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## Smelting Ray Concentrates at Hayden, Ariz.

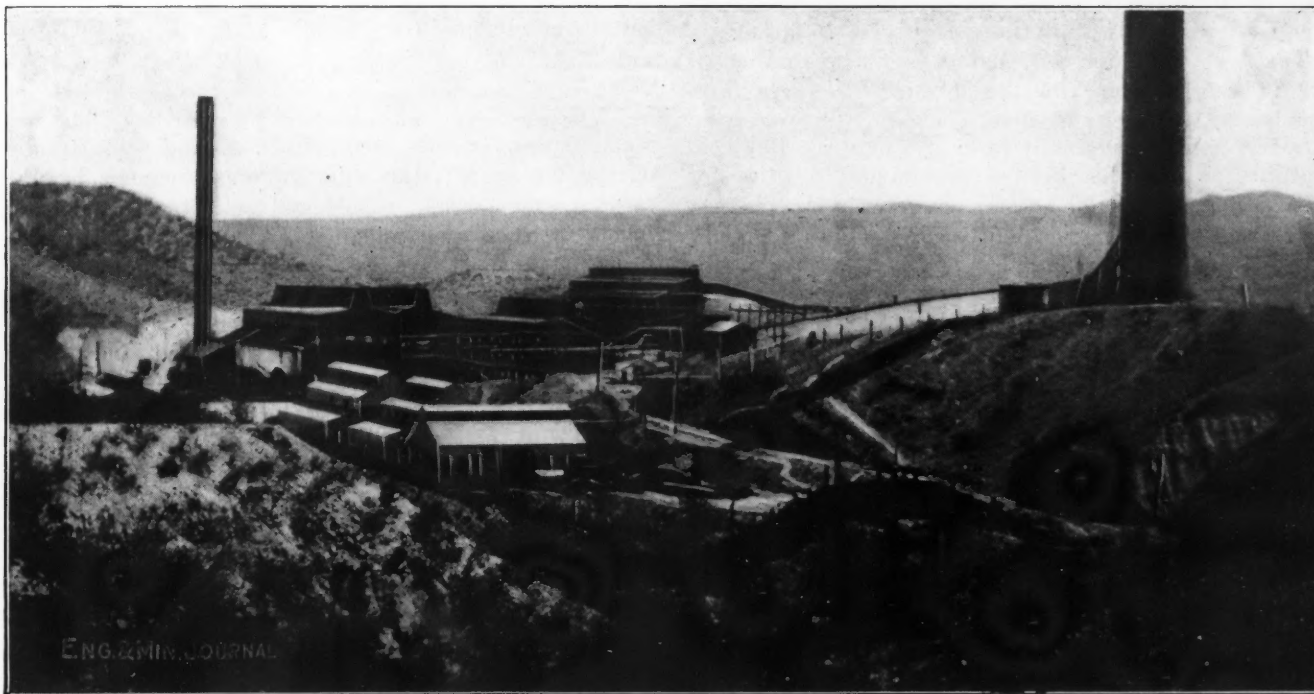
BY RICHARD H. VAIL

*SYNOPSIS—The works of the American Smelting & Refining Co., at Hayden, Ariz., was built in the remarkable time of about eight months, and is a typical reverberatory smelting plant, no blast furnaces having been installed. The most striking feature of the smelting practice is the use of cold converter slag for fettling; a record tonnage of copper from Peirce-Smith converters was obtained at this plant.*

The Hayden plant of the American Smelting & Refining Co. was built in remarkable time; ground was broken

superintendent of the Garfield plant and an operating metallurgist of long experience, who has been intimately associated with the building of a number of the company's plants in recent years. This idea of benefiting by the coöperation of operating officials was further carried out by having the future superintendent of the plant, James Heggie, assigned to duty while construction was in progress.

The Hayden plant was built primarily to smelt the concentrates made by the Ray Consolidated Copper Co.; after operating a year an elaborate metallurgical cutoff



GENERAL VIEW OF SMELTING WORKS AT HAYDEN, ARIZONA

for this construction on Sept. 15, 1911, the first charges put in the furnaces on May 6, and the first copper poured on May 17, 1912. Not only did the engineers make a remarkable record in the construction, but the design of the plant shows that much attention was given to convenience of operating, doubtless the result of a metallurgist being consulted in the early stages of the work. The engineering department of the American Smelting & Refining Co. was aided in this respect by W. H. Howard,

was made to determine a standard figure for the metallurgical loss, and settlements for Ray concentrates were adjusted to this basis; since July, 1913, other ores and concentrates, particularly a portion of the Chino concentrates, are being smelted at this works. The Ray Consolidated mill is at Hayden, and the Ray company also began excavating for a smelting works adjoining the mill. When the American Smelting & Refining Co. took the contract for smelting the Ray concentrates, it

decided to build its plant on a new site, and on a somewhat magnified scale; hence the haste necessary in the construction work, and the joint power house used by the two companies. On account of the extraordinary expedition necessary to have the plant ready to begin treating the Ray concentrates, construction work was carried on part of the time with both a day and night shift. The cost of the plant was in consequence higher than it would have been normally; a value of \$1,600,000 was placed on the plant in the company's last report to the Arizona State Tax Commission.

The concentrates treated at Hayden vary from 18½ to 20% Cu, 28 to 32% insoluble, 22 to 25% Fe, 25% S, 1% CaO, 5 to 6% Al<sub>2</sub>O<sub>3</sub>. A considerable proportion of the concentrates is fine, and with the slimes, which are high in silica, have a tendency to form on the surface of the reverberatory furnaces, an infusible siliceous blanket, which is difficult to flux.

#### THE RECEIVING SYSTEM

The Ray concentrates are received in 60-ton gondola cars and are unloaded by hand and shovel sampled. The shovel sample, every tenth shovelful, is thrown into a small tram car that runs alongside the railroad track and discharges the sample on a coning floor under the trestle track. Here the sample is coned at a convenient time and removed to an adjacent sample-grinding room. Limestone and flux are crushed and sampled in the limestone-crushing plant, which contains a 15x24-in. Blake crusher, a set of 36x16-in. rolls, a bucket elevator and two Vezin samplers; all of this equipment is run by a 75-hp. motor.

The trestle bins for concentrates and fluxes are about 322 ft. long, and for the concentrates, there are three bins having a capacity of 2000 tons each. The receiving capacity, planned originally to handle only the Ray concentrates, is now too limited in storage facilities for present operations. The works, however, were planned for the enlarged operations and space was left for additions to capacity as required.

A system of three 20-in. Robins conveyors transfers the concentrates, limerock and converter flux to the roaster building. There is a horizontal conveyor under the receiving bin, an inclined conveyor to elevate the material to the roasting plant, and a third conveyor, equipped with the usual automatic tripper, distributes the material to the roaster hoppers. On the No. 2 conveyor there was installed originally an automatic electric weigher that has since been removed. Separate limerock hoppers are provided in this building, and when desired, this material may be passed directly to the calcine cars, or may be delivered on the bottom hearth of the roasting furnace. Siliceous converter flux is usually passed through No. 8 roaster, though climatic conditions prevailing at this plant do not always compel the drying of siliceous ores fed to the converters.

#### ROASTER BUILDING

The roaster building is a four-story structure, 233 ft. long by 48 ft. wide. It contains eight McDougal roasters; three of these are Allis-Chalmers furnaces, 19 ft. 6 in. in diameter, having six hearths; the other five furnaces are 24 ft. in diameter and have five hearths. A line shaft driven by a 30-hp. motor supplies power to all the furnaces. Each furnace has two uptakes, made of brick to avoid corrosion; No. 1 furnace, however, has

steel uptakes. The dust flue has pipes leading to the calcine hoppers, so that any dust deposited within the building is delivered with calcines below. There are two feed hoppers of 35-ton capacity for each of the large furnaces, and hoppers of 32-ton capacity for the smaller furnaces. Each furnace is provided with four calcine hoppers of 10-ton capacity. The limerock hoppers previously mentioned have chutes capable of delivering directly to the calcine cars and may be used for limerock, siliceous ore or any other material that may be desired for delivery to the reverberatory or converter bins. The calcines and fluxes are transported in electric larry cars, of 5½-ton capacity, having arc gates at the bottom. On the way to the reverberatory building, the calcines are weighed on a 15-ton track scale.

One oil burner is used in each McDougal furnace, being placed at the door on the fourth floor. Oil is used intermittently for 15 or 20 min. and then perhaps not for two or three hours, as it is not desired to burn off much of the sulphur. The aim in the roasting plant is to reduce the sulphur from 25% to 12 or 14%. The warmest hearth here is the bottom one, though the temperature in the roaster is low, speaking generally. The oil consumption varies from three to four gallons per ton treated.

The roasting furnaces at this plant make but a small amount of flue dust, the dust recovered in the dust chamber being less than 1% of the tonnage charged. The draft for the furnaces is regulated by a damper in the flue, which is lowered until the last roaster in the line barely smokes; the draft usually amounts to 0.15 in. of water.

When the roasting plant was first started, the average tonnage per roaster was about 85 tons per day. The wet material was formerly inclined to bank and slide around on the top hearth; this difficulty was overcome by discarding every second rabble and substituting a longer rabble for those that remained. The roaster arms were formerly provided with cast-iron rabbles, but now when the rabbles become worn down sufficiently, they are drilled and a steel or cast-iron plate, 6x8¼ in., is bolted to the stub. An apron around the column on the second, fourth and sixth floors was eventually supplanted by a curved rabble that distributed the feed better over the hearth; with this change, the capacity of the furnaces was increased to about 100 tons per day, though the tonnage has been as high as 110 tons for 10-day periods. The capacity of the furnaces is limited by the delivery of the material from the receiving bins, as the belt crew works only on day shift; however, the plant has sufficient roasting capacity so that it is not handicapped by this fact; consequently, no increase is made in the number of shifts worked in the receiving department.

#### REVERBERATORY DEPARTMENT

The reverberatory building is of steel and covers an area of about 127x160 ft. It contains at present two reverberatory furnaces, 19x112 ft., and also houses six 350-hp. waste-heat Stirling boilers. At the other end of the reverberatory buildings are three converters, arranged in a converter aisle at right angles to the axes of the reverberatories. The reverberatory furnaces are built on a concrete slab, 3 ft. 6 in. thick, on top of which are 24 in. of silica. The walls of the furnaces are of silica brick, 2 ft. 10 in. thick, outside of which are five

inches of fireclay brick. The furnaces are oil fired, five burners of the Steptoe type being provided, although only three of these are ordinarily used. Air is supplied to the oil burners from the converter air main, but there are also available for this service two Roots blowers, having a capacity of 3600 cu.ft. per min. at 48-oz. pressure.

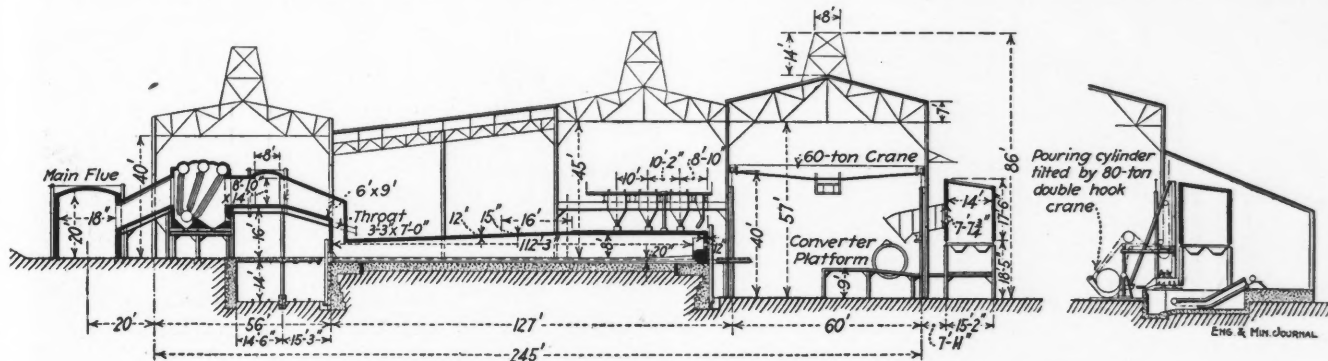
The reverberatory charges are dropped from six charge hoppers, each having a capacity of 200 cu.ft. The hoppers are 6 ft. square and have the Garfield "torpedo" or plunger to close the bottom of the hopper; this operates on the principle of a needle valve; the cones are machined and there is no leakage of fine material. As in most newer furnaces, the hopper casting does not extend down to the roof, but to a "dog house," built thereon of firebrick, 12 or 15 in. high and protected on top by a casting.

At the skimming end of the furnaces, the gases are removed by a high flue, leaving plenty of "head room" above the skimmer, who is thus protected from the heat inflicted upon him in many plants by a flue only a few feet above his head. The skimming box is equipped with a Garr tilting spoon to catch the slag while slag cars are

pots. An endeavor is made to put in the molten converter slag immediately after charging calcines, as the speed of smelting is thereby increased; the metallurgists at this plant report that a visible reaction takes place between the hot converter slag and the calcines.

FETTLING WITH CONVERTER SLAG

The fettling practice here is unusual. A decade ago it would have seemed heretical to have used converter slag for fettling a reverberatory furnace. Nevertheless, this material has been found to be the most available for the purpose at the Hayden works. This reverberatory plant has perhaps carried the revolution in fettling material a stage farther than has been done at most places. Here, as in many other places in the Southwest, the metallurgists began by using eupreous siliceous ores for fettling, when difficulty was experienced in getting high-grade silica, or in making the silica stick to the side. As at many plants, the siliceous ore was inclined to slough off as badly as the straight quartz formerly used and it also increased the blanket that was inclined to form on the surface of the slag by reason of the siliceous slimes from the Ray Consolidated mill.



SECTION THROUGH MAIN SMELTING BUILDING AT HAYDEN, ARIZONA

being shifted. This idea first developed by Richard Garr at the Garfield smelting works has since been adopted in most of the newer reverberatory plants. The reverberatory slag is caught below in slag ears having single-piece motor-dumped bowls of 225-cu.ft. capacity. These slag cars have been most satisfactory, the slag shells usually leaving the single-piece bowls as soon as the pot is turned over. The slag ears were built by the M. H. Treadwell Co., of New York, and are hauled in trains of four by an 18-ton Baldwin-Westinghouse electric locomotive.

The capacity of the reverberatory furnaces has been as high as 350 to 400 tons per day for 10-day periods, making 40 to 42% matte, and slag running from 43 to 45% SiO<sub>2</sub>, 28 to 30% Fe, and 7 to 10% CaO. Lime flux is added to make the slag more fluid; when the CaO falls below 7%, the slag loss seems to increase. Such lime as is needed is put in the bottom of each car of calcines. For example, 1500 lb. of limerock may be drawn and then the ear is filled with calcines. This method gives a fairly good mixture of limerock and calcines by the time the charge is in the furnace.

Two 5½-ton charges are dropped at about 30-min. intervals, without shutting off the oil or opening the doors. When hot converter slag is to be poured through the reverberatory roof, the converter-slag pots are taken to the reverberatory charge floor and the slag tapped into a short launder by opening tapholes near the bottom of the

The siliceous oxidized copper ore floating on the surface was pulled off in skimming, and augmented the metal loss in the slag.

At the Hayden plant there was no supply of siliceous copper-sulphide ore, and the metallurgists resorted to the use of cold converter slag shells for fettling. As already stated, the hot converter slag was regularly poured into the reverberatory furnace through the hole between the charging hoppers. The cold converter slag, which had formerly gone into the furnace through this hole, would sometimes drop to the bottom of the furnace and stick. When this happened it was difficult to remove, and the trouble experienced with "bottom building" suggested to the metallurgists that this material might also stick to the sides of the furnace. As the siliceous ores floated off into the furnace and consequently had to be smelted in a manner not contemplated in the fettling plan, it was decided to try broken converter-slag shells for fettling. This eventually proved to be the best material tried for protecting the furnace walls at this works.

There is no blast furnace at this plant, and when the broken converter-slag shells began to stick on the bottom of the reverberatory furnace, it became something of a problem to dispose of this coarse material without increasing the bottom-building troubles. The converter flux used at this time contained much alumina and in con-

sequence, was giving trouble in the converters, causing such a large amount of nonfluid slag that a plan had to be considered for the disposal of the cold converter slag. The use of the slag shells for fettling material proved a solution for both problems.

At the time these notes were taken, the No. 2 furnace had been in operation 10 months, and converter-slag shells had been used for fettling this furnace during the entire campaign, with the exception of the first month, when straight quartz was used; the furnace walls still appeared to be good for several months' service.

There is a fettling hopper for the bridge having eight outlets with "bootlegs" to direct the material into holes in the roof; the bridge-wall is thus fettled in a short time, usually not exceeding 15 min. Raw concentrates, converter flue dust, mixed converter slag and silica, or the cold converter slag alone is used for this purpose; these materials are also used at times for fettling the sides. On the furnace side for four or five doors there are fettling hoppers that permit the fettling to be dropped from the roof; beyond this point the sides are fettled from a movable hopper through openings in the arch; for the next furnace, movable hoppers provided with multiple openings will be used, so as to permit fettling to be done more quickly.

#### FUEL CONSUMPTION

The draft in the reverberatory furnaces is so regulated as to keep the flame at the sixth door, or about the middle of the furnace. The draft at the eighth door is usually about 0.2 in. of water, 0.6 to 0.8 in. at the throat, 1.6 in. in the main flue, and 0.9 in. at the base of the stack when two furnaces are in operation. The oil consumption per furnace is from 12,500 to 13,500 gal. per day when smelting from 350 to 400 tons of charge. The oil consumption per ton of charge ranges between 0.75 and 0.85 bbl.; the oil used contains between 18,000 and 18,500 B.t.u., and has a gravity of about  $13\frac{1}{2}^{\circ}$  Baumé. The viscous oil goes to the furnace building in a 4-in. oil line; the oil is heated at the storage tank by a steam coil, and at the furnace by another coil contained in a 12-in. pipe about 12 ft. long, surrounding the oil line just before it is tapped for the individual burners. It is now aimed to heat the oil to 200° F. Formerly, in summer, the oil entered the furnace at a temperature of from 160 to 190° F., and in winter at about 150°. It is difficult to atomize the oil when the temperature falls below 120°, even with air at 10- to 13-lb. pressure. The burners are of the Steptoe type, modified. The  $\frac{3}{8}$ -in. oil pipe, instead of having a cap with a cross opening, has a circular opening, as the viscous oil used here is inclined to clog the cross opening.

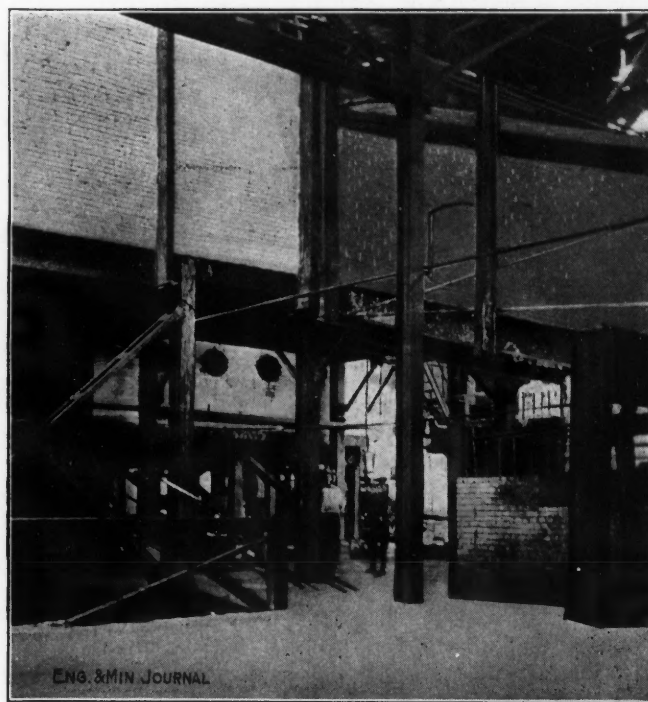
The gases from the reverberatory furnaces pass into a silica-brick header flue, 8x19 ft., and are then distributed to the Stirling water-tube boilers, of which five are ordinarily in use when two furnaces are running. A thermal efficiency of about 35% is obtained in steam from the oil burned in the reverberatory furnace. The gases from the reverberatories are under complete control by means of the various dampers. Each boiler is equipped with individual dampers, both front and rear, and there are two dampers in the header flue for use in case either reverberatory furnace is "down." All dampers are hung from Yale & Towne triplex blocks, so that they may be conveniently operated—characteristic of the care that was

taken in the design of this plant. The boilers are served by a Worthington duplex steam pump and there is a reserve installation of a Deane triplex motor-driven pump. There is also a 500-gal. steam fire pump, and hydrants at suitable places throughout the works for fire-protection.

The gases from the waste-heat boilers pass through firebrick flues, 8 ft. wide by 7 ft. 10 in. high, to the main dust flue, which is 18x22x950 ft. long. For 300 ft., the main flue has reinforced-concrete walls with brick jack arch. The main stack of the smelting works is 300 ft. high by 25 ft. inside diameter and is built of radial bricks. It is lined for 100 ft. with bricks laid in acid-proof mortar. The inside joints near the top of the stack and for 40 ft. on the outside are also pointed with acid-proof mortar.

#### CONVERTER PLANT FREE FROM SMOKE

The converter aisle is 256 ft. long by 60 ft. wide. It contains two Pierce-Smith converters and a 12-ft.



