphia, Penn., assignor to Haslup & Peacock, Inc., New York, N. Y. (U. S. No. 1,279,145; Sept. 17, 1918.)

Steel, Ingot Mold for. Benjamin Talbot, Middlesbrough, England. (U. S. No. 1,279,-037; Sept. 17, 1918.)

Steel—Four-Pass Hot-Blast Stove. James I. Larimer, Joliet, Ill. (U. S. No. 1,278,-173; Sept. 10, 1918.)

Sulphuric Acid, Manufacture of. Joseph F. Cullen, Midvale, Utah, assignor to United States Smelting, Refining and Mining Co. (U. S. No. 1,278,308; Sept. 10, 1918.)

Tungsten and Nitrogen, Producing Compounds of. Carl Bosch and Alwin Mittasch, Ludwigshafen-on-the-Rhine, Germany, assignors to Badische Anlin u. Soda Fabrik, Ludwigshafen-on-the-Rhine, Germany. (U. S. No. 1,278,580; Sept. 10, 1918.)

Tunnel Excavating System. Joseph Perna, Philadelphia, Penn. (U. S. No. 1,279,-148; Sept. 17, 1918.)

Zinc, Apparatus for Treating. Charles A. H. de Saulles, New York, N. Y. (U. S. No. 1,278,292; Sept. 17, 1918.)

Editorial Correspondence

SAN FRANCISCO—Oct. 22

Full Constitutional Authority for the operation of the State Industrial Accident Commission is being sought in Senate Constitutional Amendment No. 30, to be voted upon at the fall election. This amendment will give no additional power to the commission. The Supreme Court has decided the compensation, insurance, and safety act, under which the commission operates, to be constitutional on appeal from a compensation award. But no opinion has been given on the safety and insurance provisions of the law. Both these departments are firmly established and are doing commendable work, and as the law has proved itself, the commission believes it is entitled to the approval of the people of the state and to permanent establishment on a firm foundation. It was thought that the constitutional amendment of 1911, upon which the act was founded, was broad enough. The law, with some modifications, has been in operation for five years and generally has given satisfaction to both employees and employers. But there is still some doubt as to the constitutionality of some of the provisions of the act. It is for the purpose of validating all the Legislature has done in the enactment, by making the whole act constitutional and so put the legislative power expressed in the law beyond controversy, that the passage of the amendment is now asked.

Whitman Symmes, for many years mine manager of the Northend Comstock mines, at Virginia City, Nev., has been elected president of the several companies which his management controlled. H. L. Slosson, Jr., for an equal period president of these companies, and who for several years previously directed the business interests, has retired from the presidency. It was thought necessary to levy assessments for the purpose of continuing vigorous prosecution of development work; but Mr. Symmes, it is stated, has raised the necessary money by other means, so that the work will go on without interruption. The group or chain of mines affected by this change in the presidency comprises the Union Consolidated, Consolidated Virginia, Ophir, Mexican, and Sierra Nevada. F. M. Sharon remains superintendent of the Sierra Nevada. The development and production following the unwatering of the mines have been satisfactory in most respects, but extraction of ore has at times been sacrificed to the development of new orebodies or the recovering of known drifts and stoping ground containing ore of profitable grade. A large amount of labor has been expended on the Consolidated Virginia, at the southern end of the group. The shaft of this mine has long been used as the pump shaft for the entire group, and though it was known to contain prospective orebodies and was once one of the large producers of the Comstock, it has seemed for several years, owing to its relative situation, to be of greater economic advantage as the water clearance department of the enterprise. Since the lowering of the water in July, 1917, to a point below the 2900 level, there has been greater opportunity and more time and labor available for the prospecting, exploring, and developing of the ore deposits, and the result today is that the Consolidated Virginia has developed into the largest producer of the Comstock. But that does not mean the lessening of the importance of the other properties. In the matter of high-grade ores, the Mexican has for a long period held the lead, the Union was the largest producer, and Ophir was steadily dependable. Sierra Nevada has recently made some excellent showings in the quality of the ore produced. The fact that all of the ore extracted in the Northend is hoisted through the Union, all the air goes in through the Ophir, and all the water goes out through the Consolidated Virginia, explains much that might be misunderstood regarding the operation of the Northend in the last few years. During the period of reconstructive development no other method of operation was possible, and none other will be possible for some time. It is not essential to the ultimate success of the Northend that the period of large profits should be reached quickly. The thorough development and complete exploration of the levels below the Sutro tunnel level are far more essential. There is still one thing lacking—the opening of a second upcast shaft. This necessity will be met, as all others have been, by the application of patience, energy, and engineering skill. Labor shortage has greatly retarded operation on the Comstock, as in other districts of Western mines.

SALT LAKE CITY—Oct. 25

Carnotite Ores are being mined and shipped from near Castleton, in the south-central part of Grand County, by the United States Metals Reduction Co., a close corporation controlled by Pittsburgh people. The nearest shipping point is Cisco, necessitating a 30-mile haul to the railroad. The ore of shipping grade carries about 2% uranium oxide. A plant is being installed to treat lower-grade material. The present output is being shipped to Pittsburgh.

Western Salt Producers held a meeting here on Oct. 24 at which 20 of the largest salt producers of the Western states were represented. An association is to be formed. It was brought out that the cost of production had increased to the extent that at present little or no profit was being made, and that producers generally have not raised their prices. The chief expense at present is coal, which has increased in price above all other materials used in production. Although salt is obtained easier in Utah than in most places, the cost of refining is said to make the process as expensive as in the Eastern states for certain grades of salt. The object of the Salt Producers' Association is to coöperate in ways and means of reducing the cost of production. D. B. Doremus is secretary.