VIEW SHOWING HEIGHT OF FLUE OVER SKIMMER

Great Falls type converter, added last summer. The converters are electrically operated and are served by a 60-ton Morgan crane, the crane rails being 40 ft. above the floor. The working platform for the converters is about 9 ft. high, and on this platform are the gages, control levers, power-house signals, and a telephone connecting with the Ray Consolidated power house, from which compressed air is conveyed in a 36-in. main about 2000 ft. long. Matte is brought to the converters in cast-steel ladles of 76 cu.ft. capacity and flux is fed from boats in the usual manner. The converters are served by a dust chamber, 14x17 ft. in section, leading to a separate stack. The passages for the gases have been designed amply large, and dampers provided for the converter hoods have never been installed; this has not been found necessary, as the converter room is as free from smoke as any other part of the plant. In this respect, the converter department is one of the most comfortable plants in the country to work in. The converter stack is of the Garfield

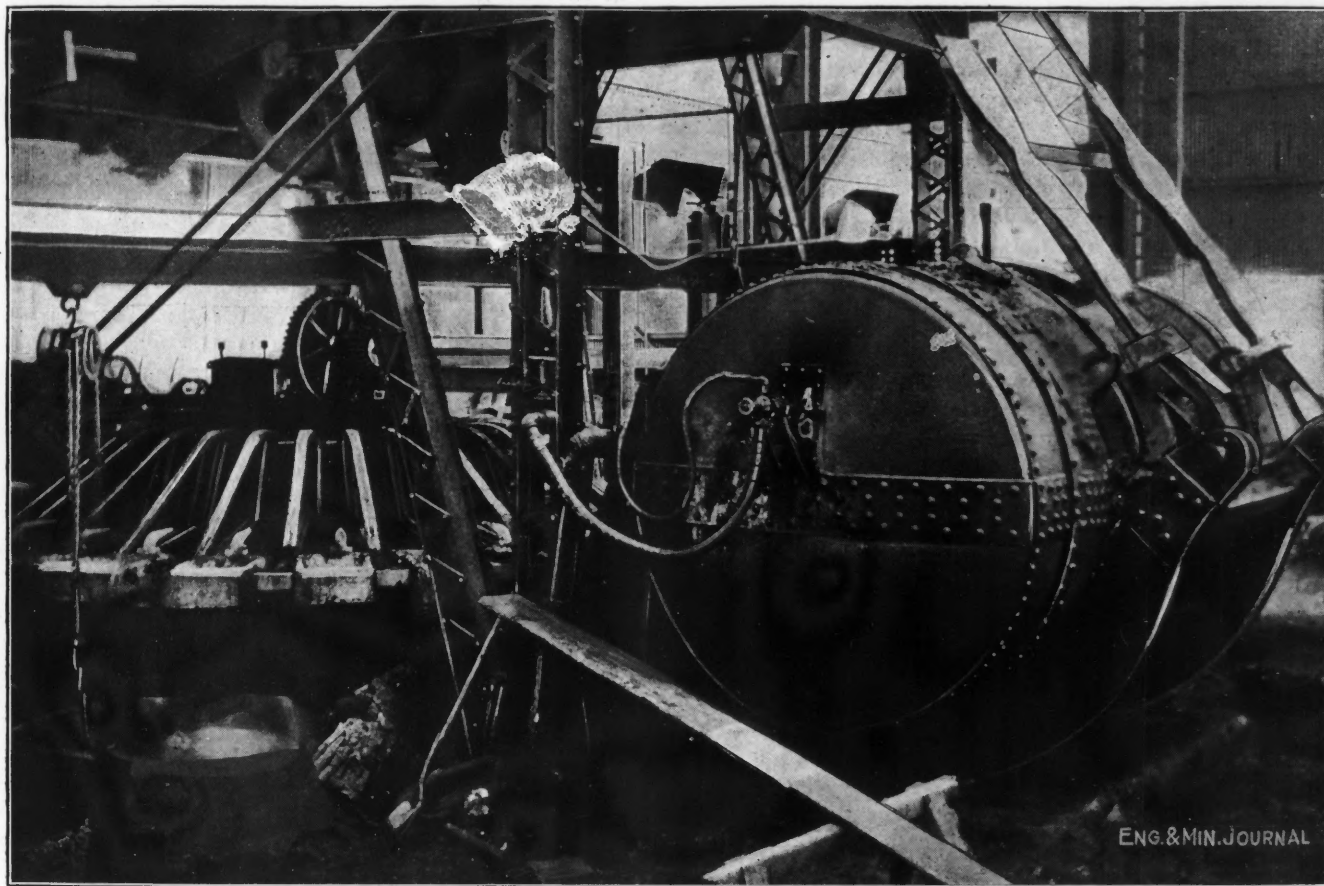
type, built of structural steel and corrugated siding. It is 253 ft. high and has a rectangular section, 10x12 feet.

The two Peirce-Smith converters originally installed were of the standard type, 25 ft. 10 in. long and 10 ft. in diameter. These converters made some unusual records in output, producing what at the time was the greatest amount of copper ever made on a single lining in this type of furnace; No. 1 converter in its second campaign produced 7758 tons of copper from 42% matte, the average tonnage of four runs having been 5400 tons per lining. Up to the end of March, 1914, in 22 months' operation, the two Peirce-Smith converters at this plant had produced 50,250 tons of copper. The repairs at no time have been more than a patch to renew the tuyere line and the mouth.

It is interesting to give some figures regarding the ex-

May 22; repairs were completed May 25; the converter began blowing again on May 26. The magnesite brick lining of these converters is made 18 in. thick at the tuyeres, 12 in. at the breast, 9 in. at the arch, and 18 in. thick on the bottom. The converters have thirty-six 1 $\frac{1}{4}$ -in. tuyeres, but it is probable that these will be changed to 1 $\frac{1}{2}$ -in. on account of the increased duty obtained at Garfield, Utah, with the larger-size tuyeres. When two converters are blowing, about 10 lb. air pressure is maintained and about 13 lb. when only one converter is blowing.

The upright converter is 12 ft. in diameter and has twenty-six 1 $\frac{1}{4}$ -in. tuyeres and a distance of about 12 in. from tuyere line to bottom is maintained; the converter was first started with this distance only 5 in., but this was found inadequate as has been the case in other sim-



COPPER-CASTING EQUIPMENT AT HAYDEN, ARIZONA

pense of repairs for No. 1 converter. This converter in its first run produced 6155 tons of copper and then required repairs costing \$699.29, of which \$495, or 71%, was for material and \$204, or 29%, was for labor; of the expense for materials, 31% was for metal replacements and 69% for replacement of burned brick. The repairs consisted of patching for about 18 in. at the line of the tuyeres and some repairs to the burned places on the shell.

On the second run of this converter, 7758 tons of copper were produced after which the cost for repairing was \$575.97; material in this case amounting to 73% and labor to 27% of the expense. The work this time consisted of repairs at the mouth and a patch at the tuyeres. It is interesting to note the time the converter was out of commission for this repair. The converter went down on May 16; was sufficiently cooled to begin repairs on

ilar installations, it having been necessary to deepen the bottom in most cases before successful running was obtained. The upright converter had not been in operation long enough to obtain a satisfactory comparison with the Peirce-Smith horizontal type. In any event, such comparisons would be of little value to another plant unless the same magnitude of operations prevailed. Both types of converters seem to give entire satisfaction when the operatives become familiar with them and the choice in the selection of the converters seems to be largely a matter of the scale of operations. The upright converter has a slight advantage by reason of its being a smaller unit, not interfering so much with the output or operations of a plant when one is down for repairs; the upright converter has a more direct escape for the hot gases, and also permits a better coating of magnetite at

the tuyere line. It would be interesting to be able to compare the converting costs at a large plant using Peirce-Smith converters with a plant of equal capacity using the upright converters.

The silica flux for the converters at this plant is crushed to about walnut size and dried in the McDougal roasters. It is delivered to bins alongside the converter aisle and drawn into boats for feeding into the converters. The flux usually contains from 60 to 70% silica, and enough alumina to preserve the lining of the converter, to a certain extent. With 43% matte and the low-silica aluminous flux, the converter is inclined to run rather cold and build up; however, when high-grade flux containing 85 to 90% silica is used, the converter gets hot and is inclined to cut at the tuyeres. The character of the flux used consequently has to be taken into consideration in controlling the operation of the basic-lined converter. When crushed fine, i.e., from pea to nut size, the flux spreads better in the converter; when the flux is coarse, it sometimes forms balls which have to be broken up.

The converter charges used here usually average one 8-ton ladle of matte with one 5000-lb. boat of flux. The converter slag usually ranges from 20 to 23% SiO<sub>2</sub> and from 48 to 53% Fe. The converter skimmers at this plant are paid \$4 per day, but receive a tonnage bonus in case the life of lining exceeds a standard amount.

#### COPPER-POURING CYLINDER

The converter copper is handled in a pouring cylinder of the type usually employed in the A. S. & R. plants. The pouring cylinder at the Hayden plant is 14 ft. long by 8 ft. in diameter. The cylinder holds from 50 to 70 tons of copper, depending upon the amount of incrustation; about 8000 tons are handled before a cylinder requires relining. The cylinder shell is made of 5/8-in. steel plate and was formerly lined principally with silica brick, 12-in. brick being used on the bottom, 9-in. brick above the copper line, 12-in. brick at the firing end, and magnesite brick at the skimming end. Lately the pouring cylinder has been lined with magnesite "bats" to a little above the slag line, above which a firebrick arch is used. This is much better than the silica-brick lining.

The cylinder is lifted by an 80-ton Morgan stationary electric crane connecting with the cylinder frame, which is so pivoted as to keep the pouring nose at practically the same point. As will be seen from the accompanying illustration, the cylinder has a removable cover and when it is desired to pour in converter copper, this lid is raised by a small auxiliary electric hoist. The copper is poured on two shifts only, and in the interim between casting, the copper is kept molten by the use of oil, from 400 to 500 gal. per day being required for the pouring cylinder. Before pouring, the supernatant slag is skimmed off the charge through a small door at the end of the cylinder, opposite the oil burner. The cylinder delivers the molten copper to a pouring spoon, operated hydraulically, and the copper is cast in a 27-mold Walker casting wheel operated by a 5-hp. motor; a 3-hp. motor operates the straight-line bosh conveyor that delivers the copper bars weighing from 275 to 300 lb. to a loading platform on a level with the floors of the box-cars on the bullion track. Two shifts of nine men, each, stack, trim and load 110 to 140 tons of copper per day.

#### POWER AND WATER SUPPLY

The steam from the reverberatory waste-heat boilers is taken through a 12-in. line, protected by Johns-Manville magnesia covering, to the Ray Consolidated power house about 1800 ft. distant. The steam required for the operation of the smelting works is utilized in the Ray Consolidated power house in the smelting company's Nordberg engine, the excess steam being used by the Ray Consolidated Copper Co. to provide power for its concentrating mill. The steam used by the smelting company is measured through a St. John meter and another St. John meter measures that used by the Ray Consolidated company. The additional steam required by the Ray company is generated at its power plant in oil-fired boilers. While the Ray company buys steam of the smelting company, it sells the latter such electric power as is required in the smelting works. Adjustments of these accounts are made monthly.

The smelting company maintains at the Ray power house an engineer and an oiler for each shift. The 860-hp. Nordberg blowing engine is operated condensing with a 25-in. vacuum. The engine has 36x56-in. steam cylinders, 54-in. air cylinders and 48-in. stroke. At 72 r.p.m., it has a capacity of 18,000 cu.ft. per min., when compressing to 14 lb.

The water-supply for the works is obtained from wells in the Gila River bed, a short distance from the plant; the domestic water-supply is drawn from a reservoir on a neighboring hill. The water-supply is owned by the Ray Consolidated Copper Co., and is operated for the joint use of the two interests at Hayden.

The smelting works is situated in a comparatively isolated town, and consequently the company has established thoroughly equipped mechanical shops for the purpose of expediting repairs.

The Hayden works, while handicapped to an extent by the lack of a blast furnace to work up coarse material, represents a remarkably "workable" plant, convenient for the operating crew, and comfortable to work in; considering the extraordinary expedition of its construction, the results reflect much credit on its designers. With certain additions required by the increased ore supply now being received, the plant will be one of the representative reverberatory smelting works of the United States. The plant is under the general management of Kuno Doerr, and in direct charge of James Heggie, superintendent, and R. B. Green, assistant superintendent.



#### Eastern Market for Ozokerite

In spite of our large exports of paraffin, natural mineral wax (ozokerite) is imported, for the reason that its melting point is very high, and although paraffin wax from petroleum can be produced with this high melting point, the process is difficult and costly, according to Bull. 599, U. S. Geol. Surv. Ozokerite occurs in considerable quantity in Utah in the region of Soldiers Summit, and has been produced there, but the cost of extracting it from low-grade material, together with the cost of transportation to the market, has made it possible for the foreign material, which comes from Galicia, to compete successfully in the Eastern States. Domestic ozokerite may now replace the foreign material.

# Investigation of the Performance of Hammer Drills

BY SVEN V. BERGH\*

**SYNOPSIS**—Results of an exhaustive series of tests carried out on all the drills in use at the Malmberget mines in Sweden. Comparison between various American, Swedish and German machines of different types, in their drilling performances. Special tests to show effects of replacing certain worn parts; of various air pressures; of removal of cuttings by air and by water; of different methods of feed; of different sizes and lengths of steel. Formula for relation between size of bit and rate of drilling.

The Malmberget mines are situated in the province of Lapland, at a latitude of 67° 11'. From these mines are exported yearly about 1,000,000 tons of iron ore, averaging 65% in iron. The ore, both finely and coarsely crystalline, consists chiefly of magnetite, although considerable hematite is found, and it sometimes contains

The diameter of the drill steel varied from 7/8 in. to 1 1/8 in., the diameter of the bit from 1 in. to 2 in. The angle between the cutting faces was for soft rock, 90°; for hard rock, 105°.

In Table I are given important dimensions and data concerning the drills used at Malmberget.

The Cyclop 32 was used in the hard rock, which gave comparatively fine cuttings; the Little Jap, Finspong F I and F II and the Flottmann D-hammer in the soft rock, which naturally gave coarse, heavy cuttings. The Finspong F I and F II drills were run on test in order to find out if they could replace the Little Jap and Flottmann D-hammer. In adits and tunnels, the heavy types of Atlas, Finspong and Ingersoll drills were used.

The stock of Cyclop 32 in use consisted both of old and new drills. The Little Jap and the Flottmann D-hammer had been running for a long time without any

TABLE I—SPECIFICATIONS OF THE DRILLS IN USE

Name of Drill	Type of Drill	Weight of Piston, Lb.	Length of Stroke, In.	Diameter of Piston, In.	Length of Feed, In.	Length of Drill, In.	Weight of Drill, Lb.	Type of Valve
<b>Ingersoll, U. S. A.:</b>								
Little Jap .....	Handle	...	4 1/8	1 3/8	..	..	20	Axial Valveless
MC 22 .....	Telescopic	...	4	{ 2 1/2 } { 1 1/2 }	20	50	65	Valveless
MC 32 .....	Telescopic	...	3 1/2	{ 2 1/8 } { 1 1/8 }	20	53 1/2	70	Valveless
<b>Atlas, Sweden:</b>								
Cyclop 32 .....	Handle	2	5	1 1/4	..	21	30	Spool valve
Cyclop 32 .....	Telescopic	2	5	1 1/4	17 3/4	50	52	Spool valve
Cyclop 42 .....	Telescopic	3.1	2 3/4	1 3/8	17 3/4	48 3/4	66	Spool valve
Dux .....	Telescopic	3.6	2 3/4	{ 2 1/2 } { 1 }	18 3/4	48 3/4	67	Valveless
<b>Finspong, Sweden:</b>								
F I .....	Handle	1.3	4 3/8	1 3/8	..	16 1/2	23	Tubular valve
AF I .....	Telescopic	1.3	4 3/8	1 3/8	19 1/8	43 3/8	47	Tubular valve
F II .....	Handle	...	9 1/2	1 3/8	..	21 5/8	29	Tubular valve
AF II .....	Telescopic	...	9 1/2	1 3/8	19 1/8	47 3/8	52	Tubular valve
<b>Flottmann, Germany:</b>								
D-hammer .....	Handle	...	2 3/4	2 3/4	..	..	40	Ball valve
Air-supply pipe, 3/4 in.								

a good deal of apatite. The orebodies exist as lenses with a steep dip and are imbedded in a country rock consisting of different varieties of gneiss.

## MINING AND DRILLING PRACTICE

Methods of mining include the use of opencuts and of underground rooms with or without filling. The drilling practice at the mines at the time that I conducted the tests to be here described was as follows:

Hammer drills with handles were in use for overhand and underhand stoping and in driving narrow drifts. In all other cases telescopic air-feed drills were employed, either mounted or unmounted. The cuttings were removed by exhaust air, live air or water, introduced into the bore hole through the hollow drill steel. At most of the mines the gage pressure of the air was kept between 80 and 90 lb. per sq.in. The depth of the holes drilled varied from less than 1 ft. to 14 ft. Round-section, hollow drill-steel with star bits was used, running about 0.65% in carbon. The steel with few exceptions was upset at the shank. When the dust was removed by air, the hexagon shank, shown in Fig. 1, was used, in which case the front head bushing of the drill was supplied with a leather cuff. When, however, the dust was removed by water, the Atlas shank and patented water-flushing arrangement, shown in Fig. 2, was employed.

parts having been renewed. The Cyclop 42 and the Ingersoll MC 22 had been working for one year; all the other drills for a few months only.

The cost of rock drilling in 1911 was:

Number of feet drilled.....	1,069,740
Labor, per ft.....	3.98c.
Power, per ft.....	1.17c.
Drill material, including smaller piping, repairs, etc., per ft.....	2.00c.
Sharpening bits, per ft.....	0.77c.
<b>Total .....</b>	<b>7.92c.</b>

## MANNER OF TEST

In Table II, a summary is given of "three-minute" tests carried out during the months of August and September in 1912, on all the drills in use at the Malmberget mines; 294 machines were tested altogether.

The drilling was done on big, solid blocks of homogeneous granite, placed outside the various repair shops. Vertical holes were drilled by machines with handles; horizontal holes by those with telescopic feed. Air and water were flushed through the steel as when used in the mines. All the granite blocks were compared by drilling them with the same machine.

The drill steel used had the following dimensions:

Length .....	20 in.
Diameter of bit.....	1 1/8 in.
Diameter of inside hole in the hollow steel.....	3/8-1/2 in.
Angle between cutting faces.....	90°

For every test special attention was given to the

\*Mining engineer, Chrome, N. J.

shape of the bit and the leather cuff in the front-head bushing. The method of conducting the tests was as follows:

(1) Speed of drilling and air consumption per minute were taken during a three-minute run. Time was taken with a stop watch. Drill was left in condition as taken from the mine.

(2) General inspection was made of the drill. Micrometer measurements were taken of piston and valve. Stroke was measured during the run of the drill.

TABLE II. COMPARATIVE RESULTS OF DRILLING TESTS.

Depth Drilled per Minute, Inches	Percentages of Machines Drilling at the Various Rates.								
	Little Jap	Ingersoll MC22	MC32	Cyclo-32	Atlas Cyclo-42	Dux	Finspong AF I	F II	Flottman or D
	%	%	%	%	%	%	%	%	%
1.4-1.6	5.0								
1.6-1.8	10.0								
1.8-2.0	9.0								
2.0-2.2	19.5								
2.2-2.4	21.5								
2.4-2.6	11.0			2.9	33.3	100	15.4		
2.6-2.8	15.0			2.2	33.3		50.0	50	
2.8-3.0	7.0			5.7	33.4		23.1		4.3
3.0-3.2	2.0			12.1			3.8		
3.2-3.4				12.9					13.1
3.4-3.6		100		17.1					13.1
3.6-3.8				17.1					26.0
3.8-4.0				22.2					21.8
4.0-4.2				50	6.4				8.7
4.2-4.4				50	0.7				4.3
4.4-4.6					0.7				
4.6-4.8									8.7
4.8-5.0									
5.0-5.2									
5.2-5.4									
5.4-5.6								50	
5.6-5.8									
Total	100	100	100	100	100	100	100	100	100

Notes. Diam of bit = 1 1/8 in. Test run for 3 min.

Free Air per Minute, Cu.ft.	Percentages of Machines using Various Quantities of Air.								
	%	%	%	%	%	%	%	%	%
28.25-30.02							7.7		
30.02-31.78							42.3		
31.78-33.55	1.1						27.0		
33.55-35.31						100	15.4		
35.31-37.08	2.1							50	
37.08-38.85	3.2								
38.85-40.61	4.3								50
40.61-42.37	6.5								
42.37-44.14	13.0								
44.14-45.91	15.0								
45.91-47.67	13.0								8.7
47.67-49.44	11.8								4.4
49.44-51.21	15.0								
51.21-52.97	7.5		50						8.7
52.97-54.74	3.2								
54.74-56.51	2.1	100	50						
56.51-58.27									8.7
58.27-60.04	1.1								17.3
60.04-61.80						2.1	33.3		13.0
61.80-63.57	1.1					2.7	33.3		4.4
63.57-65.33						.7	33.4		8.7
65.33-67.10									13.0
67.10-68.87						.7			8.7
68.87-70.63									4.4
Total	100	100	100	100	100	100	100	100	100

Inches Drilled per Cu.ft. of Free Air	Percentages of Machines Drilling at Various Efficiencies.								
	%	%	%	%	%	%	%	%	%
.022-.028	3.1								
.028-.034	7.3								
.034-.040	12.5								
.040-.046	12.5			1.4	100				
.046-.052	18.7			3.5					4.4
.052-.057	13.5			6.4					17.3
.057-.063	23.0			9.1					26.2
.063-.068	7.3	100		15.5				7.7	17.3
.068-.074	2.1			13.4		100		7.7	17.3
.074-.079			50	20.5				7.7	4.4
.079-.085				18.4				34.6	4.4
.085-.090			50	6.9				26.9	8.7
.090-.096				2.1				11.5	
.096-.101				1.4					
.101-.107				.7				3.9	
.107-.112									
.112-.118									
.118-.123									
.123-.129									
.129-.134									
.134-.140									
.140-.145									
.145-.151									
.151-.156									50
Total	100	100	100	100	100	100	100	100	100

Number of Drills Tested

99 1 2 137 3 1 26 2 23

All the tests are reduced to 85.4 lb. air pressure.

(3) Adjustments of drill were made. Worn-out parts were changed for new ones. Stroke was again measured.

(4) Speed of drilling and air consumption per minute were taken during three minutes of run.

DISCUSSION OF TABLE II

In Table II, an abstract is made of the results from test No. 4, as just outlined. These figures are not claimed to be an absolute measurement of the drilling efficiencies of the machines, but will give a good relative idea thereof. The great variations in drilling speed, air consumption and relative efficiency between the different drills and types of drills are, of course, due to various factors, such as the age of the drills, their handling in the repair shops and in the mines, inequalities in manufacture, and the relation between the conditions of the test and the real working conditions. It is quite possible that the best drills had been chosen for the different kinds of work in the mine where varying conditions existed, since the hammer-drill plant at Malmberget had been handled for many years by an expert in this line, H. J. Nathorst; the tests would not apply to special cases or show up features in the machines adapted to special conditions.

The following data may be given to complete Table II: The number of telescopic air-feed drills tested was: Atlas Cyclo 32, 48; Finspong AF I, 2; Ingersoll Little Jap, 21; equal to 24.2% of all the drills. The number of drills tested with water flushing through the drill steel was: Atlas Cyclo 32, 6; Atlas Cyclo 42, 2; Atlas Dux, 1; Finspong AF II, 1; Ingersoll MC 22, 1; Ingersoll MC 32, 2; equal to 4.4% of all the drills. The Atlas patented water-flushing arrangement was used with satisfaction on the Ingersoll MC 22 and MC 32.

On the Finspong F I, AF I and the Ingersoll MC 32, nearly all the front-head bushings were worn out, which caused a lower drilling speed (Table III). This appears to be especially a weakness of the Finspong drills.

TABLE III—EFFECTS ON DRILLING SPEEDS OF NEW AND OLD CHUCK BUSHINGS

Name of Drill	Air Pressure Net (Gage) Time Depth		
	Lb. per Sq. In.	of Run, Minutes	Drilled Inches
Finspong F I.....	84	3	7.8
	84	3	6.3
	78	3	14.6
Ingersoll MC 32....	78	3	12.2

New front head bushing  
Worn out front head bushing  
New front head bushing  
Worn out front head bushing

The cylinder of the Atlas Dux consists of three pieces, and was so fitted together by construction that the piston was liable to stick. The drilling results are shown in Table IV.

TABLE IV—EFFECT OF A STICKING PISTON

Name of Drill	Air Pressure Net (Gage) Time Depth			Free Air Used per Minute, Cu.Ft.
	Lb. per Sq. In.	of Run, Minutes	Drilled Inches	
Dux with old piston.....	81	3	11.3	33.5
Dux with new piston.....	83	3	10.3	33.5
Dux with old piston.....	83	3	10.0	35.3
Dux with old piston.....	84	3	7.2	32.8
Dux with old piston.....	84	3	7.0	32.8

Piston did not stick  
Piston did not stick  
Piston did not stick  
Piston did stick

SPECIAL TESTS

By a preparatory study of drilling shallow holes, and also a research into the properties of different kinds of drills, certain results were obtained, which will be discussed now.