Competent Legal Opinion regarding the proposed amendment of Section 4, Article 13, Constitution of Utah, referring to mine taxation, as expressed by some of the leading attorneys in this district, brings out the following, which should be considered by every one directly or indirectly connected with the mining industry. Should the proposed amendment be adopted, the State Board of Equalization would be vested with plenary power to assess and tax metalliferous mines at much more than the full value thereof and possibly at less than such full value; that this power so conferred upon the State Board of Equalization will be entirely independent and beyond the control of the Legislature. Also that Sections 2 and 3 of Article 13 would not in any way limit the right of the board to assess and tax metalliferous mines at either more or less than their full value. And in this connection it is manifest that what may or may not be the full value of a mine is impossible of determination. The proposed amendment, if adopted, would confer upon the Board of Equalization the right to assess and tax mines at some arbitrary valuation, depending entirely upon the judgment, whim or caprice of such board. Regarding additional powers that will be vested in the board over those it now possesses, if the amendment is adopted, the powers of the board in arriving at valuations, with the exceptions set forth in the proposed amendment, will be untrammeled and exclusive and not subject to review or control by either the Legislature or the courts unless it should be ultimately determined that the proposed amendment is violative of the provisions of the Constitution of the United States. Under the present constitutional provisions, the acts of the State Board of Equalization are subject to review by the courts, and its determination may be set aside if found to be arbitrary, discriminating, or not in accordance with legislative enactments. Should the proposed amendment become a part of the organic law of the state, neither the Legislature or the courts would have any power to curb or control the action of the state board, no matter how arbitrary such action might be. The amendment, if adopted, will be self-executing, and no legislative action will be required to set in motion the powers of the board. As to whether the Legislature will be obliged under this amendment to confer upon the board the absolute power to assess and tax mines at a rate and value to be determined by the board, or whether the Legislature will determine the tax rate, how net proceeds are determined, and what multiple or sub-multiple shall be applied, it would not be necessary for the Legislature to take any action whatever to empower the Board of Equalization to determine the valuation to be placed upon mines or mining claims. The Legislature would have the power to define net proceeds and fix what, if any, deductions could be made; but so far as any valuation of mines based upon some multiple or sub-multiple of the net proceeds is concerned, under the proposed amendment the Legislature would be powerless to interfere in any way with the action of the state board, and could not fix or determine what multiple or sub-multiple should be applied in the case of metalliferous mines. In the practical operation of the amendment, existing law would determine what the net proceeds derived from any mine might be; the machinery for determining the rate of taxation is likewise also provided. There are many objections to the adoption of this amendment which can be successfully urged. The most potent objection is that it is contrary to the spirit of American institutions and form of government. To delegate to an appointed board, not responsible directly to the people, the powers contemplated by this amendment, would be to depart from all conceptions of governmental power of taxation heretofore entertained by the people. "What would be thought of a proposal to so amend the Constitution as to clothe the Governor, individually, with a power of taxation such as the proposed amendment seeks to confer upon his appointees? Would not any such attempt be condemned by all sober, thinking citizens? Yet it is manifest that a constitutional provision clothing the Governor with such power would be no more dangerous, would be no more revolutionary, and would be no more objectionable than is the proposal to confer like powers upon his appointees." The above is the opinion of one of the best-known lawyers in Utah.

DENVER—Oct. 23

Zirconium is to be the subject of special investigation by the Rocky Mountain section of the U. S. Bureau of Mines, at Golden. Pure metallic zirconium will be prepared, and its properties will be studied. It is of interest to determine whether pure metallic zirconium exists in a form which is malleable and ductile. Problems that will receive special attention at this time are means of obtaining temperatures sufficiently high for the preparation of metallic zirconium, for its purification, and for converting it into some form suitable for the determination of its physical properties. Equipment for an Arsem vacuum furnace has been assembled, and the necessary installations are being made at the power-house of the Colorado School of Mines. Experiments have also been made with other types of small carbon-resistance furnaces, and some fairly pure metal has already been prepared. In some cases this metal containes 98.5% zirconium. This investigation of zirconium is an important war problem, in which not only the Bureau of Mines but also the War and Navy departments are much interested. The research work in the Golden laboratories will be under the general supervision of Dr. S. C. Lind, and the temporary services of Dr. J. W. Marden, of the University of Missouri, and Lieutenant Malcolm Rich, of the Chemical Warfare Service, have been secured.

BISBEE, ARIZ.—Oct. 21

Walter Douglas, president of the Phelps Dodge Corporation, stated recently that the construction of the new concentrator below Warren had been stopped on account of the shortage of steel, the Government having regarded this work as non-essential during the period of the war, as it could not be completed in time to yield good results for war purposes. The company will go ahead with the necessary grading at the mill site, and will resume construction of the building as soon after the war as it shall be practicable to secure the requisite steel. Concerning the company's production of copper, Mr. Douglas said: "We are making our normal output of copper at our mines in Arizona, notwithstanding the shortage of labor as a result of the war, but we are doing it only at the cost of a cessation of all development. Mining copper is a war measure, and all conditions, ordinary and extraordinary, must be met without excuse and without fail. After the war we shall have to meet the hard conditions that will be the result of our having for so long a time suspended all development work, but they will be overcome eventually. The war has taught us that nothing is impossible."

CALUMET, MICH.—Oct. 25

The Annual Report of the Mine Inspector for Houghton County states that there were 31 fatalities in the mines during the year ended Sept. 30. Figures for mines in Ontonagon and Keweenaw counties are not yet available, but it is stated that a reduction in each of those counties will also be apparent. The number of employes of Houghton County mines was reduced from 16,423 to 12,250 during the last year, owing to the number going into the Army and Navy and those leaving for employment elsewhere. Even with this reduction in the total number of men employed, the percentage of fatalities and the number of minor accidents showed a decrease.

DULUTH, MINN.—Oct. 25

The Canisteo District, which is the largest iron-ore producing section of Itasca County, has had a successful season, from the standpoint of developing and shipping. The Canisteo mine is the largest property and has nine shovels working in the pit, six actively engaged at stripping or removing ore as required. Development work has been under way at this property for a number of years. There is no active shipping at the Arcturus, at Marble, although stripping is being done. The concentrating plant at Trout Lake is now operating two units. The chief construction work in the district has consisted of complete electrification of operations. Work now under way contemplates the abolishment of boilers and steam plants for ordinary purposes and the use of electrical current throughout the district.

Stockpiling and Development Work will be on an extended scale at the leading properties of the Minnesota iron ranges during the winter months, with a view to substantial ore tonnages being available to move at the openings of the 1919 season, says the *Iron Trade Review*. Improvements in the way of new headframes, hoisting and handling machinery are being carried through at several mines, including those of the Oliver Iron Mining Co., M. A. Hanna Co., Republic Iron and Steel Co., and the Tod-Stambaugh Co. Prompted by the urgent demand for manganiferous ores, the Cuyuna Range has set the pace during the present season in development work. Manganiferous ore shipments from that range for the season are expected to aggregate 700,000 tons, as compared with 225,000 tons last year.

TORONTO—Oct. 26

Data on the Cost of Production in the gold mines of the province has been asked for by the British government, and Thomas W. Gibson, Deputy Minister of Mines, has taken up the matter with the officials of the leading gold-mining companies. This step is regarded as foreshadowing some measure of government assistance to the gold-mining industry.

The Canadian government has issued an order authorizing the Canadian War Trade Board to take possession of and operate for a period of five years, if necessary, any mines which are producing or have produced chrome ore. This step is taken to remedy the shortage of chrome ore that has resulted through war conditions. Should the War Trade Board and the owners of mining properties be unable to agree as to the amount of compensation to be paid, the matter may be referred to the Exchequer Court for settlement.

VICTORIA, B. C.—Oct. 25

Aspen Grove Amalgamated Mines, Ltd., of British Columbia, with headquarters at Merritt, B. C., has been formed for the purpose of taking over and operating several large groups of mineral claims in the Aspen Grove district. The property includes 60 claims. Considerable work is contemplated. Officers are: J. A. Bate, president; M. A. Durland, secretary-treasurer; M. L. Grimmett, director and solicitor; Joseph Walters and Dr. J. J. Gillis, directors.