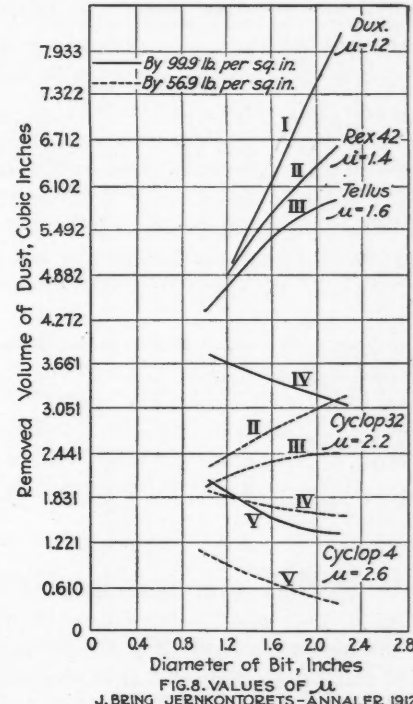
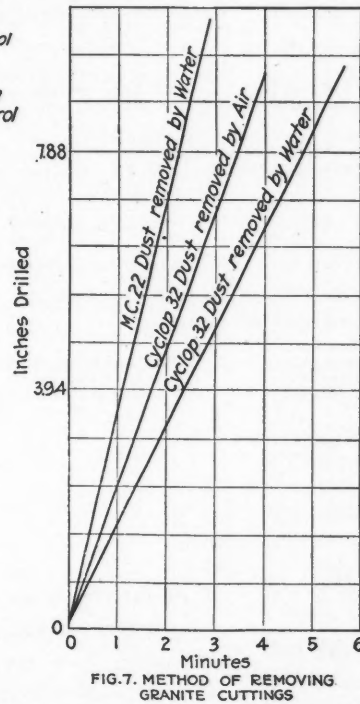
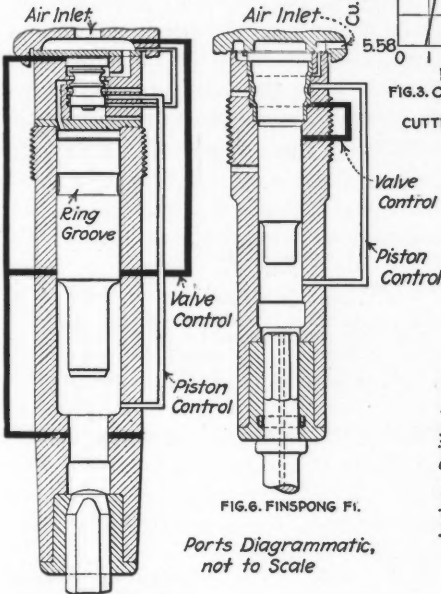
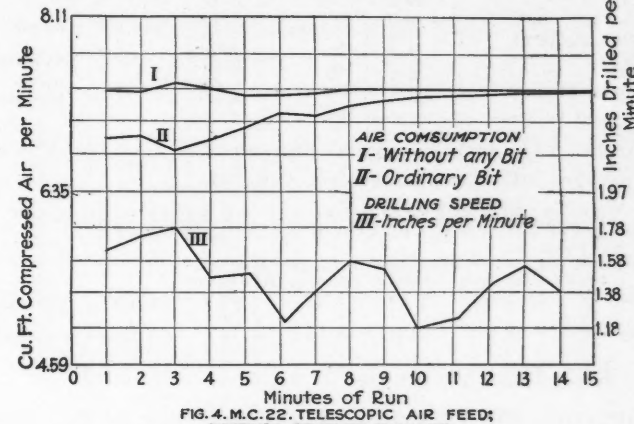
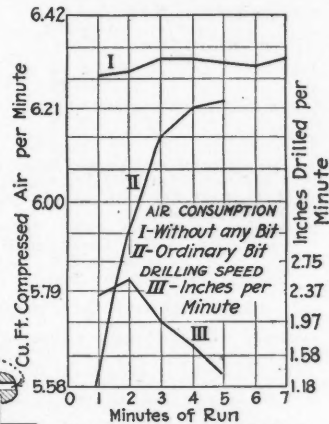
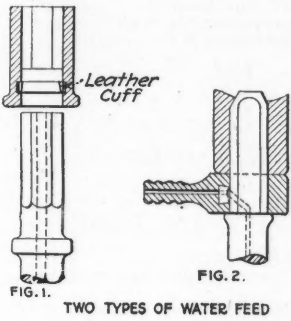


In Fig. 3 is graphically shown how the drilling speed and air consumption per minute of a Cyclop 32 for each minute of a 5-min. run vary with the time. A similar record is shown in Fig. 4 for an MC 22. The increase of the air consumption per minute during the drilling performance is due to the bits running away on head. That is to say, as the bit becomes dull and the force of the piston recoil increases, the number of blows per minute also increases. From this fact, a method is obtained for getting the proper design of a drill bit. Among other things, Fig. 3 also shows that the average

by the position and motion of the piston, the latter compressing air behind the piston and thus throwing the valve, as shown in Fig. 6.

TABLE V—EFFECT OF VARIOUS AIR PRESSURES ON LENGTH OF STROKE

Air Pressure (Gage) Lb. per Sq. In.	Length of Stroke in Inches				
	Cyclop 32	Rex 42	Little Jap	Finspong AF I	Finspong AF II
85.4	4 7/8	2 3/4	4 1/8	4 7/8	8 5/8
71.2	4 1/2	2 3/8	3 7/8	4 1/2	7 3/4
56.9	3 3/4	2 1/8	3 1/2	4 1/4	6 1/8
42.7	3 1/2	2 1/8	2 1/2	4 1/4	6 1/8
28.5	3 1/8	...	2 1/8	3 1/2	...
14.2	2 3/4	...	2 3/8	3 1/8	...
Greatest possible stroke	5	2 3/4	4 3/8	4 3/8	9 3/4



SOME DETAILS OF CONSTRUCTION AND CURVES OF PERFORMANCE OF CERTAIN SWEDISH, AMERICAN AND GERMAN DRILLS

drilling speed for a 5-min. run is about 12% less than that for a 3-min. run.

Table V shows how the stroke varies with the air pressure in tests carried out on the different types of hammer-drills. With the Cyclop 32 and 42 and the Little Jap, the valve is controlled by the position of the piston, together with the ring groove in it, Fig. 5, while with the Finspong AF I, AF II, the valve is controlled

Referring to Fig. 7, the drilling speed is higher for a Cyclop 32, when the cuttings are removed by air, than when removed by water. This seems not to depend upon the incapacity of the water to remove the cuttings, because a greater volume was removed by drilling under similar conditions with a MC 32. The inclination of the borehole was 20° above the horizontal. In Table VI, the same state of things is shown for holes drilled

horizontally. The difference in drilling speed may be caused by the fact that in one case the drill is working in water, which is an inelastic medium. The data given in

TABLE VI. EFFECT OF REMOVING CUTTINGS BY AIR OR WATER

Name of Drill	Air Pressure (Gage) Lb. per Sq. In.	Free Air Consumption per Min. Cu. Ft.	Drilling Speed, In. per Min.	Length of Stroke	Removal of Cuttings
Cyclop 32.....	82.5	40.5	2.92	4 1/8	By air
	71.2	33.0	2.48	4 1/8	
	56.9	25.8	1.64	3 1/4	
	42.7	19.0	1.28	....	
	28.5	11.6	0.56	....	
	81.1	37.0	2.60	4 1/8	
Telescopic	71.2	31.8	2.05	4 1/8	By water
	56.9	21.1	1.36	4 1/8	
	42.7	14.7	0.64	....	
	28.5	9.5	0.28	....	
Finspong AF II.....	83.9	....	3.22	....	By air
	71.2	....	2.70	....	By water
	83.9	....	2.64	....	By water
Cyclop 50.....	71.2	....	2.30	....	By air
	81.1	....	6.60	....	By water
	81.1	....	5.85	....	By water

Test run for 3 min.; rock, granite; diam. of bit, 1 1/8 in.

Table VII, however, show the opposite fact, in which case the bit, when air cooled, ran hot.

TABLE VII—EFFECT ON SPEED OF MC 32 DRILLS OF REMOVING CUTTINGS BY AIR OR WATER

Air Pressure, Lb. Sq. In.	Drilling Speed, In. per Min.				Cuttings removed by air
	1st Min.	2d Min.	3d Min.	Average	
81.1	4.35	3.50	3.28	3.70	Cuttings removed by water
71.2	....	4.10	3.65	4.10	
81.1	4.55	4.10	3.65	4.10	Cuttings removed by water
71.2	....	....	....	3.37	

Rock, granite.  
Diam. of bit, 1 1/8 in.

RELATION BETWEEN DRILLING SPEED, SIZE OF BIT AND FEED

The manner of feeding a drill against the rock during the drilling operation seems to influence the drilling

TABLE VIII—EFFECT OF DIFFERENT METHODS OF FEED

Type of Feed	Cuttings Removed by Air				Cuttings Removed by Water				Kind of Rock
	Diam. of Bit 1 1/2-1 3/4 in.		Diam. of Bit 1 3/4-1 1/2 in.		Diam. of Bit 1 1/2-1 3/4 in.		Diam. of Bit 1 3/4-1 1/2 in.		
	Air Pressure, Lb. per Sq. In.	Min. per Foot Drilled	Average	Min. per Foot Drilled	Average	Air Pressure, Lb. per Sq. In.	Min. per Foot Drilled	Average	
Telescopic	78.3	5.10	79.7	6.16	79.7	6.17	79.7	8.02	Granite
Hand	83.9	4.10	83.9	6.00	83.9	6.80	82.6	8.50*	Granite
Telescopic	85.4	3.05	83.9	3.70	83.9	3.60	85.4	4.50	Ore
Hand	85.4	3.00	85.4	3.35	85.4	3.40	85.4	4.25	Ore

\*In this case the recoil of the tool was too great for hand feed, which accounts for the low rating.

TABLE IX—VALUES OF EXPONENT μ (Derived by G. Bring)

Name of Drill	Drill Measurements				Approximate Number of Blows	Exponent					Cuttings removed by air
	Weight of Piston, Lb.	Diam. of Piston, In.	Length of Stroke, In.	Air Pressure, Lb. per Sq. In.		Granite, Quartzite, Pyrite					
						99.6	56.9	85.4	99.6	45.5	
Cyclop 4	...	1 1/4	2 3/4	...	2.6	2.6	2.5	2.8	...	} Valve drill	
Cyclop 32	2	1 1/4	5	900	2.2	2.2	1.8	2.3	2.3		
Rex 42	3.1	1 5/8	2 3/4	1200	1.4	1.5	1.4	1.2	...		
Tellus	3.6	1 1/8	3 3/8	....	1.6	1.6	...	...	...	} Valveless drill	
		1 3/8									
		1 1/2									
Dux	3.6	1 1/2	2 3/4	1400	1.2	...	...	...	...	} Cuttings removed by water	
1											

speed. In Table VIII some data are given for a Cyclop 32.

In connection with this question, some investigations carried out by G. Bring, Falun, Sweden, can be given. According to Mr. Bring, the following mathematical relation exists between the drilling speed and the diameter of bit:

$$L = \frac{K}{D^\mu}$$

- L = drilling speed in inches per minute.
- D = diameter of bit in inches.
- μ = an exponent.
- K = a constant.

The value of K is determined by using the same drill, working in the same rock, with the same manner of

cleaning the holes, the same length of steel and depth of hole and with the same gage pressure of air.

When μ equals 2, equal volumes of rock are removed per minute of drilling time by using any size diameter of bit. When μ is greater than 2, more rock will be removed by the smaller diameter of bit, and when μ is less than 2, less rock will be removed by the smaller diameter of bit. (Fig. 8.) In Table IX, some values of the exponent are given.

TABLE X—VARIATIONS IN DRILLING WITH DIFFERENT SIZES OF STEEL

Drill Steel Diameter, Inches	Length, Feet	Air Consumption in Cubic Feet of Compressed Air for Length of Run	Depth of Hole Drilled, Inches
1 1/8	2.10	31.6	7.70
	3.30	31.8	....
	4.72	30.6	8.20
1 1/8	6.25	30.8	....
	7.79	30.9	8.70
1	11.00	30.7	9.70

Air pressure, 85.4 lb. gage in all cases.  
Cuttings removed by water.  
Five minutes run in all cases.  
Rock, granite.  
Diam. of bit, 1 1/8 in.  
All holes drilled horizontally.

The exponent μ seems not to change for a Cyclop 32, when different air pressures are used, although the volume of cuttings removed per minute varies greatly. The value of μ seems to be greatly influenced by the number of blows struck per minute. This fact, together with an evident variation of μ, when the drilling is performed in rocks of different hardness, seems to indicate that the variation may be caused by the manner of feeding the drill against the rock.

VARIATIONS WITH LENGTH AND DIAMETER OF STEEL

In Table X there is shown, finally, by a test on a Cyclop 32, how the air consumption and drilling speed vary with the length and diameter of the drill steel. That the drilling speed is increased by the increasing length of the drill steel has also been proved by Mr. Bring. His results, published in "Jernkontorets Annaler," 1912, are shown in Table XI.

These seem to oppose the results of an investigation carried out by Prof. O. E. Westin, Stockholm, in which he found "that it is indifferent to the transmission of power through a round steel bar, whether the bar is long or short." In his tests, however, the steel bar was allowed to resume its condition of rest between every blow, which was not the case in the above mentioned tests.

The additional mass of the drill steel may also cause an increase of the drilling speed by counteracting the pressure of the telescopic air feed. A complete investigation

TABLE XI—INCREASED SPEEDS WITH LONGER STEELS

Name of Drill	Length of Drill Steel, Feet	Air Pressure Lb. per Sq. In.	Drilling Speed, In. per Minute
Rex 42 .....	4.80	85.4	2.68
	1.39	88.2	2.49
	4.70	88.2	3.63
	1.32	88.2	3.07
	4.72	82.5	3.27
Rex 32 .....	1.33	88.2	3.27
	4.81	86.8	2.33
	1.40	88.2	2.13
	4.71	88.2	2.32
	1.30	88.2	2.36
	5.22	88.2	2.68
	1.49	88.2	2.18

All holes drilled horizontally. Cuttings removed by water. Quartzite rock.

Diameter of bit, 1 1/8 in. in all cases.

concerning some of these facts would, without doubt, be of interest for the right understanding of the properties of hammer drill steel.

### Effect of Dredge Pond Water on Steel Hulls

By W. H. WRIGHT\*

For several years, thick water in the dredging ponds of the Folsom and Natoma fields of American River district, California, has been the bane of the dredge operators. The cause is primarily due to the strenuous objection of Sacramento people to having the city mains filled with discolored water, the city intake being near the junction of the Sacramento and the American Rivers. The prevailing red clay around Folsom easily discolors water, and it is carried in suspension a long time. In order to prevent the discoloration of the water of the American River, most of the dredging ponds have no outlets, except the natural seepage. This causes the water in the ponds to become so thick with slime that an increase in the flotation of the dredges is very noticeable.

The following test of increase in weight of the pond water over clear water was made by Natomas Consolidated on the pond water of No. 10 all-steel dredge. A 5-gal. can with a small screwed cover was used. This allowed the can to be filled exactly to the same point each time. The weights are as follows:

	Lb.
Weight of can before filling.....	3.835
Weight of can filled with pond water.....	53.151
Weight of can washed and filled with clear water....	49.100
Net weight of pond water.....	49.316
Net weight of clear water.....	45.265
Difference in weight.....	4.051

This sample was taken near the surface. With every foot of depth, the weight of the pond water rapidly increases.

To the increased wear on pumps and piping, the probable decrease in gold recovery, the increase in power consumption and other troubles caused by the thick, heavy pond water has been added its injurious effects on the steel hulls of the later dredges. In the latter part of May, 1914, Natoma No. 8 all-steel dredge was shut down to strengthen the center spud-kick diaphragm and to make several other repairs. A coffer-dam was built. When this was pumped out, it was discovered that the stern plates were badly pitted. At first appearance the pits seem harmless enough. On the surface of the

steel occur small protuberances of clay, varying in size from a pin head to the size of a ten-cent piece. When these spots of clay are scraped away, a pit will be found underneath each one, while the clay shell is lined with iron oxide. The pits are 1/8 in. deep. At the time of my visit, the plates had been scraped, sand blasted and repainted, but the pitting was still prominent.

Before launching in January, 1913, the hull was painted with a paint of a well known brand that has given excellent service on sea-going vessels. At the time of these repairs four different strips of paint were placed on the stern in an effort to discover a mixture with a greater resistance to the action of the water. The following mixtures were used:

Strip No. 1:	Per Cent.
Hematite .....	65
Kaolin .....	15
Red lead .....	15
Zinc chromate .....	5
Mixed with raw linseed oil.	Lb.

Strip No. 2:	Per Cent.
Red lead .....	25
Litharge .....	5
Hematite .....	5
Mixed with 1 gal of boiled linseed oil and 1 gal. of turpentine.	Per Cent.

Strip No. 3:	Per Cent.
Zinc white .....	20
Zinc oxide .....	20
Corroded white lead .....	45
Kaolin .....	10
Zinc chromate .....	5
Mixed with boiled linseed oil.	

Strip No. 4:	Per Cent.
Hematite .....	95
Zinc chromate .....	5
Mixed with boiled linseed oil and litharge added for drier.	

The water has been found to be slightly acid. There is a difference of opinion as to the cause of the pitting. Some claim it to be electrolytic action and others that it is chemical. The company plans a complete analysis of the water of all the ponds, but this has not as yet been done. While seemingly of slight moment, this hull corrosion, if continued at the present rate, will have a decided bearing on the question of the economy of all-steel hulls over those constructed of wood, in this particular field at least.

The Yuba River fields are singularly free from any injurious action of the pond waters. Plates that have been immersed for years, unprotected by paint of any kind, appear unaffected by the water. In fact, the dredging ponds of this field are as clear and limpid as mountain lakes in comparison with those of the American River fields.

### Oil Possibilities in Illinois

The Illinois State Geological Survey, which has performed highly important work in indicating where to prospect for oil, has issued a bulletin reviewing the oil and gas possibilities of Bond, Macoupin and Montgomery counties. The most promising structural features of the region for oil and gas exploration are enumerated in the following list: (1) Ohlman arch, (2) Hillsboro flat, (3) Carlinville dome, (4) Staunton dome, (5) Sorento dome, (6) Ayers anticline, (7) Irishtown anticline.

It is impossible to say definitely that oil or gas exist in any unproved locality. After a careful study of all available data, however, it is possible to outline the areas in which the lay of the coal indicates structure favorable to the accumulation of oil and gas, provided the sands are approximately parallel to the coal.

\*Mining engineer, 408 Foxcroft Bldg., San Francisco.

# Tube Milling at Cobalt

BY JOHN G. MUELLER\*

*SYNOPSIS*—A test of the comparative grinding abilities of a short tube mill with quick discharge, an ordinary, long tube mill and a Hardinge mill. The quick-discharge device is not considered of vital value under the circumstances. The Hardinge mill does more satisfactory work, although it does not entirely follow theory. The long tube mill has less capacity, but discharges less oversize. Screen analyses of feed and discharge each are shown.

The data herewith presented is an attempt to throw light upon the general subject of coarse tube milling or regrinding, through experience derived in the operation of the plant of the McKinley-Darragh-Savage mines of Cobalt, Ontario. Numerous articles upon the subject have appeared in the technical press in the last few months, but in none of them has any definite decision been reached, and their results have been so varied as to convey practically no information on the subject.

The McKinley-Darragh-Savage mill is a 200-ton concentrator, which embodies three different types of regrinding machines. Ideal conditions for obtaining accurate figures on the comparative capacity, power, pebble and water consumption of each have not been always available, so that in such cases careful estimates are given. This fact should be borne in mind when considering the figures presented.

## DESCRIPTION OF MILLS AND LINERS

The first regrinding machine is a 5x14-ft. Chalmers & Williams tube mill, equipped with the adjustable quick-discharge device and perforated diaphragm in each end. It is semi-automatically fed with jig tailings, a flaky mine and preliminary-crusher product, the undersize of 4-mesh and the oversize of 20-mesh. The second regrinding machine is an 18-in. (cylinder) by 8-ft. Hardinge conical mill, elevated 6½ in. at the feed end; all but 5 ft. of the apex end is lined with hard-iron El Oro ribbed, or flat liners with lifter bars in alternate liners of the cylindrical section. Its feed is directly dependent on 30 of 50 stamps, from which it receives a screen-separated undersize of 4, and the oversize of 8-mesh. The third regrinder is a 5x20-ft. Gates tube mill of the ordinary center-discharge type. It is fed with sand-table tailings, the undersize of 8- and oversize of 40-mesh.

Liners of the "Globe" type are used in each of these except the conical mill. Four-in. French flint pebbles are fed to all. The 14-ft. tube is chain driven from the mill main shaft and revolves at 28 r.p.m., consuming approximately 40 hp. Its feed is derived from either of two Harz jigs, as the conditions require. It is fairly uniform, the water being regulated by means of the jig water system, but is manipulated with an eye to the tube-mill requirements. Since the tonnage depends on the run-of-mine ore entirely, and this fluctuates considerably, a large storage bin has been provided to insure regular feed at all times.

\*Mill superintendent, McKinley-Darragh-Savage mines, Cobalt, Ont.

## EFFECT OF QUICK-DISCHARGE PADDLES

When this mill was started in June, 1913, the paddles of the quick-discharge device were closed so as to secure the coarsest grinding effect. After nearly four weeks of constant effort to secure the results expected, during which time every conceivable scheme was tried out, and an enormous quantity of feed material had accumulated, it was decided to hang up and open its paddles to the sliming position. They were so tightly wedged with small pebbles that it was impossible to move them and they had to be broken or cut out entirely. After replacing the diaphragm and refilling with pebbles, the mill was again started and the accumulated feed was rushed through at an estimated rate of 40 tons per 24 hr. The mill gave no further trouble except to discharge large quantities of "tramp" and oversize for which temporary means of screening out were provided.

No means were ever considered necessary for returning oversize, since the mill was supposed to grind a product identical to that produced by the conical mill and make a smaller proportion of minus 150-mesh slime. From our experience with the conical mill on the same feed, we had previously found that we could economically treat the oversize of 150-mesh by passing it directly over a Deister size "A" sand table, the tailings going to waste. With even a small proportion of oversize, this method of treatment becomes impossible for reasons which are quite apparent.

If the quick-discharge device is to be of any practical value, it should, theoretically, be effective in a coarse-grinding machine. By its nature, however, it draws the vitals out of the machine, since every particle that passes the perforated plate is immediately discharged, leaving a corresponding void in the working pebble load. This automatically throws just that much more work on the pebbles remaining and, as a consequence, the surviving largest cascading pebbles are deprived of that body of rolling pebbles in the mill which presents the crushing surface to them. Returning this material by hand or otherwise would result in a loop-the-loop effect, with consequences that can be imagined, and to feed new pebbles as fast as they were worn down and discharged would require the services of an extra man.

In connection with this, the fact that the initial pebble load included all the pebbles from the conical mill had absolutely no bearing on the excessive consumption of the pebbles when the mill was started, since they amounted to less than a third of the total and were essential for properly filling the liners.

## FUNCTION OF THE DIAPHRAGM

The suggestion of using a diaphragm with smaller holes is impossible, because cost and upkeep would not be commensurate with the supposed advantages and, further, the smaller the holes the nearer the approach to a solid plate, or its equivalent, the end wall of the tube mill. The perforations in the original diaphragm were the size of a pigeon's egg, and the second set were ½ in. in diameter.

The logical place for a diaphragm is in a mill arranged in closed circuit. The quick-discharge device might be

advantageous on certain ores and under certain conditions where it is expedient to force-feed a machine for the desired results. In the granulating mill, where a finished product is required, the diaphragm has no advantage in connection with the discharge device and none without it. This last is demonstrated by consideration of the fact that the feed-end diaphragm was discarded when it became worn out after six months and no difference in the performance of the mill was noted, the "tramp" and oversize discharge continuing. On the same date the original discharge-end diaphragm was replaced with the small-hole plates, and again there was no improvement except for a slight decrease in the number of small pebbles discharged. Finally, on May 1, 1914, this plate was removed and the mill thereby converted into an ordinary center-discharge tube. Although there was still some oversize and "tramp" discharge, it was very much reduced, but still enough to bring us to the decision to rearrange this tube-mill unit, providing means for classifying it for return.

CONICAL MILL IS CONVENIENTLY ADJUSTED

Referring to the conical mill, this oversize and "tramp" discharge cannot occur except as a direct consequence of overloading, for the reason that such material must remain in its zone until its reduction is effected to such a point where it rises out of the pebbles to be discharged. In this a rapid feed-water circulation and increased slope of the mill materially assists. Effective crushing in the last 24- to 30-in. section of the cone is by abrasion only, and I agree that it cannot be much. However, if a perforated plate were inserted 30 in. from the apex at right angles to the axis, no such "tramp" or oversize would issue. It has not been necessary in three years to reline this section, and the only difference I would expect, if this experiment were made, would be a slight increase in the proportion of the coarser sand of the discharge, say that which would pass 40-mesh and be retained on sixty.

The conical mill will respond admirably to coarse feeding up to a point where from 12 to 15% of the discharge is retained on the screen mesh governing the size of the coarsest particle of the ideal product. After this stage is reached, actual choking takes place, the cascading pebbles are retarded by the slush which binds the rolling pebbles, and finally the discharge includes pebbles of all sizes. This will, of course, occur in any tube mill, but in the conical mill its approach is rapid, and the remedy, when instantly applied, causes a correspondingly quick return to normal conditions without any mechanical aid. A uniform product is delivered, but if accidentally overloaded, the fact is easily detected by the mill man, who reports it to the shift boss. A half-hour usually suffices to bring it back to normal condition again. The action is readily observed by inserting a light into the mill.

The conical mill is belt driven in the usual manner from a 50-hp. motor, and makes 26 r.p.m. The motor gives ample power under all conditions and normally runs perfectly cool, so that the actual horsepower is not more than 40. A 30-hp. motor, which was replaced by this 50-hp. machine, was too light by about seven horsepower.

Judging from this information, I should say that in a conical mill there are zones where the particles are of the desired size, that is, the largest particle in any zone of the conical section is no larger than the aperture size of the coarsest sieve to which the mill has been adjusted

for producing the ideal product. In our case this would be 20-mesh.

NORMAL WORK OF TUBE MILL

The detailed description of the Gates tube mill is not necessary beyond saying that it has given entire satisfaction under our conditions. It runs 24½ r.p.m., and takes approximately 40 hp. to grind 40 to 45 tons per 24 hr., with water at the uniform rate, equivalent to 75% moisture, in the feed. There is a slight oversize discharge, but not sufficient to cause any losses in the subsequent treatment.

In referring to "tramp" particles, this name has been applied to those pieces of ore accidentally included in the feed through a break in the mill sizing screen, but never larger than ½ in. "Marble" is the name applied to the worn-down, 4-in. pebbles that pass the diaphragm perforation or are discharged as a result of overloading. "Oversize" is essentially a part of the uniformly sized feed, usually about 8-mesh, which seems to float through the mill, not showing the slightest trace of having been in contact with the pebbles.

Screen analyses are according to the Tyler screen standard unless otherwise noted. "Ton-Cap" type of mill screens are used throughout with aperture widths as follows:

Four-mesh.....	0.180 in.
Four-mesh battery.....	0.187 in. × 0.375 in. actual aperture
Eight-mesh.....	0.080 in.
Twenty-mesh.....	0.022 in.

Results of a recent test after the discharge-end diaphragm was removed, on a reduced capacity of about 30 tons per 24 hr. is shown in the accompanying table. The oversize is included between + 6 and + 48 mesh, but does not include several pieces of "tramp."

TEST ON CHALMERS & WILLIAMS 5x14-FT. TUBE MILL

Feed	Product No. 1 Sample	Product (Check Samples) No. 2 Sample	
+4	1.69%		
+6	40.31	0.05%	
+8	17.18	0.05	0.05%
+10	16.00	0.05	0.10
+14	10.72	0.10	0.10
+20	7.23	0.25	0.24
+28	-20 6.87	0.59	0.62
+35		1.77	1.81
+48		2.96 average	3.33
+65		6.16 (on 48 mesh)	5.87
+100		12.91	6.03% 13.19
+150		14.93	14.90
+200		10.69	8.90
-200		49.06	51.00

The screen analysis of a sample taken some time ago, before the diaphragm was removed, gave 10.10% on 48-mesh, and 0.07% on 6-mesh.

The accompanying table shows the average of 6 screen analyses of feed and discharge of the Chalmers & Williams machine:

AVERAGE OF FEED AND DISCHARGE SCREEN ANALYSIS

Feed			
All Passes Four-Mesh Ton Cap Screen			
+6	32.78%	Cumulative %	35 tons per 24 hr.
+8	22.05	54.83	Pebble load level with discharge
+10	17.39	72.22	6.5 tons pebbles per ton of ore
+14	11.11	83.33	35 to 37½ hp.
-14	16.46	99.79	32 imp. gal. water per min.
Product			
+48	6.69%	9.57%	
+65	7.85	13.20	25.42
+100	14.58	16.88	14.06
+150	17.60	13.87	13.52
-150	55.96	46.48	46.92
	(1)	(2)	(3)

- (1) is an average of five tests after the discharge device was removed, much experimenting was done in this period.
- (2) is an average of ten tests before diaphragm with small holes was inserted more constant running conditions prevailed during this period.
- (3) is an average of eight tests just before this diaphragm was removed.

In connection with the product averages, it should be borne in mind that the proportions on 48-mesh always included "tramp" and oversize in such quantities as to cause losses in the treatment if temporary return apparatus had not been installed.



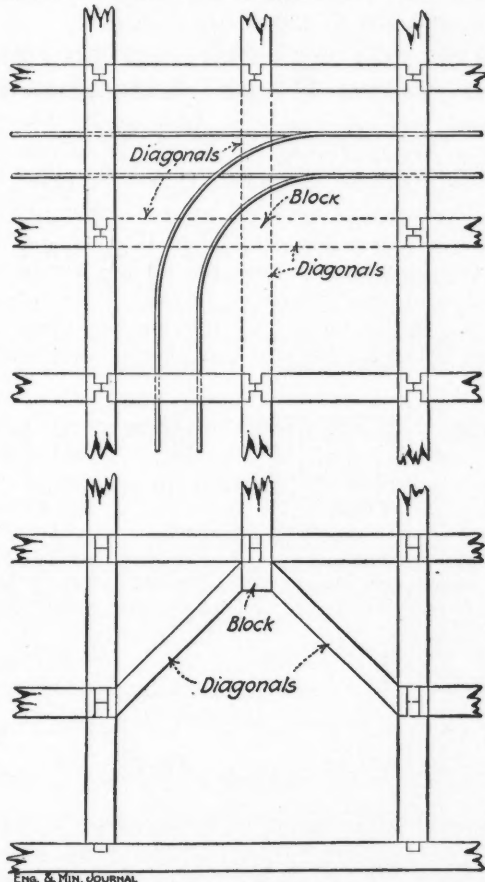
# Details of Practical Mining

## Square-Set Timbering at Switches

By FREDERICK W. FOOTE\*

At the Butte & Superior mine, Butte, Mont., the haulage tracks in places pass through large stopes which require special care in timbering. The insertion of switches and curves was accomplished without disturbing the general system of timbering and without bringing undue strain on any of the parts.

At the point where the switch or curve was to be



METHOD OF OBTAINING ROOM FOR CURVES IN SILL FLOOR OF SQUARE-SET STOPE

placed, a post of the sill floor, and the corresponding post of the floor above were left out. Where the top of the upper post would have come, a block was placed. Four diagonals reached from this block to the tops of the sill sets. In this way the post of the floor above was supported.

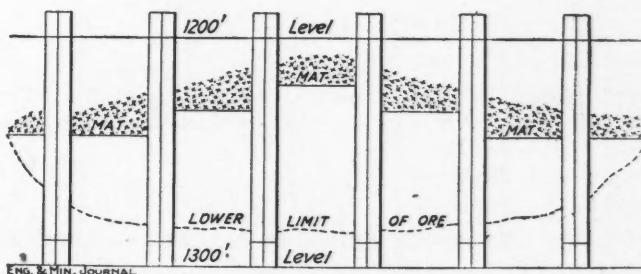
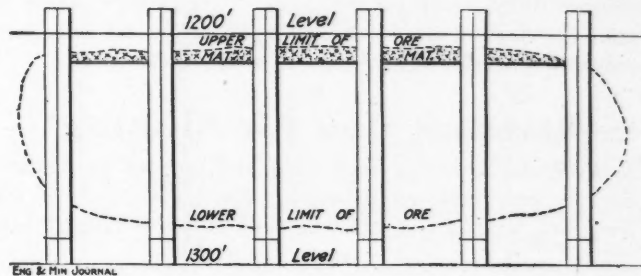
The **Schneider Shaft Sinking Process** was used by the Julius Wilhelm Mining Co. Ltd., of Celle, Hanover, according to the "Mining Journal." A driving cylinder is closed at the lower end by a heavy shaft bottom similar to a tunnel shield. A rotary shaft drill is operated under this by a turbine in the cylinder; simultaneously the cylinder is forced down with hydraulic presses. The rock bored out is sluiced out with water by a special apparatus and hoisted to the surface by an electric pump.

\*Britannia Beach, B. C.

## Top Slicing in Bisbee\*

Top slicing consists in first driving the main-level drifts, cross-cutting and finding the extent of the orebody, putting up raises to the top of the ore and commencing operations at the extreme top of the orebody.

The slicing simply consists of driving lateral drifts and taking out the ore in small blocks, making sure to clean the top of the orebody, placing lagging upon the sill of every individual slice as the operations are continued downward, and thereby forming a mat upon which the overburden and debris will rest after caving. It is usually found that the heaviest weight from the overburden is manifested when the first three or four slices are being extracted. After this, the mat is in a measure self-



SUCCESSIVE STAGES IN TOP SLICING

sustaining. This system is applicable and desirable in soft or wet ground.

Top slicing has been commenced at the Copper Queen in what is known as the Dividend slice of the Czar mine: This orebody contains perhaps 750,000 to 1,000,000 tons of exceedingly soft, wet, aluminous ore, and wherever square-setting was tried, it was found to be extremely expensive; it was almost impossible to complete a section successfully. As a preliminary to starting this slice, a drift was driven in the foot wall on the 400 level, the orebody lying on the foot wall and extending about 50 ft. above the 200 level. Raises were then put up to the 200 level in the foot wall, as it has been found that raises in the orebody will not stand the terrific pressure which is brought to bear upon them. On account of the ores being wet and sticky, it is hard to handle in the

\*From A. I. M. E. "Bulletin," August, 1914.

chutes, and concrete-lined pockets were designed; these resemble great bottles with the big ends down.

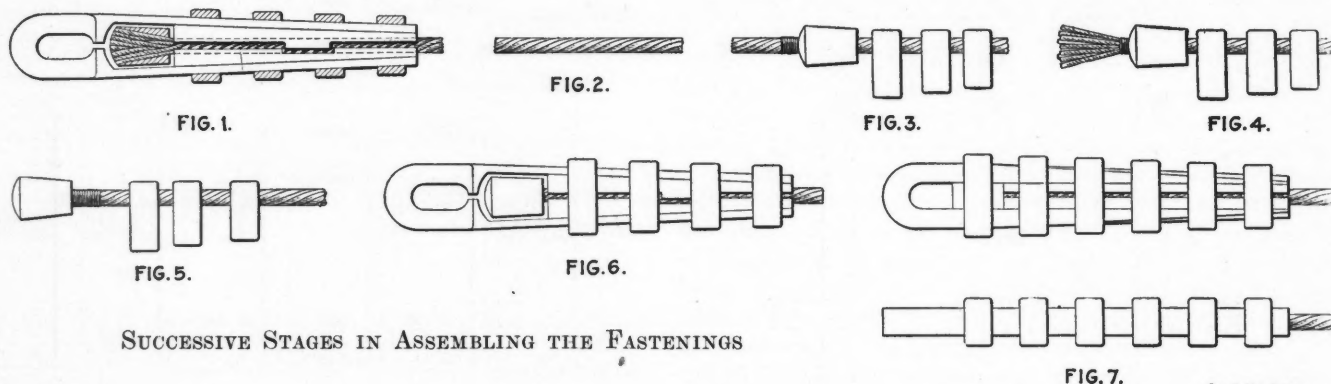
The work has not progressed to a point where a comparison of costs can be made, but it is thoroughly believed that the operation will be successful.

One advantage of top slicing is its elasticity. Drifts for prospecting may be driven in any direction from any floor, and the waste disposed of in the workings. Another advantage is that the ore is mined clean, and still another is that, wherever desirable, inclined raises may be put up at any point from main raises to the mining floor in order to lower the cost of trammung. Several orebodies in the Czar, Gardner and Sacramento mines are being developed upon this plan, and the management is of the opinion that they will show a material lowering of costs, as compared to square-setting. It must be understood, however, that top slicing can be used only where it will not damage any portion of the mine, and particularly, it must be demonstrated that there are no orebodies above the territory worked upon this system.

Fig. 1 shows a slice started and the mat formed. Fig. 2 shows extremities of the orebody being taken down in advance of the central portion. This is done where a main haulage drift is immediately below the slice, in order to obviate repair costs in main levels.

### Blasting Box for Sinking\*

A device which is ingenious and, so far as known, unique, was employed in sinking the Palms shaft of the Newport Mining Co. It was a paraffin pasteboard box,



SUCCESSIVE STAGES IN ASSEMBLING THE FASTENINGS

9x3 $\frac{1}{2}$ x1 $\frac{1}{2}$  in. deep. In the sides of this box, near the bottom, holes were made with an iron punch just large enough for a fuse to fit snugly. As first used, a positive electric wire was led through one end and a negative through the other, and the ends of these connected with a one-ampere electric fuse. Two of the boxes were used at once to blast the cut, which consisted of about 40 holes. From the surface, two positive wires of 14-gage copper were strung, one for each box; the negative wires from the boxes were connected to the air pipe. After fuses of proper length were inserted through the holes in the box, a small quantity of F. F. rifle powder mixed with ordinary black blasting powder was strewn over the one-ampere fuse and the box was covered with a wooden lid.

When the men reached the surface they tested with a galvanometer to find out whether the wire connections

were satisfactory when the circuit was closed. Then a 250-volt current was thrown on and the one-ampere fuse was melted so that the powder ignited, and in turn ignited the fuses leading into the boxes. The cross spitting of the fuses across the boxes made it almost impossible for a misfire to occur. The lengths of the fuses were adjusted to get the proper sequence of holes.

It was found, however, that the preparation of the one-ampere fuse box required too much labor, so that later an electric blasting squib was used to ignite the powder in the box. A squib was placed through a hole in each end of the box, two being used to insure igniting the powder, and the boxes were connected in series with only one No. 14 positive copper wire from the surface and with a single negative wire connected to the air pipe. Finally, a du Pont relay electric fuse igniter was used and connected with the squib.

The powder was 80% du Pont gelatin, the stick being 1x8 in. in size. From 250 to 300 sticks were used on the 7-ft. cut, and 200 to 250 on the 5-ft. cut.

### Two Wire-Rope Attachments

A capel type of wire-rope attachment described in *Science & Art of Mining*, has important advantages. One is that the rope can be quickly capped, another that the conical block can be adjusted so as to stand clear of the wedges, as shown in the illustration, Fig. 1, thus enabling it to be constantly seen that the wedges are performing their function. In this capel, instead of the taper or enlarged end being formed by turning the wires back on the rope, a conical block is put on the rope, and this is

run up with white metal. The necessary operations to attach this capel are: Bind the end of the wire tightly with two lashings of soft annealed wire, each lashing being of approximately the same length as the conical block. The wire should be of suitable size, for an average-sized rope, say No. 14 gage, and should be put on with a wire binder. If the rope has to be cut it should be tightly clamped on the top of the first lashing, and should be cut with a sharp, well tempered knife as near to the clamp as possible. This facilitates cutting and prevents undue displacement of the wires. Cutting the rope by a hacksaw does this work much better. Remove the clamp, pass the rings on the rope and then the conical block, Fig. 3. If desired, the clamp can be replaced at the front end of lashing No. 2. In the case of a nontwisting rope of locked coil, or other type, the clamp should always be used. Take off the first lashing, untwist the wires, it is not necessary to straighten them, and if the rope has

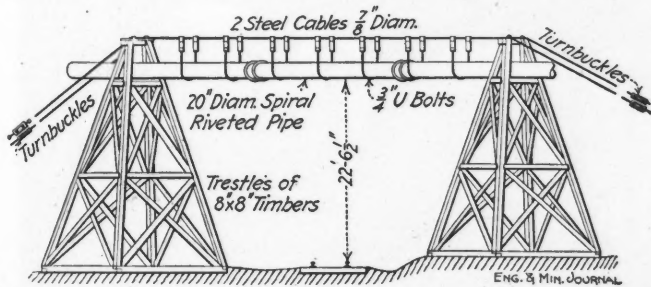
\*An excerpt from an article presented before the Ishpeming meeting of the Lake Superior Mining Institute, Aug. 31, 1914.



a hemp core cut it out, Fig. 4, after which with the aid of a brush and kerosene, clean off any grease that may be on the wires. Burn off the kerosene over a coke fire and dust the wires with powdered resin. Draw the conical block back to the end of the rope, Fig. 5; wrap a piece of tar cord at the base of the block to keep it in position and to prevent the white metal from running through; then hold the block upright and pour in the white metal. The block should be slightly heated before the white metal is poured in. Take off the tar cord and the remainder of the binding wire. Clean off any excess of grease that may be on the rope and put the capel on, but first grease the backs (not the grooves) of the wedges. In putting the capel on, the conical block can be kept a little way back from the wedges, as shown in the illustration, so that it may be seen whether the wedges are performing their function. The conical block is put on rather as an extra safeguard, but it will stand the full breaking strain of the rope.

### Suspension Bridge for Water Pipe\*

In the construction of the 20-in. discharge line for the mud and water from Kerr Lake drainage operations, the most difficult job was getting the line across the Temiskaming & Northern tracks. It proved more feasible to take it over the tracks than under. For this, two towers were constructed as shown. They were built of 8x8-in. posts on a 16-ft. square base, well tied and cross-braced. The angle of crossing made the span from one support to the other 90 ft. Saddles for the pipe were provided 4 ft. below the top of the towers. Over the tops, which were iron-shod cross-pieces, two 7/8-in. steel-wire cables were passed, 20 in. apart, and carried to ground. These were anchored by dead-men, made of



TOWERS AND CABLES FOR CARRYING PIPE OVER TRACKS

stout logs, sunk to a depth of 6 ft., and weighted with stone. Turnbuckles were provided, by which the cables were stretched as taut as possible.

The pipe was laid and joined up as far as the first tower. Three flanged lengths were then laid alongside on the bents of the pipe line and bolted together to make the span. One end of the joined lengths was slung in a carrier, made of an iron loop ending in sheaves to run on the two cables, and was pushed out over the railway to the far tower. Connection was then made with the pipe already laid. The span of pipe across the railway was supported by 2x1/2-in. strap-iron hangers, passing under the pipe and hooking over the cables at 8-ft. intervals. Each hanger had a turn-screw and nut to take out all sag in the pipe. An angle flange and two connecting lengths

\*From a paper, "Draining Kerr Lake," presented at the Salt Lake meeting of the A. I. M. E.

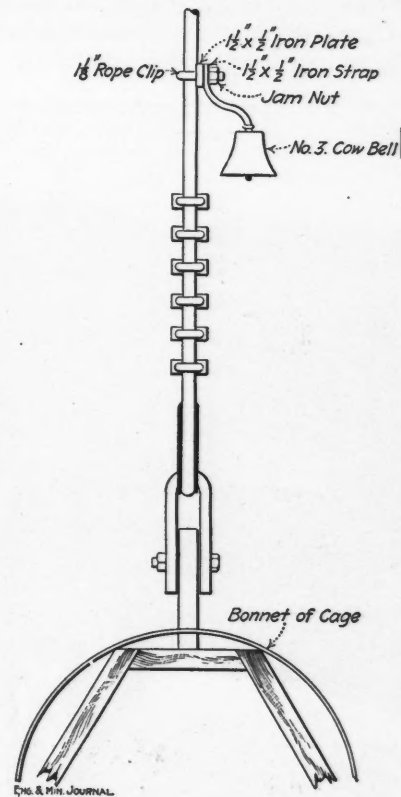
carried the line from the tower to a rock-filled crib pier where another angle flange was connected, and anchored by long eye-bolts passing to a dead-man, to guard against displacement of the pipe by the force of the water coming over the sudden drop from the tower.

In operation, it was found necessary to add two more of the 7/8-in. cables to the pipe support to prevent the pipe from sagging, and to shorten the span 24 ft. by means of props from each tower out over the track, held by bolts from the top of the towers and set in notches.

### Alarm Bell for Cage

BY W. H. JOBE\*

The accompanying illustration from my annual report for 1912-13 shows a bell attached to the hoisting rope of a cage; it is caused to ring by the vibration of the rope and thus indicates the approach of the cage. The arrangement was devised by Capt. Edward Jacka, of the Armenia mine.



BELL ON HOISTING ROPE TO INDICATE CAGE APPROACH

an air auger when drilling their holes in the shaft sets.

Forty holes were drilled in the bottom of the shaft per cut, the outside dimension of the shaft set being 10 ft. 10 in. by 17 ft. 6 in. In the soft slate, 8-ft. holes were drilled. During drilling, the holes were cleaned by using a blowpipe, this being found indispensable if rapid drilling was desired. The steel was 7/8-in. hollow hexagon. A No. 5 Leyner sharpener was used, and the proper dies were found to be satisfactory for shanking this steel. The bits ranged in size from 1 1/4 to 1 3/4 in.

**Wire Rope for Slings** is preferable to chains or hemp rope (N. F. A. Safety Bulletin, June 1, 1914). It is stronger for the same weight and gives evidence of wear more quickly. Spliced ends made by experts are preferable to clamped ends; conical sockets filled with spelter are also good. When the sling is to be subject to heat, a hemp center is inadvisable.

\*Inspector of mines for Iron County, Crystal Falls, Mich.

†An excerpt from an article presented before the Ishpeming meeting of the Lake Superior Mining Institute, Aug. 31, 1914.