The Need of Developing an Iron and Steel Industry in British Columbia was the keynote of an address delivered by C. F. Law, chairman of the mining committee of the Vancouver Board of Trade, before a convention of the British Columbia Boards of Trade on Oct. 15. He asserted that there were 12,000,000 tons of iron ore in sight in the iron deposits along the coast, the gulf islands, and in northern sections of the province. He advocated a bonus by the dominion government on pig-iron production.

Construction of the Big Bend Road, which runs from the Revelstoke north along the Columbia River, is one of the most important public works undertaken by the Mines Department of British Columbia with a view to opening a promising mineral district to development. The country in this region, generally speaking, is rough and mountainous, and construction has been and is an expensive and difficult work. The road now is open to La Forme Creek, in which place are situated a number of mining prospects from which much is expected.

Several Thousand Miners and Prospectors in the Kuskokwim River district of Alaska are threatened with famine, according to a report brought from the North by the captain of the power steamer "Ruby," which has reached Seattle, Wash., in a damaged condition. This boat, which was the only one to set out with food and other necessities for the miners of the Kuskokwim, was unable to complete her journey, because of heavy storms which drove her into Seward, Alaska, for shelter. The prospect of getting relief to these people, it is said, is slim, as it is believed to be too late for another vessel to make the trip.

The Mining News

ARIZONA

Cochise County

COPPER QUEEN (Douglas)—Employing women in the assay department of the smeltery.

Gila County

AMERICAN ASBESTOS (Globe)—Work suspended on property in the Sierra Ancha Mountains, owing to inability to get needed machinery.

VAN DYKE COPPER (Miami)—To sink 1500-ft. shaft to cut rich ores believed to be at depth. Good-grade copper ore was cut by drilling at 1156-ft. depth at this property. Company desires to purchase headframe and suitable hoist. C. W. Van Dyke is president.

LAVELL GOLD (Winkleman) — Shaft down 240 ft. New 50-ton mill on the ground ready to be set up.

Maricopa County

SOUTH VERDE (Mesa)—Driving tunnel 400 ft. to cut vein. Dave Crismon is in charge.

Mohave County

MOSSBACK (Oatman)—Shaft has been sunk to 500 level, and station will be cut. Hoist, compressor, and pump are being installed. W. H. Holcomb is general manager.

TOM REED (Oatman)—Building pocket at the 500 level of Aztec shaft to handle ore mined at Bald Eagle. Stopes being opened up on 500 level of the Bald Eagle. Aztec shaft down 650 ft. and crosscut being driven to the vein.

Pima County

EMPIRE ZINC (Tucson)—Have taken over old Sahuarita smeltery, seven miles distant. Developing on 600 level of mine, and has blocked out large orebody on three upper levels.

RAMSDELL (Tucson)—Shipping 45 carloads of a copper ore a month from Vail station. Veich mine also shipping from same station.

REINIGER-FREEMAN (Tucson)—Drifting on 330 level to cut three fissure veins.

Santa Cruz County

EXPOSED REEF (Patagonia)—Sinking airshaft to old tunnel, from which development work is to be started soon. Dan Dawson is in charge.

WORLD'S FAIR (Patagonia)—New 225-ton concentrator started. Large tonnage of low-grade ore available. Hiram Whitcomb is manager.

Yavapai County

KAY (Canyon)—Lens of copper ore has been cut 2000 ft. north of the main shaft on the 180 level. George Long, formerly of United Eastern, is manager.

ALVARADO (Congress Junction)—Dismantling its 150-ton mill.

ARIZONA BINGHAMPTON (Mayer)—Mill to be enlarged and new shaft sunk.

ARKANSAS

Marion County

MORNING STAR (Rush)—To start mining and milling operations soon. The property has been idle for some months.

EDITH (Rush)—To start operations soon.

NORTH STAR (Yellville)—To start mill soon. Completing cable to mill.

ONWATA (Yellville)—Building small mill. C. G. Rogers is superintendent.

WASSELL (Yellville)—Installed a small compressor and air drills recently.

CALIFORNIA

Colusa County

PLATINUM DEPOSITS of commercial value are reported at Snow Mountain, in the extreme northwest corner of the county, by John M. Connolly and W. R. Zumwalt, of Colusa.

Monterey County

KING QUICKSILVER (Parkfield) — Sinking 6 x 6-ft. shaft. Treating ore in retorts and will start furnace. Property leased by Patriquin brothers.

Mendocino County

CHROME DEPOSIT on Cow Mountain, operated by Gus Angle, of Ukiah, has 45 tons ready for shipment. Angle has also located copper deposits.

Riverside County

LEAD AND ZINC properties situated in northeastern part of county near Nipton, owned by A. Hamstadt, sold to Thomas Murphy.

Stanislaus County

CHROME DEPOSIT, one mile east of Camp Jones, operated by George V. Borchsenius, has several carloads ready for shipment. Stock company being organized.

Trinity County

ESTABROOK GOLD DREDGING (Trinity Center)—Rushing motor haulage of material and machinery from Southern Pacific R. R. at Redding to complete construction of dredge before heavy weather blocks roads.

Shasta County

AFTERTHOUGHT (Ingot)—New electrolytic-zinc treatment plant ready for initial test. Mine development on large scale.

MAMMOTH (Kennett)—Curtailment of mine extraction threatened by large number of cases of influenza. Keswick and other copper and gold camps likewise disturbed.

IDAHO

Shoshone County

RICHMOND (Adair)—Making regular shipments of crude copper ore.

BIG CREEK (Wallace)—Shipping at the rate of five carloads crude and hand-jigged ore per month. Planning for mill next year.

C. & R. (Wallace)—Prospecting with diamond drill. Development work has disclosed considerable ore.

MICHIGAN

Copper District

CALUMET AND HECLA (Calumet)—Has installed electric furnace for making stamp shoes at foundry.

CENTENNIAL (Calumet)—Seven levels extending under Wolverine territory.

LA SALLE (Calumet)—All rock coming from Kearsarge lode. Second shaft is bottomed at 23 level. Nothing being done on Osceola amygdaloid now, but operations will be resumed when labor conditions become normal.

WOLVERINE (Gay)—Making slow progress in sinking shaft for water system. Foundations for pump and other equipment have been installed.

MAYFLOWER-OLD COLONY (Houghton)—Shaft being sunk by selective service men now being trained at the Army school at the Michigan College of Mines.

MASS CONSOLIDATED (Mass)—Will not suspend operation during the winter.

MONTANA

Jefferson County

LEGAL TENDER (Clancy)—Retimbering 500-ft. shaft.

ECONOMY (Mitchell)—Placing machinery in new concentrator. Charles E. Freyberger is superintending construction.

Lewis and Clark County

COFFEE-BYRNES CLAIMS (Helena)—Has shipped two carloads of high-grade silver ore to smeltery. Owen Byrnes is manager.

SCRATCH GRAVEL GOLD (Helena)—Mine closed, and will remain idle until spring, when a new shaft is to be sunk.

PEERLESS JENNIE (Rimini)—Struck ore in east drift. To raise 200 ft. and crosscut.

LIBERTY MINING (Silver Camp)—Has taken over Mike Horse mine and mill, and will mine and treat silver-lead-zinc ores.

NEVADA

Elko County

NEW TUSCARORA (Tuscarora)—Developing under management of W. J. Craig. Scarcity of miners retarding development of district.

Esmeralda County

TULE CANYON PLACERS, 35 miles south of Goldfield, working again. One Goldfield company has sunk 40-ft. shaft in wall rock, drifted to gravel bed, and is now treating 15 tons daily. Return erratic, but average grade good. North of this Harris and Field have sunk shaft to bed rock, installed gasoline pump, and are now working gravel below water level.

Humboldt County

ROCHESTER COMBINED (Rochester)—New mill started and will be operating to capacity in a short time. Development work in Kroemer workings opening good-grade ore. Other development work to be done when more storage room for broken ore is made available by mill operations.

ROCHESTER MINES (Rochester)—Suit brought against company by Joseph Nenzel, who claims apex of the vein from which the Rochester mines have been extracting ore.

Lyon County

MASON VALLEY MINES (Thompson)—Shipments received at smeltery for week ended Oct. 16 were: Nevada-Douglas, 944 tons; Bluestone, 1770; Mason Valley mine, 1833; miscellaneous, 325 tons; total, 4872 tons. During same period, three cars of blister copper was shipped.

HILL TOP (Yerington)—Producing shipping-grade copper ore.

MONTANA-YERINGTON (Yerington)—Fire on Oct. 16 destroyed shafthouse, hoist, headframe and blacksmith shop. Other hoisting equipment to be installed at once, and shipments will not be delayed long. Lower shaft is equipped with small gasoline hoist, and workings from this shaft will be connected with main-shaft workings by raise, and additional production made.

Mineral County

JUMBO COPPER (Mina)—Development on 385 level opening copper ore. Lessees previously produced good tonnage, but company has now purchased all rights and will operate exclusively. Company originally subsidiary of Jumbo Extension Mining Co., of Goldfield.

Nye County

TONOPAH DISTRICT ore production for the week ended Oct. 19 was 8417 tons, of an estimated milling value of $143,089. Producers were: Tonopah Belmont, 1086 tons; Tonopah Mining, 2250, Tonopah Extension, 2365; West End, 895; Jim Butler, 214; Rescue, 65; Montana, 338; Tonopah Divide, 200, and miscellaneous, 4 tons.

GREAT WESTERN (Tonopah)—Larger pumping plant to be installed. To accommodate new equipment, shaft will be enlarged from one compartment to three compartments. Work to start at 850 level, and will take four months. Property in west end of district.

MARRIS CHALCEDONY QUARRY (Tonopah)—Operating at full capacity. Quarry furnishes artificially rounded tube-mill pebbles to milling plants of southern Nevada at cost less than half that of Danish pebbles.

MIDWAY (Tonopah) — Drift extended 140 ft. in vein recently opened.

TONOPAH DIVIDE (Tonopah)—New electric equipment installed and operating successfully. Development work on No. 3 level will now be pushed, and shaft sunk another 100 ft. Property situated on Gold Mountain, six miles south of Tonopah.

WEST END CONSOLIDATED (Tonopah)—Connection made on 800 level between Ohio shaft workings and No. 2 shaft. Electric locomotive made by company put into use, and all ore hereafter will be handled through No. 2 shaft, equipment of which has been improved to handle this increased tonnage.

Storey County

CONSOLIDATED VIRGINIA (Virginia City)—Drifting on 1800 and 2000 levels and raising on 1900 and 2000 levels.

White Pine County

CONSOLIDATED COPPERMINES (Kimberly)—September production was 1,196,884 lb. of copper, and mill gave 79% recovery. On the 1200 level, three crosscuts are exploring the ore zone.

OKLAHOMA

Joplin District

LUCKY JENNY (Hockerville)—Expect to have new 300-ton mill completed by December 10.

DALLAS-PICHER (Picher)—Operating new 300-ton mill. A. J. Harrington, Carthage, Mo., is managing director.

GOLDEN STATE (Picher)—Recently resumed operations on shaft where work was abandoned last spring, and is now in ore. John Gifford, of Baxter Springs, Kan., is manager.

JEFFERSON (Picher)—To build mill. One shaft down 240 ft. and second shaft has been started.

MAURINE (Picher)—Completed new 250-ton mill.

MOGUL (Picher)—Sinking shaft. When complete second shaft will be sunk and ground developed. Contemplating mill.

PELICAN (Picher)—Box hopper has been found unsatisfactory, and starting of a new mill is being delayed while new hopper is being built.

AURORA (Quapaw)—New mill ready and will be operated by gas power entirely. John E. Turner is vice president and general manager.

BIG V (Quapaw)—Completing 250-ton mill on 40-acre lease. Operating two shafts, both in ore. J. C. Voorhees is president, and C. S. Voorhees is vice president and general manager.

LIGHTNING (Quapaw)—Has suspended operations.

ONTARIO SMELTING (Quapaw) — Started construction of a refinery which will have a capacity of 600 tons per week.

CONSOLIDATED (Saint Louis)—Sinking shaft to cut ore developed by Huttig Lead and Zinc Co. to the southeast.

KEENO (Saint Louis)—Installing boiler at shaft, now 197 feet.

OREGON

Jackson County

RANIER QUICKSILVER (Beagle) — Building two 12-pipe furnaces of 500 flasks' capacity. Expect to purchase equipment. Samuel Bertleson is superintendent.

CANADA

British Columbia

DRUM LUMMON (Douglas Channel)—Gibson mill and concentrator of 36 tons per day capacity to be completed soon. Mill installed as an experiment, and if results are satisfactory, additional units will be built.

ACTIVE DEVELOPMENT is in progress in the Lightning Peak district near Edgewood, on the west side of the Arrow Lakes and 100 miles from Revelstoke, and six properties are being worked. High-grade ore is being shipped from the Waterloo, and it is the intention of the operators to continue work all winter. Development is under way at the Silver Spot, Dictator and Extension, and the Rampolo. The Lightning group will be worked without cessation, and the Lumpy group, a new discovery, is to be opened up by tunnel. A pack trail is the only means of transportation, and it is understood that the government is to be asked for financial aid in the construction of a permanent trail or wagon road.

ECHO SIVER-LEAD (Silverton)—To make daily shipments soon. Ore has been opened on three levels.