### Jackhamers for Sinking†

In sinking the Palms shaft of the Newport Mining Co., jackhamers were used. To the end of the 6-in. compressed-air line, a flange fitting was connected containing eleven 3/4-in. valved outlets for hose connections. Ten Ingersoll-Rand jackhamers were used, and the eleventh connection served the timbermen for running

## Details of Milling and Smelting

### Mechanical Shops at Hayden Smelting Works

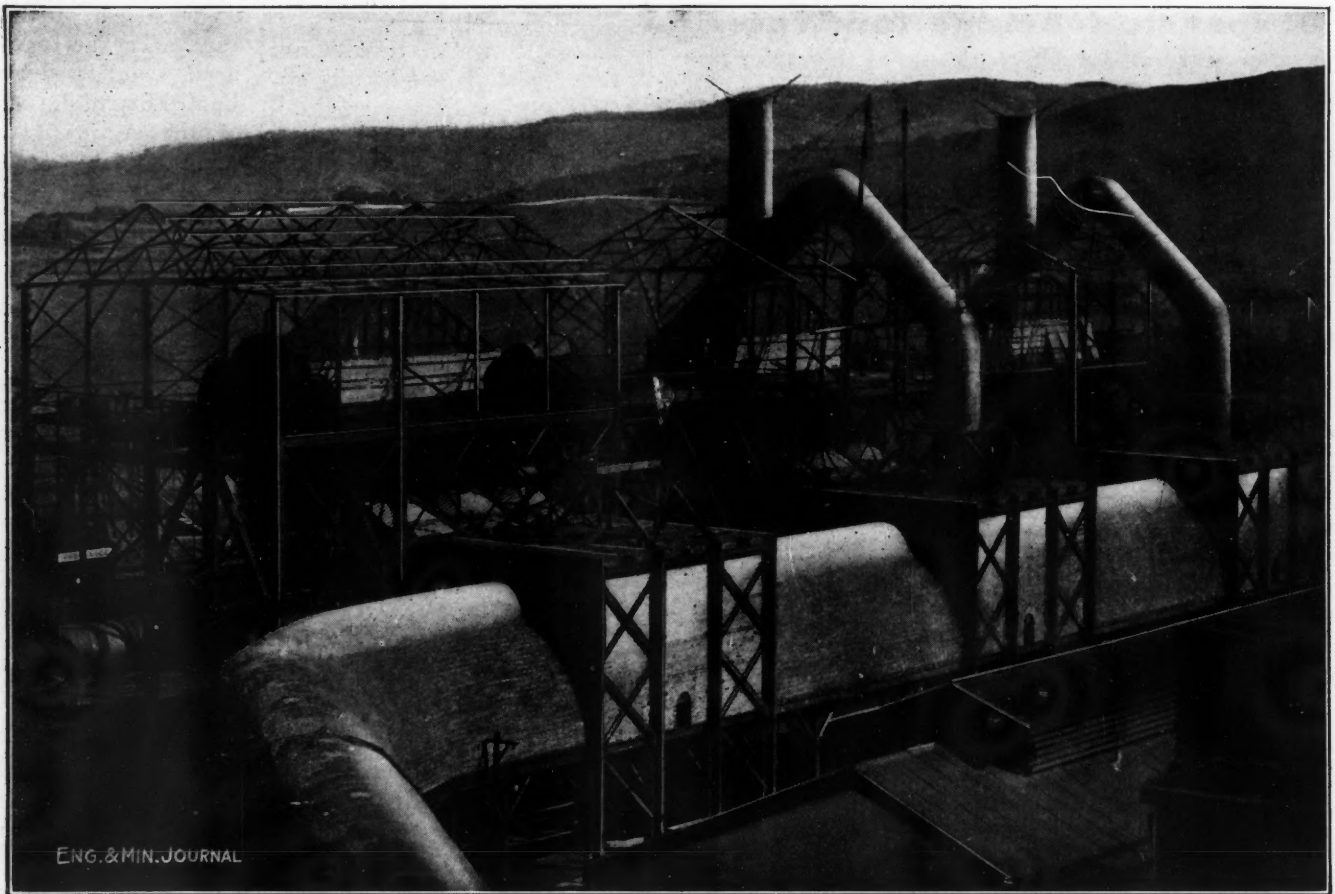
The Hayden smelting works of the American Smelting and Refining Co. is situated in a comparatively isolated Arizona town and in order to expedite repairs the company has established thoroughly equipped mechanical shops.

The machine-shop equipment includes: One 48-in. x 16-ft. American lathe; a 32-in. x 10-ft. Woodward & Powell planer; a 24x24-in. Cincinnati shaper; a Racine high-speed draw-cut power hacksaw; a 180-ton Caldwell hydraulic press, 38 in. between guides; a Blount

rolls; an 18x36-in. Hilles & Jones shear; a 36-in. Hilles & Jones combined punch and shear; and a 10-ft. Hilles & Jones flanging machine. A 15-hp. Allis-Chalmers motor supplies power to the boiler-shop equipment.

### New Mount Morgan Furnaces

On the opposite page are presented general drawings of the new furnaces that have recently been built at Mt. Morgan for pyritic smelting. In the letter of transmittal accompanying the drawings, B. Magnus, general manager of the Mt. Morgan Gold Mining Co., Ltd., stated



REAR VIEW OF MT. MORGAN FURNACES, DURING CONSTRUCTION

double-emery wheel; a 5-ft. grindstone; a Niles-Bement-Pond circular saw for sawing copper samples; a Reliance double-chuck bolt machine; a Barnes 18-in. drill press; a 6-ft. Dreses radial drill; a Bignall & Keeler 10-in. pipe machine; a Bignall & Keeler 4-in. pipe- and bolt-threading machine; a Hendey 12-in. x 7-ft. lathe; two Allis-Chalmers 15-hp. three-phase motors operate the above machinery.

In the blacksmith shop is a 1500-lb. steam hammer made by the Chambersburg Engineering Co. and a jib crane to assist in handling heavy pieces. In the boiler shop, the equipment includes a set of 8-ft. Bertsch & Co.

that he expected to blow in the new furnaces in June. From the accompanying photograph, we assume that three of these new furnaces have been erected.

The Mt. Morgan furnaces are interesting as showing the difference in practice in Australia and America. Perhaps the most striking difference is the height of the furnace shaft, as compared with those used in America for pyritic smelting. The new furnaces are 56x336 in. at the tuyeres, and the shaft is water-jacketed for a height of 25 ft. Another feature of interest is the removal of the flue dust and the furnace gases below the feed floor. While this has been the practice in many lead



drawing that the spout and bottom plate were of cast-iron and not water-cooled, but this is hardly likely to be the case, in view of the fact that a hot low-grade matte will probably be made; the reproduction is from a general drawing, and it is probable that no attempt was made to show such details. The furnaces are tapped at the ends, and oval settlers are placed between the furnaces, so as to give the greatest opportunity for matte settling before discharging the slag to waste.

As already mentioned, the furnaces are provided with a downcast below the feed-floor plates, but there is also an overcast leading to the main flue, as well as a vertical stack, which is closed ordinarily. It is assumed that most of the furnace gases and flue dust will be drawn off below the feed floor. The arrangements for feeding are also somewhat unusual; the charge is tipped on a plate near the charge door and a mechanical pusher pushes the charge into the furnace, this being designed to give complete control of the placing of the charge at any desired point in the furnace. It is interesting to note that no special provision has been made for settling the dust out in a large general chamber immediately behind the furnaces, as in many American works.

### Production of Free Sulphur in Sintering

The installation of four Dwight-Lloyd sintering machines at the U. S. Smelting Co.'s plant at Midvale, Utah, introduced an unforeseen complication in connection with the operation of the baghouse. Soon after the Dwight-Lloyd machines were placed in operation, mysterious sudden rises of temperature and pressure began to occur in the flue system. The dust caught in the bags changed in character, becoming sticky and clogging them so that vigorous hand shaking was required to free them, reports Supt. L. D. Anderson (July Bull. A. I. M. E.). Finally, one of the sudden rises in temperature became so great as to set fire to several hundred bags, the dust in the hoppers and flues also burning vigorously. It began to appear as if the gases from the Dwight-Lloyd machines could not be filtered.

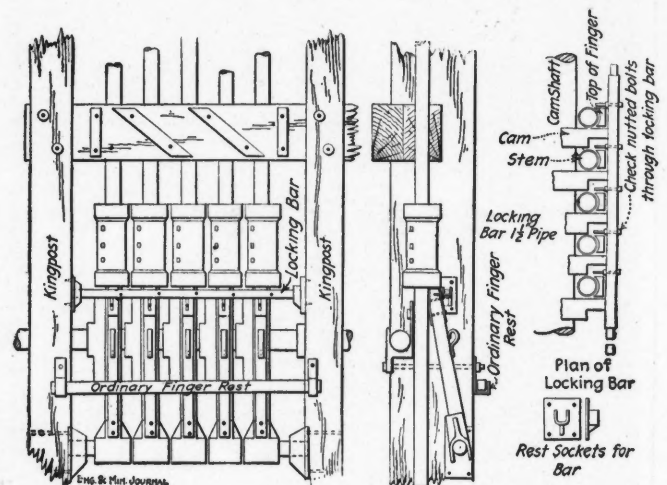
As the plant could not run unless all gases went through the baghouse, extensive experiments were set under way in an effort to solve the difficulty. It finally became clear that the trouble was due to the production of elemental sulphur, which occurred in the gases in a state of vapor. This free sulphur vapor would apparently ignite on small provocation, there appearing at times to be an actual spontaneous combustion of the material with the arsenic present, considerable arsenious sulphide being produced, while at other times probably sparks drawn through the wind boxes of the sintering machines were the cause of ignition. The steam generated from the moisture contained in the sintering-machine charges probably produced the neutral or reducing atmosphere required in the Hall process of producing free sulphur. Here, however, this free sulphur was most unwelcome, and every effort was made to oxidize it or arrest it before it reached the baghouse, but with small success. Water sprays of many types were tried, but the free sulphur vapor proved practically as elusive as lead fume, which all metallurgists know is scarcely touched by water.

Strangely enough, the percentage of free sulphur produced became less and less as the weather became warmer and the air drier. Probably if the machines could be supplied with dry air, after the manner of the pyrites burners in the Mannheim contact process for the manufacture of sulphuric acid, the production of free sulphur could be prevented. The cost, however, appeared prohibitive. Among many other schemes tried was the use of crushed limestone on the grates under the ore charge proper. This did to a small extent diminish the percentage of free sulphur produced. It was not sufficient, however, to prevent a second explosion in November, 1913, when the atmospheric air had again become damp. When this occurred, the machines were shut down except for sintering pre-roasted matte, which operation did not appear to generate free sulphur, and for sintering sulphide ores low in pyrite.

### Dick's Device for Securing Stamps

The attached drawing shows the working design of a device which has been prepared by O. E. Dick, of Geldenhuis Deep, Ltd., a practical mill man, who has had many years' experience in South Africa, and who received a severe injury to his hand some time ago, the result of a stamp falling accidentally on it.

The locking bar has not necessarily to be fitted to each



ARRANGEMENT OF LOCKING BAR FOR STAMP FINGERS

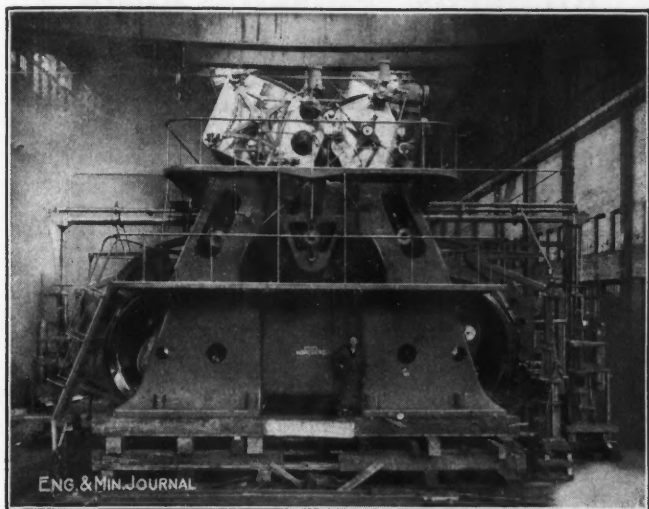
set of five stamps, since it is interchangeable and can be moved, provided that the necessary sockets are attached to each kingpost. The bar can be made of any cheap material, such as old boiler tubing, provided it is sufficiently strong.

This device was originated in response to an appeal to employees by the manager of the Geldenhuis Deep, Ltd., at the instance of the Prevention of Accidents Committee of the Rand Mutual Assurance Co., Ltd. It was put before the Mine Managers' Association on the understanding that for each of such mines as the suggestions given in the drawing are acted upon, a bonus of £5 should be paid to Mr. Dick by the company using the device. Such payments may be made either through the Association of Mine Managers or the Rand Mutual Assurance Co., Ltd.

## Mining & Metallurgical Machinery

### Large Compound Condensing Hoist\*

The largest compound condensing hoisting engine in the world was recently ordered by the Homestake Mining Co., and built by the Nordberg Manufacturing Co. The engine is of the duplex inclined cross-compound type, as shown by the side view. The two high-pressure cylinders are 28 in. diameter, the two low-pressure cylinders are 52 in. diameter, all with a common stroke of 42 in.



NORDBERG COMPOUND CONDENSING HOISTING ENGINE

The hoist is built with two reels, each on separate crankshaft. The reels are driven by axial plate clutches and equipped with gravity post brakes, air-operated. The hoist lifts 12,000 lb. net of ore per trip from a depth of 3200 ft. in a vertical shaft. The rope is  $\frac{5}{8} \times 7\frac{3}{4}$  in., and the total rope pull is 41,900 pounds.

The initial steam pressure is 150 lb. gage. All cylinders are steam-jacketed and the exhaust pressure is maintained at 26-in. vacuum by a special design of counter-current jet condenser developed by Mr. Nordberg for hoisting-engine work. The circulating and dry-air pumps are direct-connected and driven by a simple corliss engine.

The unique arrangement of this hoisting engine having two main crankshafts connected with side rods and a reel mounted on each shaft, was made a necessity, owing to the topography of the ground around the shaft where this hoist is being installed. The only desirable location for the engine house bore such a relation to the shaft that the two ropes from the head sheaves to the hoist stand 12 in. center to center. With two ropes each  $7\frac{3}{4}$  in. wide and their centers 12 in. apart, it is obvious that it would be impossible to mount two reels on one shaft, as is commonly done.

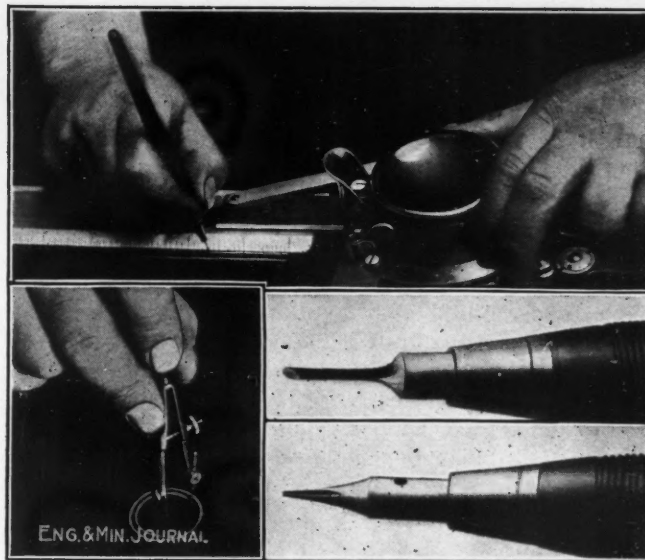
The inclined cylinders and relative position of cranks are such as to give practically a uniform turning effort.

\*From data furnished by the manufacturers.

On small compound condensing hoisting engines working from depths of less than 1000 ft., the Nordberg Manufacturing Co. has obtained economies of less than 30 lb. of steam per shaft horsepower-hour, including the steam used by the condenser and it is expected that the Homestake hoist will break all records for low cost of hoisting as soon as it is put in operation.

### Something New in Drafting

The Universal Drafting Machine Co., of Cleveland, has just placed on the market a new material for drafting purposes which is distinctly an innovation. It is called Unidraft fabric and looks like a brown-print paper mounted on cloth. Its use involves a reversal of the ordinary process of drawing. Instead of making a dark line on a black background, a light line is made on a dark background; the brown coating of the fabric is lifted off with a steel point, leaving a white and translucent line.



SCRIBE, COMPASS AND THE UNIVERSAL DRAFTING MACHINE

From such a drawing, printing can be done direct and the result is ordinarily a positive, i.e., a dark line on a white background. The material thus takes the place of both paper and tracing cloth. No pencil drawing is supposed to be done. Furthermore, the labor of getting a positive print is cut in half. By the old system, a pencil drawing was made; this was traced on tracing cloth, a negative print on a brown paper was made, and from this, positives could be printed. Using Unidraft fabric, a negative drawing is made, and a positive print taken from this. The lines can, of course, be blue on white or black or brown on white.

Two drawing tools are shown in the illustration; other forms have been tried, but the upper tool on the right

shown has proved most satisfactory in general. In use, this tool is held with the beveled side away from the direction of motion and with the handle end inclined forward, leaving the bevel face about vertical. The weight or width of line is varied by varying the pressure on the tool. It is not difficult to use. Similar points are fitted to compasses, as illustrated.

Erasing is done by simply inking over a line so that it is again as opaque as the original coating. Such a line inked over can be drawn upon as before, the tool removing the ink and part of the undercoating. Dotted and other broken lines can be made in a similar fashion.

The surface is not scratched by drawing tools. The speed of the blueprinting is about the same as through tracing cloth. Sharp, clean prints are obtained. The process of printing can be reversed in several ways and white lines obtained on a blue background. The drawings show a brilliant contrast and do not change color with age.

The manufacturers claim for the material the following advantages: Saving of time in the combined process of drawing and printing; elimination of pencil sharpening, pen filling and waiting for ink to dry; saving in total cost; elimination of errors in tracing, with consequent ease of checking; production of a more beautiful and more legible drawing; freedom from soiling; reduction in eye-strain; possibility of making prints at any stage of the drawing; ease of erasure; durability because of the cloth backing.

The great question that will arise in the mind of the reader is, of course, that of erasure. Most draftsmen find it necessary to do a great deal of erasing of pencil lines. Part of this is due to slovenliness, part is almost unavoidable. Erasing on Unidraft fabric is apparently easier than erasing ink, but would not seem to be as easy as erasing pencil marks. In much drafting, however, where the work is standardized and the drawings vary only in a few details, no erasing should be necessary. Pencil lines, furthermore, can be made to show slightly and could be used as limit lines for the scribing tool. Finally, if the drafting be done with the Universal drafting machine, as in the illustration, a constant guide for the lines is provided.

It is stated that Unidraft fabric costs between 25% and 50% more than the combined cost of drawing paper and tracing cloth.

### Iler Disk Pulverizer

A machine for grinding crushed ore or sand to very fine pulp has been brought out by Frank M. Iler, of Denver, Colo. The feature of this machine is the two disks revolving in opposite directions about a common axial line. They are constructed of radial segments of alternating steel and chrome steel. In each disk there are two concentric sets of these segments.

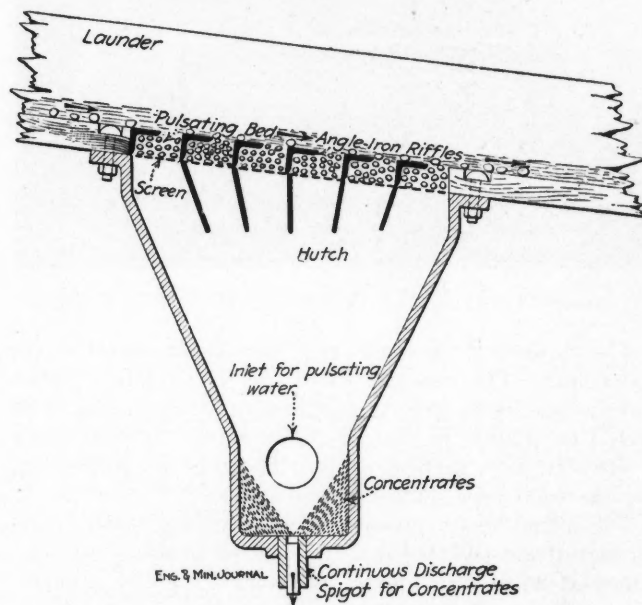
The feed is handled automatically and passes through the first disk. It then is thrown outwardly to the contact surfaces where it enters the slight dish-like depressions in the faces of both disks produced by the natural wear of the softer steel. The revolution of the disks pulverizes the sand, while centrifugal action keeps it moving outwardly. Since there are two sets of the segments on each disk, there is small chance for coarse grains of sand to reach the surrounding discharge space.

Sets of thrust journals are provided on each shaft midway between the driving pulleys and the disks. The right-hand shaft is supported on stout rocker arms and its disk is kept in close contact with the left-hand disk by a tension rod underneath. Upon this rod two toggles are so disposed as to bear upon an intermediate small plate providing, in emergency, release of pressure between the grinding faces by the breakage of the plate.

But one machine has been put to practical use and its service was interrupted, through no fault of its own, before details of its performance could be worked out. The best figures available state that the machine, with 18-in. disks, pulverized 2 tons of hard vein-quartz sand per hour, consuming 6 electrical horsepower. No screen analyses of the feed or product were made, but the product is described as apparently uniformly fine.

### Richards' Pulsator Riffle

A late addition to the family of Richards' pulsator classifying and concentrating machinery, manufactured by the Denver Engineering Works Co., is the pulsator riffle, intended for use in hydraulic mining. The accompanying drawing shows the device, which consists of the ordinary Hungarian riffles, on a wire-screen bed, placed a jig hutch. Blades extending into the hutch are for dis-



THE RICHARDS PULSATOR RIFLE

tributing the pulsating water equally through the feed. In operation a gravel bed is formed on the screen, through which the pulsating water passes, keeping up a constant agitation. Gold and black sand particles work through the bed into the hutch and are continuously discharged, doing away with the labor usually necessary in cleaning up.

### "Giant" Fuel Oil Engine

The Chicago Pneumatic Tool Co. has just put a new line of oil engines on the market, known as the "Giant." They occupy floor space from 3 ft. 1 in. by 9 ft. 2 in., up to 4 ft. 7 in. by 13 ft. 6 in., and are rated from 12 to 45 brake horsepower.

# Welfare Work of the Calumet & Hecla\*

*SYNOPSIS—Description of the branches of welfare work carried on by the Calumet & Hecla Mining Co. and its subsidiaries. The aid fund, to which both company and employees contribute, was originally used to provide help in case of sickness, accident and death. Since the Michigan compensation law came into effect the aid fund has been used to relieve cases of sickness only. Employees contribute to medical fund, on which the company loses, however. Houses are rented to employees at low rates and land is rented on which employees build their own houses. Schools and churches taken care of by the company. Pension fund established. Miscellaneous charities and public works. Pastures and farms provided.*

§

It is admitted that the Calumet & Hecla has taken good care of its men and their families and of the community in general. Its activities along this line include an aid fund, hospital service, a pension system and many other branches of work.

The Calumet & Hecla aid fund was organized in 1877 to provide help for the company employes in case of sickness, accident or death. The rules provided that every man desiring to accept benefit from the fund should be charged 50c. per month through the mine office, and every boy whose wages were under \$30 per month should be charged 25c.; and to the amount thus collected the Calumet & Hecla added a similar amount each month. A contributor disabled by reason of an accident while engaged in work was to receive from the fund \$25 per month or fractional part thereof.