Manitoba

LULEO (Rice Lake)—Operating with a small force in charge of Ellico McDonald. Sinking shaft to 54 ft., open pit. Down 35 ft. and large amount of open-cut work and stripping. Mill to be built during winter.

Ontario

LUCKY GODFREY (Elk Lake)—Examination being made by interests connected with the O'Brien Mining Company.

CLEVENGER-PROPHET (Gowganda)—Operations being carried on under direction of Kirby Thomas, consulting engineer. Shaft is down 300 ft. and lateral work is being done at 200 level.

M'INTYRE (Porcupine)—Annual statement for year ended June 30 showed ore treated of the value of $1,793,197. Estimated ore reserves were valued at $4,490,-432. Net profits were $680,361, and surplus was $872,172. Average operating expenses were $5.14 per ton, and average value of ore treated was $10.05. The mill treated 178,327 tons, with a recovery of 95.6 per cent.

LA ROSE-O'BRIEN (Cobalt)—Some confusion has arisen as to the boundary line between the Violet property of the La Rose and the O'Brien. The disputed area is about 56 ft. wide. If the O'Brien contention is correct, its boundary will take in a part of the Violet workings, including part of the shaft. Surveyors have been engaged and are going over the ground thoroughly.

OPHIR (Cobalt)—Winze being sunk has cut Keewatin formation at 141 ft., or 580 ft. below the surface.

TEMISKAMING (Cobalt)—Vein 14 in. wide cut on 400 level.

LAKE SHORE (Kirkland Lake)—Report for September shows production of approximately $44,500 from the treatment of 1860 tons of ore, with a recovery of $23.92 per ton. Mill ran 96.21 per cent of possible running time.

TECK-M'KINLEY (Swastika)—Group of nine claims near Temiskaming & Northern Ontario Ry. being explored by diamond drilling.

MONDEAU (Boston Creek)—Additional machinery has been received. Work will be started soon and shaft continued to 100 level. Property under option to A. McKinnon, of Montreal, and associates.

Quebec

CISCO (Hurricanaw River)—A number of quartz veins carrying gold have been found, and development is in progress.

MARTIN (Hurricanaw River)—Additional machinery being installed.

AFRICA

Belgian Congo

UNION MINIERE DU HAUT KATANGA (Elizabethville)—During September produced 4,887,598 pounds of copper.

ASIA

Chosen

ORIENTAL CONSOLIDATED (Unsan)—Ore exhausted at Charabowie mine, which has been closed down. Maibong mill permanently closed down.

The Market Report

SILVER AND STERLING EXCHANGE

Oct.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Oct.	Sterling Exchange	Silver New York, Cents	Silver London, Pence
24	4.7500	101⅛	49½	28	4.7500	101⅛	49½
25	4.7500	101⅛	49½	29	4.7500	101⅛	49½
26	4.7500	101⅛	49½	30	4.7500	101⅛	49½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Oct.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
24	*26	†	8.05	7.75	8¾@8⅞
25	*26	†	8.05	7.75	8¾@8⅞
26	*26	†	8.05	7.75	8¾@8⅞
28	*26	†	8.05	7.75	8¾@8⅞
29	*26	†	8.05	7.75	8¾@8⅞
30	*26	†	8.05	7.75	8¾@8⅞

* Price fixed by agreement between American copper producers and the U. S. Government, according to official statement for publication on Friday, September 21, 1917, and July 2, 1918.

† No market.

The above quotations (except as to copper, the price for which has been fixed by agreement between American copper producers and the U. S. Government, wherein there is no free market) are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars.

We quote electrolytic cathodes at 0.05 to 0.10c below the price of wirebars, cakes and ingots.

Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis.

LONDON

Oct.	Copper Standard Spot	Copper Standard 3 M.	Copper Electrolytic	Tin Spot	Tin 3 M.	Lead Spot	Lead 3 M.	Zinc Spot
24	122	122	137	334	334	29½	28½	54
25	122	122	137	334	334	29½	28½	54
26	...	...	...	...	...	...	...	...
28	122	122	137	334	334	29½	28½	54
29	122	122	137	334	334	29½	28½	54
30	122	122	137	334	334	29½	28½	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb. 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, reckoning exchange at \$4.7515: £29½ = 6.2576c.; £54 = 11.4545c.; £110 = 23.3333c.; £125 = 26.5151c.; £260 = 55.1513c.; £280 = 59.3937c.; £300 = 63.6362c. Variations, £1 = 0.2121205c.

Metal Markets

All of the markets that are free from Government control, and therefore are able to reflect commercial conditions and opinions, exhibit an easier tendency, owing to the prospects of early peace, which the markets interpret as bound to diminish demand. This is shown most emphatically in the antimony market, while the market for ores—chrome, manganese, molybdenum, tungsten, etc.—is nervous and softening. Zinc continues strong as to the prompt and the November-December position, but there are sellers of forward contracts at concessions of at least half a cent per lb. below what is at present the major market.

Copper, Tin, Lead and Zinc

Copper—The producers are striving heroically to increase their production, but they are the victims of circumstances and are unable to achieve what they would like to.

Official announcement of the continuation of the price of copper to Jan. 1 was made on Oct. 28. Though the agreement with the producers had been made a week previous, it is the policy of the War Industries Board to make no announcement until the agreement has been approved by the President. The official announcement in full is as follows:

"The President has approved an agreement, made between the producers of copper and the price-fixing committee of the War Industries Board (after investigations by this committee in conjunction with the Federal Trade Commission as to the cost of production), that the maximum price of copper shall be continued at 26c. per lb., taking effect Nov. 1, 1918, for shipments after said date, but subject to revision after Jan. 1, 1919, f.o.b. cars or lighters at Eastern refineries, f.o.b. cars or lighters at Pacific Coast refineries for Pacific Coast destinations, and f.o.b. cars or lighters New York if shipped to Eastern or interior destinations from Pacific Coast refineries and from refineries in the interior of the United States. All shipments made after Jan. 1, 1919, are subject to any change in price made by the price-fixing committee to take effect after that date. This maximum price is subject to the additional charges on copper shapes approved by the price-fixing committee to take effect after that date. This maximum price is subject to the additional charges on copper shapes approved by the price-fixing committee on June 5, 1918.

"The conditions are: First, that the producers of copper will not reduce the wages now being paid; second, that they will sell to the United States Government, to the public, in the United States, and to the Allied governments at not above the maximum price; third, that they will take the necessary measures, under the direction of the War Industries Board, in the distribution of copper to prevent it from falling into the hands of speculators, who might increase the price to the public; and fourth, that they will pledge themselves to exert every effort necessary to keep up the production of copper so as to insure an adequate supply so long as the war lasts."

Copper Sheets—The base price of copper sheets is 36c. per lb. Copper wire is quoted at 28¾@29¼c. per lb. f.o.b. mill, carload lots.

Tin—Occasional small lots are offered for resale, which is permitted by the American Steel Products Co., but such offerings are only sporadic.