From July 1, 1877, to Jan. 1, 1913, the men contributed a total of \$504,881, and the amount added by the company was \$625,483. The total disbursements to members were \$1,596,707. The excess of disbursements over contributions is due to the fact that some of the surplus in early days was invested in Calumet & Hecla shares, and the dividends accrued to the credit of the fund. At one time the fund had borrowed money on its stock to the extent of \$110,290, and owned 472 Calumet & Hecla shares, valued then at \$193,520.

## CONTRIBUTIONS NOT CONSTANT

Beginning in 1897, there was a period of 40 months in which no collections were made from the men, and during this time the company paid into the treasury the sum which would have been paid by both men and company, if the latter had contributed. When collections from the men were begun again, the amount was raised 2½% in order to take care of the lack of contributions. There were no contributions, furthermore, made by men after Jan. 1, 1913, inasmuch as the surplus was large and it was thought best to reduce it somewhat. On Jan. 1, 1914, the balance was \$76,934.

## RELATION TO COMPENSATION LAW

In the fall of 1912 the new Michigan compensation law came into effect, and the rules of the aid fund were

changed to provide for payment therefrom only in case of sickness, the compensation fund taking care of accidents. All kinds of sickness were included, whether connected with the occupation of the employee or not. There was, furthermore, a contribution entirely outside of the aid fund, made by the mining company in case of death from sickness not connected with the miner's occupation. This contribution amounted to from \$200 to \$250, and the practice of making it has been followed from the time the rules of the aid fund were changed.

The manner of assembling the fund just described applies only to the Calumet & Hecla Mining Co. proper; in the case of the funds maintained by its subsidiaries there are no contributions made by the companies.

## REPORTS AND ADMINISTRATION

All of the funds issue annual statements, and the Calumet & Hecla fund issues monthly statements, showing disbursements for each month of the entire year preceding, and an annual statement showing receipts and expenditures, assets, liabilities and the credit balance. The monthly statement gives the names of the men receiving aid and the cause therefor.

The fund is administered by a committee of five, of whom the mining company appoints two and the men elect three. The elections are carried on by a ballot system. At the Calumet & Hecla, Mr. Knox, the general superintendent, together with the company's head physician, represents the company on the administrative board. Under the old rules the mining captain, the head physician and a miner were selected to administer the fund. The only difference between the Calumet & Hecla fund and those of the subsidiary companies lies in the fact that in the case of the latter the companies do not contribute. The system of administration is the same.

## THE HOSPITAL AND DOCTOR FUND

Each married man of the Calumet & Hecla and all its subsidiaries pays \$1 a month to a hospital and medical fund, and this entitles him and his family to medical and surgical attendance, with all medicine. Each single man pays in 50c. a month, with the same privileges. This is a source of loss to the company. For instance, with the Calumet & Hecla company, from May 1, 1871, to Jan. 1, 1914, the operating expenses of the hospital, not taking into consideration the cost of the plant itself, which is provided by the company, were \$1,528,291. The collections from the men were \$1,064,912, so that the net loss to be borne by the company was almost a half a million dollars. This holds true with respect to the subsidiary companies, but not to so great an extent, since they are usually smaller and younger than the Calumet & Hecla proper.

The money for this fund is collected from the employes through the office and goes into the general treasury of the Calumet & Hecla, while the company pays for medicines, supplies, physicians' salaries and salaries of other employees. At the time the strike started, the company was about to begin the foundation for a \$200,000 hospital.

\*From testimony given by James MacNaughton, manager of the Calumet & Hecla, before the Congressional Committee investigating the recent strike of the miners in the Copper Country.

The hospital charge for a man or any member of his family, except a small child, is \$20 per month for board while he is in the hospital; there is no other charge made for medical or hospital service.

#### COMPANY HOUSES

The Calumet & Hecla company owns in Calumet 764 houses for renting to its employees. The average rent for these is about a dollar per room per month, and this includes free water, the removal of garbage and repairs, such as painting, carpenter work and papering. There is usually a lot attached to the house large enough for a small vegetable garden. The water is obtained from Lake Superior, about five miles away. The houses are electrically lighted by the Houghton County Electric Light Co., and, at the instance of the employees themselves, the system was begun of making collections for electric lighting through the company office, a lower rate being thus obtained. A year or two ago a general appraisal of the houses by independent appraisers resulted in a valuation of \$981,500. The total average annual expenditure for repairs, improvements, etc., during a period of 10 years up to 1913 or 1914, was \$61,229. The total amount of rent collected per year was \$61,863. Therefore, the total annual profit on the investment was \$634.

#### EMPLOYEES' HOUSES ON LAND LEASED FROM COMPANY

There is a greater demand for houses than can be supplied and no employee is required to live in a company house. The company, however, leases lots to its employees, upon which the latter build their own houses. These lots are about 120x50 ft. and are rented at the rate of \$5 per year, free water and the removal of garbage being included. The house owner is not at liberty, however, to buy his lot; the reason for this, as given by Mr. MacNaughton, being that it might become necessary to move the house at some time for construction purposes connected with the mine. In such case, the company would move the house at its own expense and give the man an equally good lot somewhere else, usually a selection of three or four lots. This case has arisen several times.

The Calumet & Hecla has about a thousand houses on leased lots at the present time, which would be valued at about a thousand dollars apiece. When the system for leasing lots for buildings was originally installed, the thousand houses were built in a period of two to three years, and the company bound itself for a period of 20 years from the date of the lease to repurchase the house at an appraised valuation, one appraiser to be appointed by the company, one by the house owner, and these two to select a third.

This limitation expired in 1911, and at present, if a man is discharged or vacates his house, he has a chance to sell it to some other employee. Failing this, he has an opportunity to rent it, inasmuch as houses are in strong demand; if he leaves the district entirely, the company attends to renting his house, collecting the rent and remitting it to him. It is stated that the company has never at any time forfeited or taken possession of any improvement that a man has put on a leased lot.

#### SCHOOLS AND CHURCHES

The company is the largest taxpayer in the township where Calumet is situated, its payments being 85% to

90% of the total receipts. Consequently, the company feels that it does not make much difference whether it builds a school house and leases it to the township or whether the township builds it, so far as expense to the company is concerned; and it has been accustomed to build school houses and lease them. About 12 have been built this way, 11 of them costing \$352,270. The annual rental obtained from the township for these is \$11,027, amounting to about 3% on the investment. Of course, this is to a large extent merely a repayment by the company to itself. At the subsidiary mines the school district usually pays for the schools and owns them, taking a lease from the mining company for the land on which the schools are erected. These leases are for the life of the corporation, which is usually 30 years, and then may be renewed. A somewhat similar policy is followed in regard to churches.

#### PENSION FUND

In 1904, the Calumet & Hecla company started a pension fund for its employees. Those who had attained the age of 60 years and had been in the employ of the company for 20 years or more were retired on a pension proportionate to the length of service and wages earned and payable for a period of five years. Such pensions ran from \$9 to \$30 per month. The amount thus paid to the date of the hearing was about \$87,000.

It is evidently necessary, in the case of a mining company, to have a definite limitation on the length of a pension, since the mining company's own life is limited and the pension would become most burdensome just at the time when earnings became less.

There is a pension board made up of the heads of departments, which decides when a man shall be retired. The man is recommended by the head of his department for retirement, and so far there have been no cases where such a recommendation has been turned down. Usually the man himself makes application, but if he does not the head of the department has a right to recommend him, and the employee then has no choice as to whether he is pensioned or not.

#### THE 40-YEAR AGE LIMIT

The company today has in its employ more than 300 men who are over 60 years old. As a matter of fact, many men have been getting pensions without its being so specified, since, although too old to be of any real service, they have been kept on at their regular wages. The company felt that, in view of this, it ought to take on as new men only those under 40 years of age, in order to keep the average low. This led to some complaint on the part of the men, who claimed that if a man were discharged at the age of 40 he could not get back to work with the company.

The rules governing the administration of the pension fund are extremely flexible, about the only one fixed being that a man must be 60 years old and have worked with the company 20 years. In practice the 40-year limitation is not applied rigidly, but only in the case of men whom it is undesirable to reemploy for other reasons. The employees make no contributions to the pension fund.

The Calumet & Hecla company engages in many other activities for the benefit of its employees. For instance, it maintains a system of free fuel distribution among the poorer classes, especially in the case of widows and fam-



it maintains a system of free fuel distribution among the poorer classes, especially in the case of widows and families of widows. This is not maintained as a separate fund, but is kept track of on what is called a "charity account." The mere delivery of the fuel costs \$100 a month.

There is also a voluntary relief fund provided wholly by the company, which takes care of widows whose circumstances seem to require it, for as long as necessary after the death of the supporting member of the family. In some cases, payments of this kind have been continued for 12 years. In one case over \$1200 was paid to a widow in less than four years, at the end of which time she remarried; 180 widows and orphans, only a few of the latter, have been paid from this fund to date.

#### SPECIAL RELIEF FUND

Then, again, there is a fund established by the company, or, rather, an expense account maintained by it, used to relieve the wants of men who are not entitled to aid from the employees' aid fund, according to its rules. For instance, under the rules of the latter, aid to a sick man is maintained for eight months only. He can in some cases be reestablished on the fund, and in other cases, such as an incurable disease, he is not so reestablished, but the mining company takes care of him from this special expense account. In some cases a man who is not really fit for work is allowed to go back to work for a day or so, almost at the expiration of an eight months' term, in order that he may be reestablished on the aid fund for another eight months.

Mr. MacNaughton himself usually determines the necessity of relief in the cases just mentioned. A record of all widows is kept and their circumstances are continually being investigated to see that they do not suffer, even though they do not make application.

The company some time ago built a \$40,000 library and maintains it and the 30,000 volumes which it also provided. About four years ago it built a bath house at an expense of about \$45,000, and at this any male member of the community may bathe for an extremely small amount, while women and children are entitled to bathe there free. At the time of the strike, the company had planned club houses for the various subsidiary companies and had outlined a plan for the Calumet & Hecla, afterward to be extended to the subsidiary companies, calling for visiting nurses. There is employed a social worker, who keeps in touch with the condition of the employees.

The company maintains pastures on which any employee of the company can pasture one cow free. For more than one he is charged a nominal amount. The company also leases land for farming purposes. Such farms may run from 40 to 160 acres, there being no fixed limit on the size. The rental received is about \$10 per year for a 40-acre tract to \$40 as a maximum. The question of improvements on such land has never come up, since no tenant has had to be asked to vacate up to date, although there is one tenant said to be in arrears for 10 years' rent, having had bad crops for several years.

The company has cooperated with the Bureau of Mines rescue car in instructing its employees in first-aid work, and maintains first-aid stations underground. In case of an accident, a man is put on a stretcher, taken to

the shaft and a man car signaled for. The man at the surface sees that the man car is lowered and immediately calls for an ambulance and a surgeon from the hospital. The surgeon meets the injured man at the collar of the shaft.

### Frederick A. Thum

Frederick A. Thum, for many years eminent as a mining engineer and metallurgist, died at his home in Newark, N. J., Sept. 9, aged 80 years. He was born at Freienseen, in Oberhessen, Germany, where his father was pastor of the Lutheran Church. He received his education at the Mining Academy of Clausthal, making copper, lead, silver and zinc his special studies and also taking great pains to acquaint himself with the methods of the classic industry of the Harz Mountains.

His first practical experience was gained in a position with the Vieille Montagne company, of Belgium, and among the zinc mines and smelteries of the Rhine and Ruhr districts of Germany; later with the extensive zinc and lead industries of Silesia and the neighboring parts



FREDERICK A. THUM

of Poland and Galicia. After that followed an inspection tour in the service of the Austrian government under the direction of Dr. Lypold, then Austrian state geologist. This tour included geological studies and the examination of the lead and zinc mines and deposits in the Klagenfurt, Villach and Bleiberg districts. Later, he extended the tour into Croatia and Servia and his discoveries of zinc deposits there resulted in the development of mining enterprises and the installation of reduction works, which was entrusted to Mr. Thum. Considerable initiative and ingenuity had to be displayed to find in the neighborhood necessary raw supplies, such as refractory clays for retorts and furnace linings, and to install the necessary appliances to produce the finished materials used in the operations of the mine and smelter.

With such extensive practical experience in mining and

metallurgical operations, Mr. Thum went to England in the early '60s and remained there with short intermissions for approximately 17 years. During this period he was identified with the development of the zinc industries of Great Britain, examining a large number of mines for English companies all over Europe, especially in Spain, Italy, Sardinia and Corsica. Several zinc smelters were erected and managed by him and his work in developing the metallurgical methods of zinc recovery is well known to the profession, having been described by him in numerous contributions to technical literature, especially in the *Berg und Hüttenmannische Zeitung*. His paper on the rolling of zinc was published in pamphlet form in nearly all modern languages.

At the age of 46 years, in 1880, Mr. Thum emigrated to the United States, perceiving with keen forethought the wonderful possibilities of this country as a metal producer and the opportunities offered here to mining and metallurgical men. Shortly after his arrival, he accepted a position with the smelting and refining works of Ed. Balbach & Son, of Newark, N. J., later the Balbach Smelting & Refining Co. Here his association was with men of keen foresight and capital, who had developed the first important smelting and refining plant in the United States by the introduction of the Parks process for desilverizing lead. His creative ability brought out some wonderful results in the development of the electro-metallurgical refining industry in the United States. These results were the more remarkable when it is considered that, as an engineer of the old school, he had received his training before the era of electricity.

The first work taken up at the Balbach plant by Mr. Thum was the introduction of the Oker blue-vitriol process for the extraction of gold and silver from granulated black or blister copper in which gold and silver had been collected in high concentration. It was soon evident that this process could not begin to handle the quickly increasing quantities of gold-silver bearing copper on account of the over-production of copper sulphate. Most of the gold-silver bearing mattes and copper bullions were then shipped to Europe for refining. It was then that Mr. Thum proposed the electrolytic treatment of copper bullion as the only remedy; and he was immediately entrusted by Mr. Balbach with the experimental work on electrolytic copper refining. In an incredibly short time, Mr. Thum achieved the desired success and in 1882-3, the first electrolytic copper-refining plant was in successful operation.

All the problems involved, such as arrangement of tanks and conductors, the making of starting sheets, the correct chemical and electrical conditions, the important problems of circulation of electrolyte, insulation of tank system and all the hundreds of details, were successfully worked out and are, with slight modifications, standards of the so called multiple system to this day. The series system was a later development. A further important invention of Mr. Thum, developed at the Balbach works, was the refining of crude-nickel anodes by electrolysis. Many thousands of tons of nickel cathodes were produced in this manner from the crude nickel of the Orford Copper Co., which now uses this process. Most of this was absorbed by the armor-plate makers of Europe.

In connection with this nickel work, Mr. Thum invented a very useful apparatus in the shape of an anode

basket arrangement for electrolytic series refining work, which eliminated the necessity of casting nickel anodes and making nickel starting sheets. Important improvements in the methods of electrolytic parting of doré bars were made jointly with Mr. Balbach. This development constituted an improvement on the Moebius method.

Mr. Thum never acquired patent rights for his epoch-making inventions, but in later life he patented a few processes of minor interest, among which a tilting anode mold and the above mentioned nickel series basket deserve special mention.

Mr. Thum was a contributor to the *ENGINEERING AND MINING JOURNAL* before he came to the United States, but since 1880, he contributed but sparingly to technical literature, centering all his efforts on his work. Of 60 years of active life, 29 years were spent at the Balbach work. On his retirement, he was retained in a consulting capacity. The successes attained in all of Mr. Thum's undertakings were remarkable, but they were the well earned reward of extraordinary knowledge, experience and energy, and a devotion to his professional work and duties, but rarely met with.

Mr. Thum leaves two sons, William Thum being superintendent of the Grasselli plant of the United States Metals Refining Co. He leaves also three grandchildren.

### ♣ Courses for Practical Men at Michigan College of Mines

The Michigan College of Mines will introduce this year a series of special short courses in mining, metallurgy, mapping, drawing, concrete construction and like subjects, open to any practical man who can read and write the English language. The college proposes to afford the ambitious workman in the mining and related industries an opportunity to gain the amount of technical training that may be necessary for advancement in his line of work. This step has been under consideration for many years and is now a permanent extension designed to broaden the usefulness of the institution.

The admission requirements for these short courses are simple, and of two classes, the first requires that the man be able to read and write the English language to a fair degree. The second will require a man to be of good character and to have had experience in the mine, mill, smeltery, shop and the like. The college, however, will not admit the high school boy who can get training in his own school. Successful practical work will be held a strict requirement.

The courses will be 5, 10, 11 or 12 weeks long, and will probably run coincident with the regular college terms so that a special man will not have to undertake too long a term of work. The same teachers and equipment will be used as in the regular college courses. Every course will be given under the head of the department to which the subject belongs.

There has been no attempt to place definite limits on the number of courses or the ground to be covered. They are to be arranged to suit the demand. It is planned to pay particular attention to men who come for special work whether they have had previous technical training or not. It is thought that this opportunity for specialization may appeal to many technically trained men who in their later practical experience have seen keenly the limitations of their training in certain branches.

In this connection President McNair has stated: "The foundation on which we propose to build is the foundation of experience and mental training that these men have gained in working with the materials and conditions of their jobs and in every course the instruction will start from those things which are already familiar to the men."

Full particulars regarding the proposed courses may be secured from the college at Houghton, Mich.

### Henry Bratnober

Henry Bratnober, whose death in California, on Sept. 14, was briefly noted in the JOURNAL last week, was one of the most widely known of Western mining engineers. Although his home was, for the most part, in California, he also lived for a good while in Tacoma or Seattle, Wash., and for a number of years the larger part of his time was spent in Alaska. He was not unknown also in the Transvaal and in Australia. Not much is known of his early mining experience, which was mainly in California, but he first came into prominence as manager of the Drumlummon mine, in Montana, for a number of years worked by the Montana Mining Co. He was also connected for a time with the Elkhorn Mining Co., in Montana. Later he was employed by the Exploration company, of London, and in the service of that company he traveled extensively. He was, for several years, in the Transvaal, and he also traveled in Australia, visiting all the principal mining camps on that continent. During this period of his life, while connected with the Exploration company, he was interested in the management of the Leroy No. 1 mine, at Rosslund, B. C. He was instrumental in the exposure of the London & Globe Co., of which Wittaker Wright was the leading spirit.

Mr. Bratnober left the services of the Exploration company in 1899, and thereafter conducted business on his own account as a mining engineer and explorer. He was one of the pioneers of Alaska, having gone there in the early days of the Klondike rush and later having visited, or been identified with, almost every prominent district in that territory. In 1897, on his first return from Dawson, he contributed to the columns of the JOURNAL the first reliable article on the Klondike gold placers, which had appeared; it was a brief but clear and concise account, the correctness of which has never been seriously questioned. From that time on, most of his work was devoted to Alaska. Some years previously, he had cooperated with W. R. Rush and the Bunker Hill & Sullivan interests in building the smelting plant at Tacoma, Wash., and he retained an interest in that plant.

Mr. Bratnober was the first, perhaps, to realize the importance of railroad communication with the Alaskan coast and he laid out substantially the route afterward adopted by the White Pass & Yukon R.R., which was built and is still operated by an English syndicate. He was at Nome in the early days, and was in the Tanana district, building the first steamboat to navigate the upper waters of the Tanana River. His last trip into Alaska was made last winter, when he went up into the Shushanna district in company with D. C. Sargent, to investigate the placers there. He came out by way of the Tanana and the Yukon; he was thrown from his horse while crossing the Tanana and narrowly escaped drowning, and this accident, which developed later into some serious complications, was the cause of his death.

He leaves a wife residing in Tacoma and two brothers, one of them head of the Bratnober Lumber Co., of Tacoma.

In 1892 he was present at the memorable but resultless monetary conference in Brussels. He was a man who was known to most mining engineers in the West—to all those of the older generation. He was a conspicuous figure wherever he went, being a man of extraordinary stature, and with his high boots, which he always wore, and his long beard, he reminded one of the pictures of a Boer general. His old friends esteemed him most highly, and placed great confidence in him.

### Miami Copper Co.

For the first six months of 1914, the Miami Copper Co., Miami, Ariz., drove 20,688 ft. of drifts and raises for development purposes and ore extraction. There were mined 639,656 tons of ore, and 638,456 tons were treated at the concentrator, producing 25,668 tons of concentrates averaging 39.12% copper.

Copper production was 20,083,096 lb., divided into January, 3,315,617 lb.; February, 3,316,482 lb.; March, 3,468,936 lb.; April, 3,406,528 lb.; May, 3,410,743 lb., and June, 3,164,790 lb. Net production of merchantable copper was 19,078,942 lb. Average ore assay was 2.275% copper, and actual extraction 69.14%, or 31.45 lb. per ton in concentrates and 29.88 lb. per ton in merchantable copper.

By some modifications in the mill, the extraction was improved, giving an increase of about 3 lb. of copper per ton. Experiments are still being continued on flotation and leaching. Reductions of cost have been made of 29c. in mining and 9c. in milling.

Average cost of copper, after deducting miscellaneous income, was 8.9743c. per lb. Gross income was \$2,716,681; cost, \$1,752,713; profit, \$963,968. Dividends Nos. 8 and 9 amounted to \$746,877, and surplus, \$217,090.

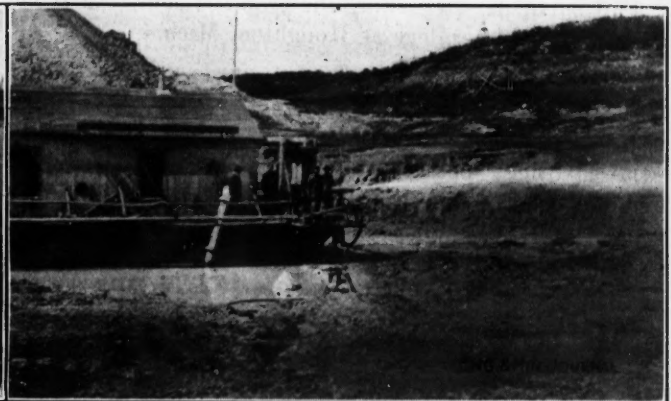
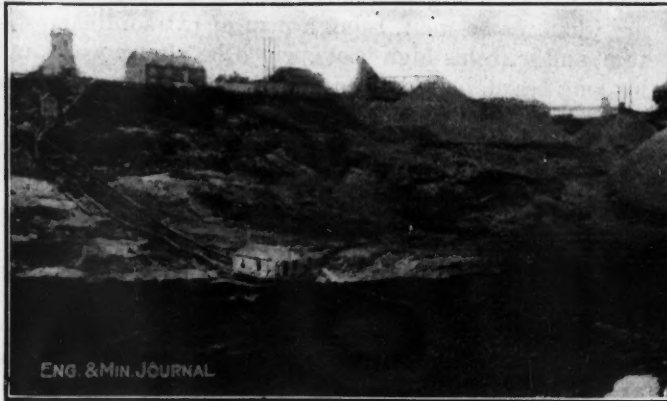
### Ohio Copper Co. Bankrupt

A friendly petition in bankruptcy was filed in New York on Sept. 16 against the Ohio Copper Mining Co. by certain Utah creditors. Under a joint bond of \$20,000, M. J. Hirsch and George C. Austin were named receivers in New York.