The exports of tin from Batavia to the United States in 1917 were 28,151,325 lb., compared with 30,980,550 in 1916.

Lead—The situation, which in recent weeks has been looking easier, is becoming less so. There is some urgent demand, and the rate of production is rather disappointing. The end of this month will probably find producers still oversold to a considerable extent.

Zinc—The market was very dull. Prompt and November spelter is undoubtedly scarce. On the other hand, there is no particular demand for December. Foreign inquiry for a large block of spelter that we mentioned last week does not seem to have been executed. Spelter for delivery during the first quarter of 1919 was offered at 8@8¼c., and some sales were effected between those figures.

Zinc Sheets—Unchanged at \$15 per 100 lb., less usual trade discounts and extras as per list of Feb. 4.

Other Metals

Aluminum—Unchanged at 33c. per lb. There is a great scarcity.

Antimony—This market exhibited further weakness, and the prospects are regarded by producers in no cheerful way. Although stocks have been greatly reduced, there is very little demand. We quote spot at 12¼@12¾c.

Bismuth—Metal of the highest purity for pharmaceutical use is quoted at \$3.50 per lb. for wholesale lots—500 lb. and over.

Cadmium—Quoted at \$1.50@\$1.75 per pound.

Nickel—Market quotation: Ingot 40c.; shot, 43c.; electrolytic, 45c. per pound.

Quicksilver—We quote \$125@\$127.50; market unsettled. San Francisco reports, by telegraph, \$118.50; steady.

Gold, Silver and Platinum

Gold—It is stated in Vancouver, B. C., that, despite the efforts of the United States authorities at the border, American gold is continuing to come into Canada for barter and exchange, especially among the Chinese, who pay as high as 35% premium for coinage. This in turn, it is claimed, is shipped out of Canada to the Orient.

Silver—The official price of silver in London remains unchanged at 49½d. The latest advices from London are to the effect that both there and in India the demand for silver for coinage is still large; but in the absence of any competition from China, supplies have been more plentiful. Exports to London for the week ended Oct. 26 were 589,000 ounces.

Mexican dollars at New York: Oct. 24, 77⅛; Oct. 25, 77⅛; Oct. 26, 77⅛; Oct. 28, 77⅛; Oct. 29, 77⅛; Oct. 30, 77⅛.

Platinum—Unchanged.

Zinc and Lead Ore Markets

Joplin, Mo., Oct. 26—Blende, per ton, high, \$78.55; basis 70% zinc, premium, \$75; Class B, \$65@60; Prime Western, \$55@52.50; calcamine, basis 40% zinc, \$40@35. Average selling prices: Blende, \$55.47; calamine, \$39.05; all zinc ores, \$53.62.

Lead, high, \$103.10; basis 80% lead, \$100; average selling price, all grades of lead, \$99.16 per ton.

Shipments the week: Blende, 8313; calamine, 760; lead, 1860 tons. Value, all ores the week, \$661,920.

Shipments ten months: Blende, 400,402; calamine, 18,702; lead, 63,375 tons. Value, all ores ten months, \$27,235,250.

Buyers falling short of filling orders last week came into the market early this week with higher offerings, and even then most buyers "went short" on filling orders for this week's purchases.

Platteville, Wis., Oct. 26—Blende, basis 60% zinc, highest price reported, \$72; base price for premium grade, \$75; base price for high-lead blende, \$52. Lead ore, basis 80% lead, \$100 per ton. Shipments reported for the week were 2268 tons blende, 182 tons galena and 432 tons sulphur ore. For the year to date the totals are 105,823 tons blende, 6551 tons galena and 37,776 tons sulphur ore. During the week 2880 tons blende was shipped to separating plants.

Other Ores

Chrome Ore—Offerings exceed the demand, and it is very difficult to make sales.

Iron Ore—Superior ores, per ton, lower Lake ports, Old Range bessemer, 55 iron, \$6.65; Mesabi bessemer, 55 iron, \$6.40; Old Range non-bessemer, 51½ iron, \$5.90; Mesabi non-bessemer, 51½ iron, \$5.75.

Manganese Ore—The makers of ferromanganese are reported to have all the ore that they can handle, and there are surplus offerings, stimulated by the high prices.

Molybdenum Ore—High-grade ore is reported held for $1.10, but with no buyers willing to pay that price. A considerable tonnage of low-grade ore was reported sold this week at prices well below. $1.

Pyrites—Prices of domestic pyrites are determined by negotiation between buyer and seller; the range is between 30@35c. per unit. Nobody is anxious to take any domestic pyrites of grade lower than 40% sulphur, and as a consequence owners of properties producing a run-of-mine of lower grade must resort to concentration to secure a marketable product.

Tungsten Ore—Quotations are nominally unchanged, but there seems to be an easier tendency in the market.

Chas. Hardy says: "During the last week business in tungsten ore has been comparatively quiet, on account of the development in the international position. Prompt material and any good-grade ore which can be delivered within the next two months are still finding a ready market. At the moment of writing business in high-grade scheelite has again been done at $26. The whole tungsten position is much under the influence of the importations from China. The market is not yet in a position to exactly gage the influence that these Chinese importations will have on the general trend. On the one hand, the imports are large—on the other, the Chinese ore, on account of its high manganese content and the tin and copper impurities, is acceptible to but few in the American tungsten industry. It has been a feature with new tungsten fields that after the discovery, the production is exceedingly large. It has always been found, however, that, once the easy mining stops, production falls off considerably. It depends now on how soon this period of lesser production in China will set in. In the meantime, efforts are being made in several quarters to absorb the Chinese product while the erection of new plants which can treat this impure ore is being undertaken, and if these plants can be started at an early date, they should handle a considerable quantity of the Chinese ore. In the meantime, the imports from Bolivia have been exceedingly small, and the importations in the previous months of the year, when the imports from South America amounted to well over 330 tons—at times even over 400 tons per month—have dropped to only 150 tons during the last month for which a record is available."

Iron Trade Review

PITTSBURGH—Oct. 29

The epidemic of influenza has risen at some points and decreased slightly at others. In the last week it has become serious in the Shenango Valley, one furnace being barely able to make its charge Sunday night, whereas the Mahoning Valley is scarcely touched, at least as yet. The Ohio works of the Carnegie Steel Co. at Youngstown has only 30 men absent owing to the disease. At the Duquesne Steel Works, near Pittsburgh, where the proportion of men laying off exceeded 20% at one time, more men are returning than are leaving. The Edgar Thomson works, which was not affected at the outset, now has 400 of 6000 men out.

Pig Iron—Distribution of pig iron is proceeding much the same as formerly, on contracts and allocations. There have been few new allocations recently, and furnaces are not in position to accept any, their output already going to preferred purposes. More than half the 100,000 tons of basic iron for export, allocated a few months ago to Northern furnaces, has been shipped. Consumers are showing no interest in late deliveries. Existing prices apply on deliveries to Jan. 1, and contracts for later delivery can only be made subject to Government price ruling at the time of delivery. The market remains quotable at the set limits: Bessemer, $35.20; basic, $33; No. 2 foundry, $34; malleable, $34.50; forge, $33, f.o.b. furnace, freight from Valleys to Pittsburgh being $1.40 and from six detached furnaces somewhat less.

Steel—There is no market in unfinished steel, all surplus production being under allocation. We quote the market at the set limits: Billets, $47.50; sheet bars and small billets, $51; slabs, $50; rods, $57.

Ferro-Alloys—A fair running enquiry for ferromanganese in small lots for early deliveries from small consumers is to be noted. Large consumers are, as a rule, covered through the first quarter and do not care to commit themselves for the second quarter, both because the market may be lower—there is no prospect of its being higher—and because, possibly, they will not need full supplies at that time. Rumors of shading cannot be fully confirmed. We quote 70% ferromanganese at $250, delivered, and 16% spiegeleisen at $75, furnace.

Coke—Production of coke in the Connellsville region has been materially curtailed by the influenza epidemic, also shipments of raw coal. Many byproduct ovens are short of coal, but they have lost little actual production. Thus far there is no definite shortage of coke at any blast furnaces, but further curtailment in supplies might force the banking of some stacks.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1916	1917	1918	1916	1917	1918
Jan.	56.775	75.630	88.702	26.960	36.682	44.356
Feb.	56.755	77.585	85.716	26.975	37.742	42.792
Mar.	57.935	73.861	88.082	27.597	36.410	43.620
April	64.415	73.875	95.346	30.662	36.963	47.215
May	74.269	74.745	99.505	35.477	37.940	48.980
June	65.024	76.971	99.500	31.060	39.065	48.875
July	62.940	79.010	99.625	30.000	40.110	48.813
Aug.	66.083	85.407	100.292	31.498	43.418	49.077
Sept.	68.515	100.740	101.125	32.584	50.920	49.500
Oct.	67.855	87.332	......	32.361	44.324	......
Nov.	71.604	85.891	......	34.192	43.584	......
Dec.	75.765	85.960	......	36.410	43.052	......
Year	65.661	81.417	......	31.315	40.851	......

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

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1917	1918	1917	1918	1917	1918
Jan.	28.673	23.500	131.921	110.000	142.895	125.000
Feb.	31.750	23.500	137.895	110.000	148.100	125.000
Mar.	31.481	23.500	136.750	110.000	151.000	125.000
April	27.935	23.500	133.842	110.000	147.158	125.000
May	28.788	23.500	130.000	110.000	142.000	125.000
June	29.962	23.500	130.000	110.000	142.000	125.000
July	26.620	25.904	128.409	119.913	140.409	134.913
Aug.	25.380	26.000	122.391	122.000	137.000	137.000
Sept.	25.073	26.000	117.500	122.000	135.250	137.000
Oct.	23.500	......	110.000	......	125.000	......
Nov.	23.500	......	110.000	......	125.000	......
Dec.	23.500	......	110.000	......	125.000	......
Year	27.180	......	124.892	......	138.401	......

Tin	New York		London	
	1917	1918	1917	1918
January	44.175	85.500	185.813	293.227
February	51.420	92.000	198.974	311.525
March	54.388	(a)	207.443	318.875
April	55.910	(a)	220.171	329.905
May	63.173	(a)	245.114	364.217
June	62.053	(a)	242.083	331.925
July	62.570	(a)	242.181	360.347
August	62.681	(a)	243.978	380.900
September	61.542	(a)	244.038	343.905
October	61.851	......	247.467	......
November	74.740	......	274.943	......
December	87.120	......	298.556	......
Av. year	61.802	......	237.563	......

(a) No average computed.

Lead	New York		St. Louis		London	
	1917	1918	1917	1918	1917	1918
January	7.626	6.782	7.530	6.684	30.500	29.50
February	8.636	6.973	8.595	6.899	30.500	29.50
March	9.199	7.201	9.120	7.091	30.500	29.50
April	9.288	6.772	9.158	6.701	30.500	29.50
May	10.207	6.818	10.202	6.704	30.500	29.50
June	11.171	7.611	11.123	7.511	30.500	29.50
July	10.710	8.033	10.644	7.750	30.500	29.50
August	10.594	8.050	10.518	7.750	30.500	29.50
September	8.680	8.050	8.611	7.750	30.500	29.50
October	6.710	......	6.650	......	30.500	......
November	6.249	......	6.187	......	30.500	......
December	6.375	......	6.312	......	30.500	......
Year	8.787	......	8.721	......	30.500	......

Spelter	New York		St. Louis		London	
	1917	1918	19 7	1918	1917	1918
January	9.619	7.836	9.449	7.661	48.329	54.000
February	10.045	7.814	9.875	7.639	47.000	54.000
March	10.300	7.461	10.130	7.286	47.000	54.000
April	9.459	6.890	9.289	6.715	54.632	54.000
May	9.362	7.314	9.192	7.114	54.000	54.000
June	9.371	8.021	9.201	7.791	54.000	54.000
July	8.643	8.688	8.473	8.338	54.000	54.000
August	8.360	8.985	8.190	8.635	54.000	54.000
September	8.136	9.442	7.966	9.092	54.000	54.000
October	7.983	......	7.813	......	54.000	......
November	7.847	......	7.672	......	54.000	......
December	7.685	......	7.510	......	54.000	......
Year	8.901	......	8.813	......	52.413	......

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

Pig Iron, Pgh.	Bessemer‡		Basic‡		No. 2 Foundry	
	1917	1918	1917	1918	1917	1918
January	$35.95	$37.25	$30.95	$33.95	$30.95	$33.95
February	36.37	37.25	30.95	33.95	30.95	33.95
March	37.37	37.25	33.49	33.95	35.91	33.95
April	42.23	36.15	38.90	32.95	40.06	33.95
May	46.94	36.20	42.84	33.00	43.60	34.00
June	54.22	36.36	50.05	33.16	50.14	34.16
July	57.45	36.60	53.80	33.40	53.95	34.40
August	54.17	36.60	50.37	33.40	53.95	34.40
September	46.40	36.60	42.24	33.40	48.5	34.40
October	37.25	......	33.95	......	33.95	......
November	37.25	......	33.95	......	33.95	......
December	37.25	......	33.95	......	33.95	......
Year	$43.57	......	$39.62	......	$40.83	......

‡ As reported by W. P. Snyder & Co.