The Ohio Copper Mining Co. is a successor to the Ohio Copper Co. and it is stated that its liabilities amount to \$170,000, aside from its mortgage bonds on which it defaulted interest payment Sept. 1. The affairs of the company have lately been in the hands of a new management headed by Pres. W. O. Allison. For a number of years the management had been controlled by F. Augustus Heinze, who still controls the Bingham Central railway, which transports the Ohio ore. The Ohio company sued to recover for alleged excess transport charges and the Bingham Central retaliated by suing for money due for services. The Ohio accounts were attached and these steps, in conjunction with the business situation and the decline in the price of copper, prevented the management from carrying the company's operation to a satisfactory conclusion.

The mine in the Bingham district and the mill at Lark, Utah, have been closed.

# Photographs from the Field



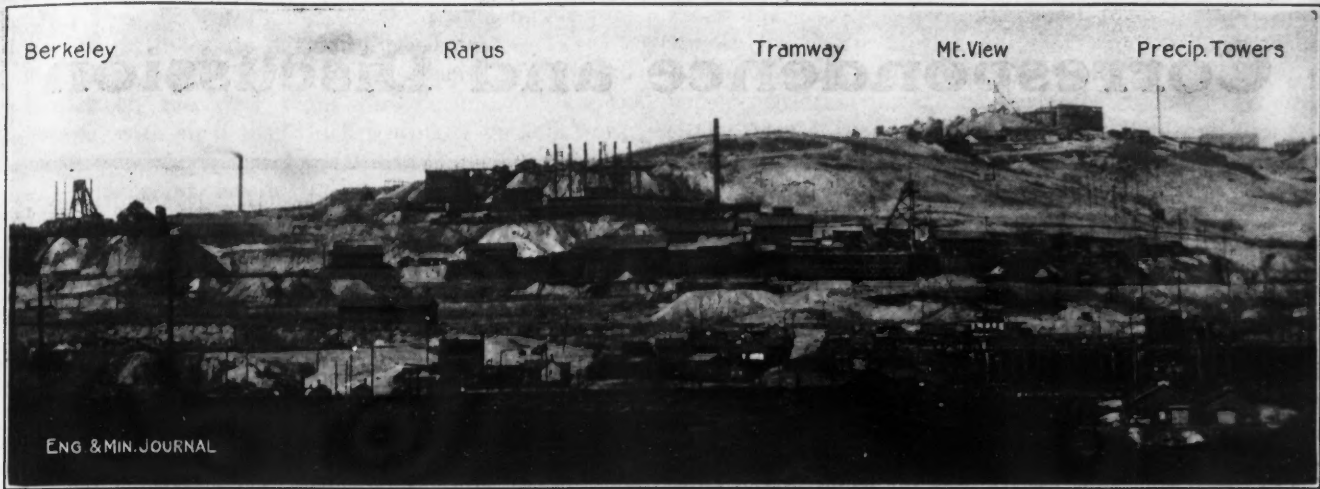
DRAINING KERR LAKE, IN THE COBALT DISTRICT  
[Pump float and pipe lines. Washing the sludge into the pump intake.]



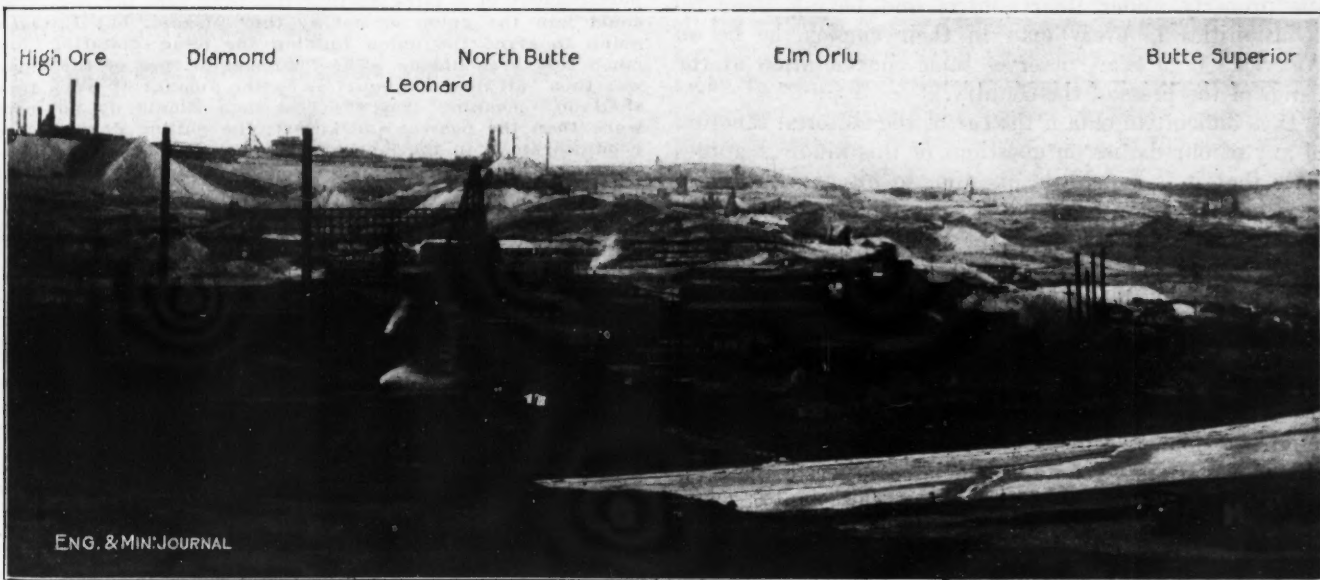
ERNESTINE MINING & MILLING CO., MOGOLLON, N. M.  
Maude E shaft house and ore pack train on the way to the mill



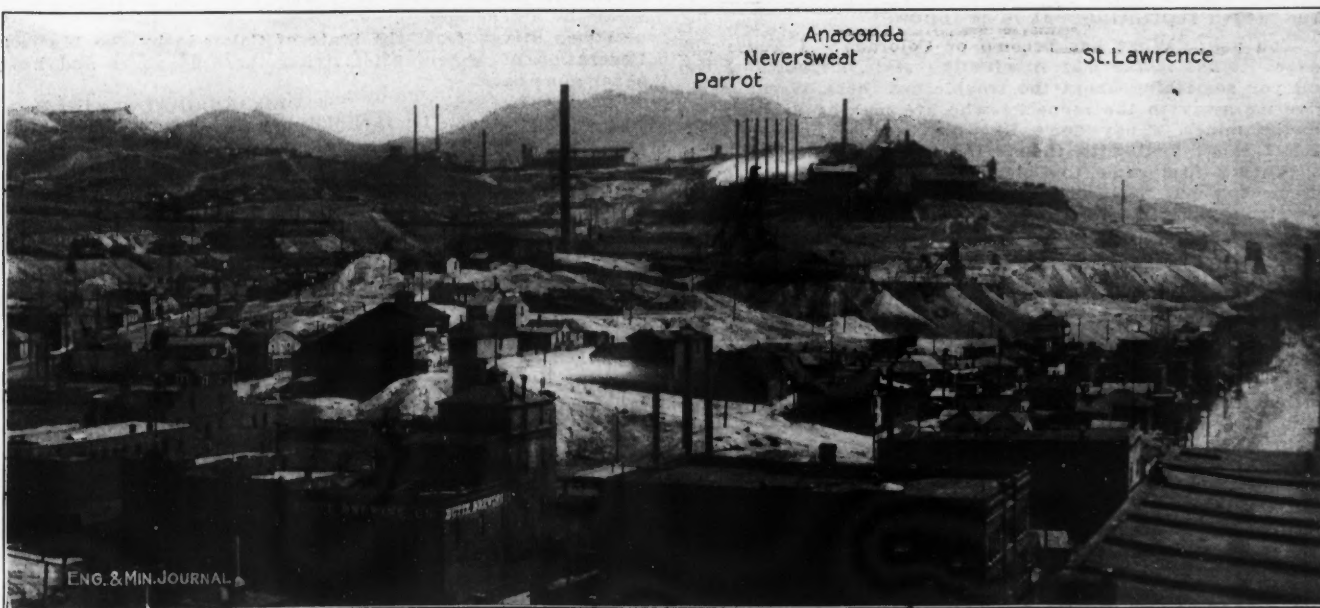
INLAND STEEL CO.'S THOMPSON PIT, CROSBY, MINN.



EAST SLOPE OF BUTTE HILL, LOOKING WESTERLY



EAST SLOPE OF BUTTE HILL, LOOKING NORTHWESTERLY



BUTTE HILL, LOOKING EAST FROM HENNESSY BUILDING

## Correspondence and Discussion

### James MacNaughton

I notice in the editorial column of the JOURNAL of Sept. 12 some reference to Mr. MacNaughton's testimony before the Congressional Committee. Mr. MacNaughton's attitude all through the trying times which have come to him has commended itself to all of his colleagues, the great body of mine managers who have had so severe and irksome a time in dealing with labor problems in the last few years. It is high time that a good word was said for the men who have had to bear the brunt of the fight popularly dubbed "The war between Capital and Labor." Men like MacNaughton, who are in positions of trust as to the property under their control and feeling their responsibilities to every man in their employ, be he an American or a Slav, deserves some consideration at the hands of the press of the country.

It is difficult to obtain the ear of the editorial sanctum of any of our dailies on questions of this kind. I appreciate that it is a delicate question to discuss, but I am sure the JOURNAL will publish some tribute to Mr. MacNaughton for his stand for the right in the face of tremendous pressure.

The situation in Colorado with regard to the coal strike has been grossly misrepresented by the newspapers of the country, as was the case in 1901 and 1902, when the troubles with the Western Federation brought disaster to the mining industry. I know that all readers of your admirable journal will be glad to hear further from you on these matters. I note the inclosed letter to the New York Sun, which seems apropos where the State of Colorado is concerned and the troubles which have followed upon the heels of the coming of the unions to that state.

BENJAMIN B. LAWRENCE.

New York, Sept. 16, 1914.

The letter in the Sun to which Mr. Lawrence refers is well worth reprinting. It is as follows:

You ask: What has become of Colorado? I guess you mean: What is the matter with the state, anyhow? I can tell you something about the trouble out there, if you won't give me away to the rednecks who are making all the fuss in the mines. They don't like me because on one occasion I raised hell with them. It's about this way:

When I first came to Colorado during the Leadville excitement, about '78, Colorado seemed to me as a young fellow from the city, as big as all outdoors and as free and fine a place as any young fellow could strike. The big mountains just seemed to welcome you. Everybody was glad to help, and there was something doing every minute. Why, if you were wandering over the hills and got hungry, having strayed a bit far from camp, all you had to do was to look about for a prospector's cabin or tent, and help yourself. It was considered etiquette to leave some sort of writing behind like: "Your beans is good, but you ain't much on biskit." "Ett some of your chuck, thanks!" signing your name of course. The good old days are past. If you leave a cabin unlocked these days you come home to an empty house.

The mines made Colorado—gold, silver, lead and copper, coal and iron. What's the matter now? Well, first of all, the old time American stock, the pioneers, strong men and women who came to Colorado in the early days, don't live there any longer. The land is all fenced in. The mines are owned by the big fellows. The miners no longer come from Cornwall and Wales; the Germans and Swedes and the Blue Noses (the fellows from Nova Scotia, who were the dandies with the

ax in the pine forests, have quit. The miners in these days are Huns and Finns and all sorts of foreigners. They don't save up to buy a small farm in the valley, not they! They live in shacks, and send their money to the countries from which they came, or else they save up and go home and take the money with them and live on it forever after and become big guns in the little villages.

I got to be a mine foreman when I was about 25. The boys that worked for me called me "the old man" and we were a regular family.

By and by, about 1900, the miners' union got busy in the State, and with the help of the politicians started trouble in the mining camps. The union leaders could do much as they pleased with the foreigners that worked in the mines, and it wasn't long before all the miners in the small mining towns scattered around the mountains had to join the Western Federation of Miners or "get it in the neck." I was superintendent of a mine at that time and told my men they could join the union or not as they pleased, but I wasn't going to stand the union running the mine, dictating how much a man should do. The fundamental idea of the union was then "all men are equal as to the amount of work they shall do," meaning that the best man should do no more work than the poorest and laziest; the pulling down of the good workman to the level of the poorest. To kill all ambition in the good workman was to me nothing short of a crime. The union leaders in our camp were men taught by the Haywood type, agitators, not wanting to work themselves, delighting in disorder, baiting capital and sowing the seeds of discord far and wide.

You know what followed: Colorado was plunged in civil war lasting two years. One of my neighbors, a mine manager, lost his life. He was shot down in cold blood by a follower of Haywood. No jury could be found to convict a union man, not much! The people were scared to death. The confessions of Orchard give you a true account of the conditions prevailing in Colorado in those days.

Could the industry of mining thrive under these conditions? No cooperation between the enterprising man anxious to develop Colorado resources and the workman; nothing but war, and a bitter war. What was the result? The people of Colorado were terrorized. Capital was driven from the state and from that day metal mining steadily declined in Colorado.

And now comes the coal fight. The same principles are involved; "recognition of the union" is the cry. Turn your property over to us to run, or we won't work. Political clap-trap, referendum, recall, put the finishing touches on the prosperity of the state. If it wasn't for the fruit raising it would be a dead one.

I was driven from the State of Colorado by the Western Federation of Miners after living there 25 years and have never gone back.

OLD COLORADO MINER.

New York, Sept. 12, 1914.

### Drilling Costs at the North Star

In the JOURNAL of Sept. 5, 1914, under the heading "Drilling Costs at the North Star," are published some tables which give figures taken from an interesting paper read at the Salt Lake meeting of the A. I. M. E. by Messrs. Robert H. Bedford and William Hague. These tables, without the paper in full, and without the general discussion on the subject, are likely to create a mistaken impression. One would suppose by glancing at the tables that a comparison has been made between the cost of operating a Water Leyner No. 8 drill and a Waugh No. 12. It is plain, however, that there is no comparative test intended, because, in the first place, one machine is a rock drill of the mounted type while the other is an unmounted stopper. In these tests the Leyner drill was

used for heading work, which means that a larger proportion of the holes are flat and down-holes.

Such work, as everyone knows, is more difficult and is harder on the steel than work, commonly known as stoping, with air drills, which is usually up-hole work, the drills clearing themselves of cuttings during operation. This point has a bearing upon the statement showing the amount of steel consumed and the cost per shift for sharpening the steel. There can be no comparative value placed upon tests of steel cost except when used in the same class of work. Furthermore the Leyner drill was used with round steel, while the stoper used the cruciform pattern. The statement is also made in this paper that 2-in. bits were used with the stopers and 2 1/4-in. with the Leyners.

Another point worth mentioning is that the Leyner drill (No. 8) referred to is no longer made, it being an obsolete pattern, the present type being No. 18.

W. L. SAUNDERS.

New York, N. Y., Sept. 8, 1914.

### Kimberley Diamonds and De Beers

The article in the JOURNAL of July 18, "Kimberley Diamonds and De Beers," by Frank Conly, needs correction. Mr. Conly evidently did not have a good time in Kimberley and his peevishness over this fact permeates his whole article and perhaps led him into errors.

To begin with, Kimberley is far from being the primitive town Mr. Conly would have us believe. One can hardly call a town with many fine streets, public library, water-works, electric lights, electric street railway, large completely equipped hospital, several fine public buildings, excellent schools, many beautiful private residences, etc., etc., primitive. In fact, Kimberley is the reverse of primitive and is in advance of most towns of 25,000 inhabitants in this country. There are at least four hotels in Kimberley, two of which, the Savoy and the Sanitorium (which is run by De Beers) are first-class. In fact, the Sanitorium, while not a large hotel, is far superior to any hotel in the same class of city in the United States. The average hotel in Kimberley is as good as the average small-city hotel in this country. In 1908, Wesselton mine was rapidly approaching the point where open-pit work would have to be abandoned and as over five years have passed since that time, I venture to say that Wesselton is also at the present time an underground working.

It is not a fact that most of the machinery used is American. With the exception of rock drills, air compressors, electric pumps and locomotives, and the equipment of the central power station, practically everything is of English manufacture.

The discovery that the blue ground crumbled and disintegrated on exposure to the air was practically contemporaneous with the discovery of the blue itself, and this phenomenon was taken advantage of by the earliest diggers.

Mr. Conley's description of the final recovery of the diamonds is sketchy in the extreme. If he imagines that it is vaseline that is spread on the grease tables, a simple experiment of spreading a layer of vaseline on a board and shaking the same under water for a few minutes will show him his error. Vaseline emulsifies with

water and flows off with it. Vaseline would also flow almost like water during the hot summer months in Kimberley, and would, therefore, make, *if used alone*, a hopeless medium for the recovery of diamonds.

One would judge that Mr. Conly's statements in regard to the treatment of the natives were based on conversations held with some anti-De Beers crank or cranks. There are many such in Africa with real or fancied grievances against De Beers just as there are many such in every country with grievances against any successful corporation or individual. Africa has as many cheap politicians per capita as the United States.

I challenge anyone to visit any or every mining camp in the world and to find anywhere a more contented, happy, and on the whole more efficient body of workers than the natives and white men employed by the De Beers company.

The term "Kafir" is a general one applied in speaking of the native tribes, and to say that the workers in the mines are Kafirs with a few Zulus, is incorrect. Nearly all the tribes of South Africa are represented at Kimberley. The compounds are models of up-to-date sanitary barracks, in which everything is done for the care of the natives, and to make their recreation hours happy. No profit is made by the company's stores in the compounds. Everything is sold at cost, and the native may obtain anything he desires, from a needle to an automobile, at cost in these stores. The minimum contract is three months and no compulsion is used to force the natives to work in the mines or about the company's plant. At most times of the year more natives present themselves at the gates applying for work than are required. They know the conditions and willingly accept them. Whatever tribal laws they may have or dealings with their chiefs are entirely within their own tribal customs and the company has nothing whatever to do with them. The number of wives who gather at the compound gates on pay-day is ridiculously small when the number of workers is considered. I venture to say that 90% of the wives are hundreds of miles away, living in the native kraals on pay-day and every other day. There are instances far too numerous to mention of natives signing new contracts at the expiration of the old without even leaving the compound. Many only leave for a week or two and some have lived continuously for years in the compounds of their own free will. Surely this speaks volumes for the treatment received.

The use of the term "slavery" in connection with the compound system is the height of South African political bombast. If it were not for the compound system and the I. D. B. Act, the diamond industry would have a hard struggle for existence.

In conclusion I beg to state I had the privilege of being, for a number of years, an official of the De Beers company, and never during my service with them did I feel that I was under espionage, nor did I have a feeling of suspicion toward any of my brother officers or men. I was never aware of the atmosphere of suspicion which Mr. Conly says exists there. A man is seldom suspected of wrong doing unless there are good grounds for such suspicion. The illustration on p. 124, labeled "Headframe at the DuToits Pan Mine," is the headframe over the rock shaft at Wesselton mine.

JOHN T. FULLER.

Little Rock, Ark., July 21, 1914.

## Editorials

### Zinc Smelting

The zinc situation of the world, broadly considered, offers some interesting grounds for reflection. These have been brought into prominence by the disturbances created by the war.

Up to a few years ago, the zinc supply of the world came chiefly from a multiplicity of small mines. There were indeed two great districts, viz., the Joplin district and Upper Silesia, which yielded a large tonnage of ore of somewhat uniform character, to which metallurgical practice was adjusted, but even in those districts there was a multitude of small producers with whom negotiations had to be conducted by the smelters to secure their supply of ore. Especially was this the case of the Joplin district, where it has never yet been possible to introduce the contract system for the buying and selling of ore except in a sporadic way.

Outside of these two districts, however, the smelters had to contend not only with obtaining ores in relatively small quantities from many sources, but also with ores of widely different qualities. This involved great skill on the part of the smelters in compounding their furnace charges, and created a more or less different smelting practice in almost every smelting works. We are now speaking especially of European smelting conditions. In America there was also a difference in smelting practice, but it was a difference by districts rather than by works until the Rocky Mountain ores began to be used.

In Europe there happened a great change a few years ago when the successful development of the flotation process enabled the Broken Hill blende to be offered in huge quantity. This ore supply was furnished by a few large mining companies, which were just as anxious as the smelters to put the zinc business upon a steady basis. They were able to employ all the metallurgical advice they needed and knew respecting the cost and profits of smelting as well as the smelters themselves, but they recognized that the smelters ought to realize a liberal profit and they were willing to contract their ore upon such terms for long periods.

The result was that an ore supply furnishing a large proportion of the world's supply of spelter was shipped from Australia to Germany. Introduced into Germany by the great metal houses, it was by them parceled out among the several smelters and became the basic supply of nearly all of the works of Germany, and many of those of Belgium. The smelters have mixed with the Australian ore such other ore as they could obtain so as to make furnace charges to their liking, but in the main the German smelters in recent years have been operating upon the basis of a uniform charge and a uniform smelting practice. It is next to needless to say that this has promoted peace of mind and metallurgical efficiency and has been due to the large and regular supply of Australian ore.

Since the beginning of the war, the German smelters have been unable to take in this ore and the mines of

Broken Hill have had to shut down. Their owners naturally began immediately to seek other outlets and, of course, turned to the United States. It is probable that arrangements will be made to bring some of this ore here, but the negotiations are greatly hampered by our tariff restrictions, which not merely impose a duty on the zinc value of the ore, but also a specific duty of  $\frac{3}{4}$ c. per lb. on the lead content thereof, although the zinc smelters cannot expect to recover more than five-eighths of the lead content of a zinc ore.

In the meanwhile there is a very serious consideration in Great Britain of an enlargement of the small zinc-smelting industry of that country. It is pointed out that Wales was the original home of the zinc-smelting business, that Welsh coal has been supplied to continental smelters, and that it is British mining companies that are concerned. We referred last week to the project of increasing the zinc smelting of Great Britain and remarked upon the long time that would necessarily be involved. Of one thing we may be sure, however. Great Britain is going to take advantage of the plight of Germany to grab every one of her industries that she can. Her only competitor will be the United States.

The United States also is building great hopes upon expanding her export trade, and doubtless will succeed in doing so, but she finds herself continually running against handicaps imposed by former legislation. One of these is our antiquated navigation laws, kept on our books at the behest of the labor unions, which are the real reason that has prevented the upbuilding of a merchant marine. Another is our tariffs, which handicap our importing. If we are going to export we must import too. Our whole system has been designed to help the producers of natural products rather than to promote manufacturing and the competition in world markets.

The zinc situation is of particular interest. The existing smelting capacity of the world is ample. America at least has a surplus. If England builds while the American surplus remains unused, there will be a waste of capital. But here the American tariff on zinc ore is a stumbling block. Perhaps Australian ore can be imported and smelted in bond, inasmuch as we are bound to supply England with spelter, but we have no seaboard smelteries. No doubt Clarksburg, Meadowbrook, Langeloth and Palmerston, situated in spelter-consuming districts, can take in foreign ore, but if the spelter therefrom has to be sent back to the coast for exporting, there would be double freight. If the Pennsylvania-West Virginia works could take in foreign ore and supply the Ohio Valley and Eastern markets, while Oklahoma and Kansas supplied England via New Orleans, there would be no waste, but our provisions for smelting in bond could hardly be managed to effect such a thing. Thus we find ourselves handicapped in seizing a business which we probably could keep if once we secured it. Nevertheless, it is likely that we shall see some Australian ore brought into this country in spite of all.



## The Study of Rock Drilling

The question of rock drilling is one of continual interest and one about which much remains to be studied. The relations of the many factors influencing the efficiency of a drill are only imperfectly understood even by experts, and scarcely at all by the ordinary drill users. We fancy that some of the results described by Mr. Bergh in this issue will be a surprise to most of our readers, as showing what unsuspected effects will follow changes in certain small points of design.