STOCK QUOTATIONS

N. Y. EXCH.†	Oct. 29
Alaska Gold M	4⅛
Alaska Juneau	2½
Am.Sm.&Ref.,com	87⅜
Am. Sm. & Ref., pf	106⅜
Am. Sm. Sec., pf., A	91
Am. Zinc	15
Am. Zinc, pf	50½
Anaconda	70⅝
Batopilas Min	1¼
Bethlehem Steel	70
Butte & Superior	25
Butte Cop. & Zinc	9⅛
Cerro de Pasco	37¾
Chile Cop	22¾
Chino	41⅝
Colo. Fuel & Iron	40⅝
Crucible Steel	55¾
Crucible Steel, pf	85
Dome Mines	13⅝
Federal M. & S.	10¼
Federal M. & S., pf	39¾
Great Nor., ore ctf	32¾
Greene Cananea	54⅝
Gulf States Steel	69⅝
Homestake	82½
Inspiration Con	54⅝
International Nickel	32¾
Kennecott	39¾
Lackawanna Steel	74
Mexican Petrol	159½
Miami Copper	28¼
Nat'l Lead, com	60
National Lead, pf	105½
Nev. Consol	20½
Ontario Min	7¾
Ray Con	24¾
Republic I.&S., com	84
Republic I. & S., pf	100
Sloss-Sheffield	55
Tennessee C. & C.	17
U. S. Steel, com	108
U. S. Steel, pf	111¾
Utah Copper	90½
Va. Iron C. & C.	71½

BOSTON CURB*	Oct. 29
Alaska Mines Corp	‡.12
Boston Ely	.85
Boston & Mont	.44
Butte & Lon'n Dev	.12
Calaveras	1
Chief Con	3½
Contact	‡.15
Corbin	.10
Cortez	.15
Crown Reserve	.18
Crystal Cop	.44
Eagle & Blue Bell	2½
First Nat. Cop	1⅛
Houghton Copper	.40
Intermountain	.05
Iron Blossom	.35
Iron Cap	18½
Mexican Metals	.33
Mines of America	.90
Mojave Tungsten	.07
Nat. Zinc & Lead	.12
Nevada-Douglas	.40
New Baltic	.75
New Cornelia	17½
Oneco	.20
Pacific Mines	‡.35
Rex Cons	.06
Yukon Gold	1

SAN FRAN.*	Oct. 29
Alta	.03
Andes	.04
Best & Belcher	.01
Caledonia	.01
Challenge Con	.03
Confidence	.10
Con. Virginia	.05
Gould & Curry	‡.01
Hale & Norcross	.02
Jacket-Cr. Pt	.05
Mexican	.10
Occidental	.40
Ophir	.04
Overman	.01
Savage	‡.02
Sierra Nevada	.02
Union Con	.06
Utah Con	.01
Belmont	2.40
Jim Butler	.48
MacNamara	.21
Midway	.08
Mont.-Tonopah	.09
North Star	.05
Rescue Eula	.07
West End Con	.97
Atlanta	.03
Booth	.02
Comb. Frac	‡.02
Florence	.11
Jumbo Extension	.09
Kewanas	.02
Nevada Hills	.02
Nevada Packard	.22
Round Mountain	.16
Silver Pick	.02
White Caps	.11
United Eastern	4.20

COLO. SPRINGS*	Oct. 29
Cresson Con	4.93¾
Doctor Jack Pot	.03¾
Elkton Con	.05½
El Paso	.10
Gold Sovereign	‡.02
Golden Cycle	1.69
Granite	.18½
Isabella	.05¾
Mary McKinney	.07½
Portland	1.00
United Gold M.	.12⅜
Vindicator	.39

BOSTON EXCH.*	Oct. 29
Adventure	‡.60
Ahmeek	80
Algomah	‡.15
Allouez	48½
Ariz. Com., ctfs	15
Arnold	‡.20
Bingham Mines	10
Bonanza	‡.16
Butte-Balaklava	‡.25
Calumet & Ariz	70
Calumet & Hecla	450
Centennial	‡11½
Copper Range	49
Daly West	2½
Davis-Daly	5½
East Butte	10½
Franklin	4½
Granby	‡79
Hancock	‡6
Hedley	‡12
Helvetia	‡.20
Indiana	‡.60
Isle Royale	‡26
Keweenaw	‡.70
Lake	‡5½
La Salle	‡3
Mason Valley	‡3¾
Mass	‡4¾
Mayflower	3½
Michigan	4¾
Mohawk	57¾
New Arcadian	‡1⅝
New Idria	‡13
North Butte	14
North Lake	‡.40
Ojibway	‡.75
Old Dominion	‡42½
Osceola	55
Quincy	69
St. Mary's M. L.	‡49
Santa Fe	‡.60
Seneca	13½
Shannon	‡3⅜
Shattuck-Ariz	‡14
So. Lake	‡1
So. Utah	‡.12
Superior	‡4¾
Superior & Bost	3¾
Trinity	‡3¾
Tuolumne	.95
U. S. Smelting	47½
U. S. Smelt'g, pf	45¾
Utah Apex	2½
Utah Con	9⅜
Utah Metal	2
Victoria	‡2½
Winona	1⅜
Wolverine	21½
Wyandot	‡.50

N. Y. CURB†	Oct. 29
Big Ledge	⅜
Butte & N. Y	‡.75
Butte Detroit	‡.05
Caledonia	.49
Calumet & Jerome	⅜
Can. Cop. Corpn	2
Carlisle	‡2
Cashboy	.04
Con. Ariz. Sm	1¾
Con. Coppermines	5⅜
Emma Con	‡.03½
Goldfield Con	.18
Goldfield Merger	.01
Greenmonster	‡⅜
Hecla Min	5⅜
Howe Sound	4
Jerome Verde	‡⁷⁄₁₆
Louisiana	‡⁵⁄₁₆
Magma	33
Majes ic	.20
Marsh	‡.03
McKinley-Dar-Sa	‡.40
Milford	‡.75
Mother Lode	.39
Nixon Nevada	.36
Ohio Cop	.75
Rawley	‡2½
Ray Hercules	‡4
Richmond	‡.56
Rochester Mines	.33
St. Joseph Lead	14
Standard S. L	‡⅝
Stewart	‡.14
Success	.10
Tonopah	‡2½
Tonopah Ex	1⁵⁄₁₆
Tribullion	‡⅝
Troy Arizona	.10
United Verde Ext	37½
United Zinc	1⅛
Utica Mines	‡.08

TORONTO*	Oct. 29
Adanac	‡.08
Bailey	.03
Beaver Con	.28
Chambers Ferland	‡.09
Coniagas	4.50
Hargraves	.03
Kerr Lake	6.00
La Rose	.37½
Min. Corp. of Can	2.00
Nipissing	8.37½
Peterson Lake	.09
Temiskaming	.29
Wettlaufer-Lor	.02
Davidson	.25
Dome Exten	.23
Dome Lake	.10
Hollinger	5.00
McIntyre	1.50
Newray	.13
Porcu. Crown	.16
Teck-Hughes	.20
Vipond	.18
West Dome	.10

* Bid prices. †Closing prices. ‡ Last quotations.