The drill user is concerned with the drilling speed of his machine, its air consumption, its cost, its life and the cost of repairs; he ought also to be concerned with its drilling speed and its air consumption after it has been some time in use, but he frequently overlooks these points. The performance of the drill in these particulars is influenced by many factors, such as the size and weight of the hammer, the length of stroke, the type of valve action, the pressure of the steel against the rock, the fit of the parts, the manner of removing the cuttings, the size and design of bits, the air pressure, the presence or absence of an anvil block, together with innumerable other features, and especially does it depend on the character of the rock. This last variable is by far the most important; in fact it appears to make the problem insoluble. It hardly seems worth while to standardize designs in order to get the most efficient drill, when all calculations will be upset by a slight change in the character of the rock. Yet such a study as this of Mr. Bergh's while not determining the ultimate design for all hammer drills, may have the result at least of eliminating designs faulty under all conditions and of clearing up many points in the operation of the machine.

The material in the article was first published in the *Jern Kontorets Annaler*, Oct. 15, 1913. It has been condensed, the Swedish text translated into English, and the metric figures into English units; this latter change accounts for the fact that many of the figures are not given in round numbers. Tests of this kind are carried on in this country; it is regrettable that the results are not more often available for publication.

In regard to the tests themselves, it will be noted that there are two American drills in the list, and that these stood up well by comparison, in spite of the fact that they were a year old and would not today be the latest model, while their type, the valveless, is supposed to have its efficiency most seriously impaired by wear. It may be stated that a drill working as well as these did after a year's use is a mighty good drill.

The Atlas machines, which were most numerous among those tested, were described in the *JOURNAL*, June 6; they have lately won favor and created a mild flurry on the Rand. The Flottmann is a well known German machine, also used on the Rand.

The gage pressures used were in general rather low compared with the nominal gage pressures used in this country, but it is not unlikely that the latter are not so high in actual practice as supposed, due to excessive friction in small pipes. The air consumptions look low, as compared with catalog figures; since the tests were accurately conducted, however, it seems likely that catalog figures on air consumption are not so understated as is popularly supposed.

A point of design, original so far as this country is

concerned, is the use of a cuff, or gasket, in the front head, to prevent leakage of air. This is particularly useful when no anvil blocks are inserted, as was the case in the tests described, inasmuch as the anvil block itself prevents a good deal of leakage. The cuffs, we understand, cost about  $\frac{1}{2}$ c. each, and will last about two shifts. If the men can be persuaded to use them, they are an excellent investment; compressed air is an expensive fluid. The question of anvil blocks has been about decided in the affirmative in this country. They probably reduce drilling speed somewhat, but they eliminate shanking the steel, an expensive and often weakening operation.

In Table II the efficiencies of the machines, based on drilling speeds and air consumption, are set forth. This is the accepted way of rating a machine. To our mind it is not the right way, since it makes the air consumption of equal value with the drilling speed as a criterion, whereas the air consumption is really of minor importance. A machine drilling 10 in. per minute on 50 cu.ft. of air gets the same rating as one drilling 20 in. per minute on 100 cu.ft. of air; with labor paid from \$3 to \$4 per shift, as against compressed air costing, say, \$1 per shift, any superintendent would choose the faster drill, other things being equal. The efficiency of a drill is relatively unimportant, it should be considered a tool and not a machine; its desirable features in order of importance are fast drilling, handiness, sturdiness, economy of air, and low first cost.

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## Welfare and Wages

To those of our readers who want a bit of interesting autumn reading, we would prescribe Part IV of the report of hearings held before the Congressional subcommittee which investigated the recent strike in the Michigan copper country. Part IV covers chiefly the testimony and cross-examination of James MacNaughton, manager of the Calumet & Hecla, and presents the most complete account of the operations of this company that we have seen; the Calumet & Hecla has always been notably reticent with technical information.

One thing stands out clearly in the report of proceedings, namely, that Mr. MacNaughton was an unusually fine witness, explaining everything clearly and in detail, and answering questions with a manner excellently compounded of good nature, frankness, temper and wit.

At the time the committee began its investigation, there was a good deal of criticism to the effect that it was a foolish move on the part of the government, inasmuch as there was nothing to investigate, and only trouble would be caused by such interference, but, judging from the reports of the hearings, the committee itself did its work in an intelligent and businesslike manner. The members were impartial and fair in general, although Congressman Casey was frankly on the side of the employees; we believe he is called the "coal-miner congressman." Among the others, Chairman Taylor, from Colorado, seemed to have had some previous acquaintance with mining, and the other three members must have felt that they had some acquaintance therewith before the hearings were over. In fact, the investigation was a liberal first course in mining for the Congressmen concerned, and one cannot but envy them their opportunity.

The JOURNAL has published some short articles based on Mr. MacNaughton's testimony, and will publish others. There appears in this issue a rather detailed account of the activities of the company in looking after the well-being of its men and the community in which its properties are situated. We are of the opinion that the liberal policy which the officers of the Calumet & Hecla pursued in this respect was inspired both by commercial and humanitarian motives. The company probably believed it paid to have its employees and its employees' families healthy, well educated and protected against poverty following misfortune. It probably did pay, but we must hand it to Boston that its citizens have often been inspired by a considerable real sense of responsibility and duty toward the less fortunate.

From the figures given, it does not appear that copper-country wages were so low as has been generally supposed. They were lower, however, than those prevailing in a typical Western camp, Butte or Bisbee or Tonopah, and while living expenses were proportionally lower, the absolute margin of saving was also lower. In fact, the policy of the C. & H. was excellent treatment and moderate wages. It was an eminently successful policy for many years. It is a policy, however, that makes small appeal to the more Americanized and independent Western miner. Such a one prefers to get all the money he can and spend it as he pleases. He detests deductions from his pay checks and has little appreciation of hospital facilities, good schools, libraries, pensions and insurance. It seems not unlikely that there was enough of this feeling among the C.&H. employees to aid perceptibly the Western Federation in its efforts to start trouble.

Mr. MacNaughton testified that he considered himself more or less of a socialist, and the policy of his company has embodied many principles of socialism. It was distinctly paternalism, and between paternalism, socialism and communism, and many other plans for the control of the world's wealth, the man-in-the-street can no more distinguish clearly than can the sponsors of the plans themselves.

The tendency toward paternalism is marked in our industrial life today, which has run its course from the small privately owned and managed concern, where the manager had personal acquaintance with his men and took a friendly interest in their affairs, through the large impersonal corporation which paid no attention whatever to its employees outside of working hours, until it has arrived now at the intelligently and humanely directed corporation, which assumes control over the health, diversions, education and religious instruction of its employees, their personal habits, domestic economy and provisions for old age. The Pennsylvania R.R. and the Steel Corporation are examples of the tendency in other industries, as the Calumet & Hecla was in mining. We do not propose here to argue the merits of this system; there is much that may be said both against and for it.

The Calumet & Hecla was distinctly what the miner calls a "home" mine. Its men were married, for the most part, and were firmly settled in the district. The company at the time of the hearing reported in its employ 1660 men, who had been hired between 15 and 45 years ago, and 344 of their sons. The total number of sons of employees or of former employees working for

the company was 1352; of grandsons, 56; of daughters, 25, and of granddaughters, 3. The Homestake in the Black Hills and the mines in Grass Valley, Calif., are also "home" mines, where, however, the companies do not so much concern themselves with their employees' doings outside of the mine.

It would be interesting to know how much this welfare work of the C. & H. cost the company per man per day and whether the same amount added to the men's wages would in the long run have pleased them and have profited the company more or less. It is certain that the region around Calumet would have been a much less pleasant place in which to live.

## BY THE WAY

The Calumet & Hecla Mining Co. during the panic of 1907 did not find it necessary to use scrip. Mr. MacNaughton, testifying before the Congressional Committee, said that his company bought gold and distributed it among the banks in Houghton County in order to meet its payroll. During the entire period of the panic the men were paid in cash.

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While the discussion on the subject of what becomes of all the mining engineers has been closed, Wayne Darlington, of Philadelphia, suggests that the reason this discussion ran to such length was the absence of a satisfactory definition of a mining engineer. So many elements enter into his makeup that Mr. Darlington's definition, presented below, ran into four stanzas. This may not seem too long when one recalls that a famous poet required just as many to define a "man." So, why should this be considered too great a length for defining a mining engineer? Who is prepared to say that he is less than a man? Mr. Darlington's poem is really an abridged definition, for it has not given all of the mining engineer's actual requirements, to say nothing of his accomplishments; most everybody will note the absence of any reference to "yellow leggings" and the "leather coat," but those things are so elementary that they hardly need be mentioned.

### THE MINING ENGINEER (With humble apologies)

If you have been to any school or college  
And possibly have got a sheepskin, too;  
If you absorbed a fair amount of knowledge,  
Or knowing not can look as if you do;  
If you can run a survey like a "civil"  
And analyze an ore by wet or dry;  
If you can build with neither square nor level  
And lay out towns with just the naked eye;  
If you can wear your dress suit, sack or jumper  
And look at ease in each one just the same;  
If you can take the job of "Supe" or pumper  
Or any other man that quits the game;  
If you can set a bone and tie up sinews;  
Or later preach a sermon for the dead;  
If you can talk like Webster, Clay or Depew  
And turn a dinner table on its head;  
If you can go to some dead far-off land-end  
And see its glorious future from the start;  
If you can stick through troubles till the grand end  
And never lose your patience nor your heart;  
If you can run a buck-saw or a kingdom,  
Or turn a petty monarch inside out;  
If you are there to see the final thing done  
That justifies the blows you dealt about;  
If you can hold a board of cross directors  
In happiness against their gauzy schemes;  
If you can dodge the wrath of the electors  
Till dividends will flow as in their dreams;  
If you can make a mine pay from the grass roots  
No matter what the time or place or year;  
Then on my soul until the final blast shoots  
We'll add the title "MINING" when we call you  
"ENGINEER."

## PERSONALS

Donald F. Irvin sailed from Boston this week for Costa Rica.

Lindon W. Bates has gone to Alaska to make an examination before returning to Brazil.

Anton and Karl Eilers returned to New York last week. They were in Munich, Germany, when the war broke out.

W. M. Drury, manager of the Mexican mines of the American Smelting & Refining Co., is in New York for a few weeks.

Theodore J. Hoover, who has been in California, is spending a few weeks in New York before returning to London.

F. Lynwood Garrison was in Seattle, Wash., last week, having just returned from Nome and the Kotzebue district in Alaska.

J. Parke Channing was operated upon for appendicitis on Sept. 18. The operation was successful and recovery is progressing favorably.

J. W. McAlpine, president of the United States Copper Co., at Hanover, N. M., is in Milwaukee, Wis., attending a meeting of the stockholders.

Morton Webber is making an examination of the McIntyre mine at Porcupine, Ont., on behalf of the Nipissing Mining Co., the prospective purchaser.

H. H. Stoek, head of the department of mining in the University of Illinois, who was in Europe when the war broke out, returned Sept. 9, to Urbana.

Percy Wilger has been appointed professor of civil engineering in the Queens School of Mining, Kingston, Ont., to succeed the late A. K. Kirkpatrick.

Prof. H. S. Munroe is now at his summer place in Litchfield, Conn. He is still far from well and does not expect to be able to return to New York until the middle of November.

J. W. Astley, who has been examining and reporting upon some of the Pacific Coast mining districts for the British Columbia government during the summer, recently returned to Toronto. He left New York Sept. 23 for England.

Evans W. Buskett has purchased the Petraeus assay office at Joplin, Mo., and is prepared to make analyses of zinc, lead, gold, silver and copper ores and metallurgical products. Mr. Buskett has had a number of years' experience in assaying and metallurgical work.

Robert E. Cranston, consulting engineer with Breitung & Co., has returned to San Francisco from an extended professional visit in Colorado. He made a number of examinations including mines at Telluride and Cripple Creek. Development was undertaken on the Last Dollar at Cripple Creek, where a 400-ft. shaft is contemplated.

The wide publicity given to the death of James B. Haggin and the fact that he was probably the last of the California Forty-niners has called out several of his colleagues in that early rush. Among others, John Colgate, of Townsendville, N. Y., now 87 years old, sailed from New York for California in 1849, but did not reach San Francisco for nearly a year, the vessel on which he was, having been nearly shipwrecked, and having to put into Rio Janeiro, for repairs.

J. C. W. Chipman, who for the last 25 years had been chief clerk for the United States Steel Corporation on the Marquette range, has retired and has been placed on the pension roll. Mr. Chipman had been eligible for a pension for upwards of a year, but was prevailed upon to remain at his post. When the company began reducing its working forces, he decided to make room for a younger employee. Mr. Chipman came to the Lake Superior region from Boston a quarter of a century ago. The company has never had a more capable or more popular official than he.

## OBITUARY

A party of eight members of the ill-fated Stefansson expedition to the Arctic region, who were marooned on Wrangel Island, have been rescued by the United States revenue cutter "Bear." Among those who died on the island was George S. Malloch, chief geologist of the expedition, who succumbed to an attack of nephritis. Mr. Malloch was born in Hamilton, Ont., in 1887. He graduated from the Kingston School of Mining, and in 1906, joined the staff of the Canadian

Geological Survey. He spent several years in exploration work in the coal regions of Alberta and British Columbia, and then took a post-graduate course in geology at Yale University. He joined the Stefansson expedition as chief geologist and topographer.

J. P. Evans, vice-president and general manager of the Colorado Iron Works Co. of Denver, died at his home in that city, Sept. 13, after a short illness. He had long suffered from asthma, but contracted pneumonia a few days before his death. He was born at Zanesville, Ohio, in 1860 and went to Denver in 1881. He engaged in railroad work there and became auditor of the Denver & Rio Grande Express Co. In 1895 he resigned and joined the Colorado Iron Works Co., with which he had since remained. He was active in furthering the advancement of the organization and in the study of milling and smelting methods. He had many friends in mining and machinery circles. He was a prominent Mason and a member of the American Institute of Mining Engineers. He leaves a widow and one daughter.

## SOCIETIES

**American Mining Congress**—Notice has been given from the secretary's office that the 17th annual session will be held at Phoenix, Ariz., Dec. 7-11. The convention will be composed of members of the Association, especially invited guests and delegates appointed by various official bodies as at previous meetings. The meeting of the incorporated body will be held Dec. 8 for the purpose of electing directors. An effort will be made to have the leading papers to be presented printed and distributed in advance, as was done at the Philadelphia convention last year. As that convention was largely devoted to coal mining, the present meeting will naturally pay more attention to gold, silver and copper mining; but the general subjects of mining investments, mining law, safety, taxation and the labor question will not be neglected.

**American Institute of Mining Engineers**—The Pittsburgh meeting will be held in Pittsburgh, Oct. 8, 9 and 10. Headquarters will be at the Hotel Schenley. Besides several excursions to works in and about Pittsburgh, several technical sessions will be held, one of which will be a general session, at which papers of general interest will be presented, including an exhibition of safety methods in mining, provided by the Bureau of Mines. The remaining papers will be read in separate sessions of the committee on petroleum and gas; the committee on electricity and miscellaneous mining topics; the committee on iron and steel; the committee on coal and coke, and the committee on non-metallic minerals. A number of interesting and valuable papers have been prepared for this meeting.

## INDUSTRIAL NEWS

The Deister Machine Co. at Fort Wayne, Ind., has moved into a new factory, so that office, foundry and factory are now altogether.

The Gun-crete Co., of Chicago, announces that it has purchased all the rights, titles, contracts and interests of the Cement-Gun Construction Co. and also the construction department of the General Cement-Gun Co. The firm name of Cement-Gun Construction Co. will be used, with offices at 914 South Michigan Ave.

At the meeting of the Engineers' Society of Northeastern Pennsylvania on Sept. 24, a series of industrial motion pictures will be presented illustrating the manufacture of National pipe from iron ore to finished product. There are three films, prepared by the National Tube Co., presenting the iron-making operation on the Mesabi range, the transport to the furnace, and production of pig iron, steel and the finished pipe.

The Hoover Steel Ball Co., of Ann Arbor, Mich., has begun the erection of two new buildings, 40x156 ft. and 40x200 ft., which will be devoted to the manufacture of high-grade balls of steel, brass and bronze, formerly imported largely from Germany and other foreign countries. The daily output of the Hoover plant will be brought up to between six and seven million balls, and ball-bearing manufacturers who have had their supply cut off by the war will be able to obtain their requirements from this source. The company uses imported material exclusively, but reports a sufficient stock on hand to last 18 months.

## Editorial Correspondence

### SAN FRANCISCO—Sept. 16

**Large Investors in California Mines** naturally take exception to a statement in this department Sept. 12 to the effect that such investors have repeatedly declined to make any cash payments. This was an error of omission. This is what the copy said and what should have been printed: "Large investors in new and old mines in California have repeatedly declined to make any cash payments in advance of development."

**The Available Supply of Sodium Cyanide** for the treatment of ores in California, at the middle of September, is equal to the essential requirements of the larger mines for the remainder of the year 1914. This is the opinion of men qualified to speak intelligently. This available supply includes shipments delayed in Mexico, which it is believed will be safely transported over the Tehuantepec line. It is not probable that any of the mines now operating, with cyanide as an agent in the reduction of ores, will be closed down for lack of cyanide; but as there is likely to be a gradual increase in price there are some properties, prepared to operate with cyanide at the price obtaining at the time of the outbreak of the European war, that could not stand a rise of 4 or 5c. There are perhaps other properties that could stand the rise in price, but new installations at such mines will probably be delayed until there is assurance that the supply will not be long curtailed, or that its manufacture may be early established to provide the requisite supply without further interruption to the industry.

**Bureau of Mines Rescue Car Number Five** made its first visit in California at Colfax, Placer County, Sept. 9, where it was scheduled to remain until Sept. 19 and whence it was to proceed to the Mother Lode region, visiting Jackson, Angels Camp, Melones, Jamestown. Returning to the Eastern states in November, the car will stop at Kennett, Shasta County. During the entire itinerary in California the car will be moved over Southern Pacific tracks without cost to the Federal or state government. This arrangement was made personally by W. R. Scott, general manager of the Southern Pacific. The work of the car is under the general direction of H. M. Wolfen, mining engineer, in connection with his duties as mine inspector for the California Industrial Accident Commission. Mr. Wolfen has visited all the districts included in the itinerary of the rescue car as well as a number of other districts and found that wherever he introduced the subject of mine rescue work both operators and miners were in accord with the idea of Federal and state cooperation in training men to first-aid work. Many of the larger mines are equipped with modern appliances and have trained men. But they recognize the value of technical instruction and practical demonstration founded upon uniform methods. The equipment of this car includes ten 1910 Draegers, one Fluess "Proto," one Westphalia artificial breathing apparatus, with pump and supplies. There are also supplies of first-aid materials, stretchers, fire hose, hand fire extinguishers, rope, crowbars, and other essentials. The car is a remodeled sleeper, and the upper berths have been retained for the purpose of making practical use of the car as an emergency hospital. In connection with this work Mr. Krogdahl conducted a first-aid field meet at Jackson on Labor Day when a number of teams in the Mother Lode region competed for prizes given by the American Mine Safety Association and mine operators and miners.

### BUTTE—Sept. 17

**In the Labor Troubles**, the past week saw no startling incidents. The preservation of order by military authorities created a feeling of comfort and safety which the citizens appreciate in a high degree. Only praise is heard for the tactful manner in which the militia has conducted the city and county affairs.

Muckie McDonald and Joe Bradley were arrested Sept. 9 in a rooming house in Butte by Major Donahue and Marshal Conley, and without offering resistance were escorted to the county jail to await trial. The prisoners had returned to the city a few days after their flight and were in hiding when apprehended. McDonald declared he had no intention of fleeing and had merely gone on a hunting trip. Hearing he was wanted, he returned with the intention of giving himself up to the civil authorities as soon as the militia had withdrawn.

It is said both men will be tried on the charge of openly preaching defiance of authority, of inciting riot and of participating in the deportation of miners.

The question as to whether the military had the right to assume jurisdiction was ventilated in the Federal court before Judge Bourquin. He finally declared he was without jurisdiction since it was shown that the prisoners were being legally detained in accordance with the proclamation of Governor Stewart. An appeal to the Supreme Court resulted in writs of habeas corpus directing the military authorities to produce the bodies of the prisoners, including McDonald and Bradley.

So far the two miners' unions have made no open attempts to interfere with the plans of the companies. Through the daily papers both gave notice to their members that they must desist from all acts of violence and assist the authorities in power to the best of their ability in maintaining order and enforcing the law.

The beneficial effect of closing the saloons is realized by the members of the unions as much as by the citizens, and petitions signed by both unions and by a large number of citizens have been submitted to Major Donohue, expressing emphatic opposition to the opening of the saloons recently granted by the major. Permission was given with the understanding that it would be withdrawn the moment such opening should prove to interfere with the maintaining of order.

By an order of the district court, Mayor Duncan and Sheriff Driscoll were directed to appear Sept. 15 and show cause why they should not be removed from office for failure to enforce the laws and maintain peace and order.

The distribution Sept. 14 of boycott circulars throughout the city led to the arrest of Robert Noble, a socialist and a member of the old jurisdiction committee of the Butte Mine Workers' Union, who was found to be responsible for their printing and distribution. The latter contained the names of merchants and business men who, some time ago, refused to sign a petition asking that troops be stopped from coming to Butte. It was evident that the circular was aimed as a boycott, and it was understood among the members of the new union that the men who did not sign the protest should not be patronized. John Doran, the new president of the union, when interviewed about this matter, promised that all circulars would be called in and that no attempt would be made to print and distribute more of them.

On Sept. 15 Daniel T. O'Regan, attorney for the United States Commission of Industrial Relations, arrived in Butte from Washington, D. C., and reported at the military headquarters where he was assured of every assistance in collecting data on present conditions for a report to be submitted by him to the Washington authorities.

The business men have decided to make Butte in all respects an open town, although action may not be taken until the troops leave the city. This necessity has been brought about by the labor unions themselves. Next to the disrupted miners' unions, the most autocratic of labor organizations has been the plumbers' union. The plumbers established a strictly closed town against all outside plumbers, even if they carried international union cards, and they raised their own wages until now they are getting \$12 per day; they established a national boycott against any manufacturer of plumbers' supplies who furnished material to any person in Montana not having the endorsement of their union. This fine piece of work attracted the attention of Washington, and the facts have been investigated with a prospect that criminal action under the interstate commerce law may be brought. The action of the plumbers resulted in a revocation of their charter by the international union, and a new organization was established by the national officers, but other local unions refuse to recognize it. Nearly all other local branches of international unions have recognized and approved the Butte Mine Workers Union, which itself has been repudiated by the American Federation of Labor and the United Mine Workers, so that the action of the local unions has, or will, cut them loose from all international or national affiliation and backing. This gives ample justification on the part of mining companies and employers generally to cut loose from them. The plan is to adjust wages in Butte to conform somewhere nearly with what the miners are paid.

**DENVER—Sept. 18**

The Colorado Power Co., which owns the extensive hydro-electric generating plant above Glenwood Springs and transmission lines across the state to Denver, finds it has more power on hand than it can market. Through its sales engineer, Harold Frodsham, the company is offering attractive rates to metallurgical concerns with the intention of inducing such companies to introduce electro-chemical and electro-metallurgical processes to supersede those older processes that utilize other forms of power or fuel. Special attention is being given first to the Leadville district. The power company may there equip a complete laboratory in which miners and metallurgists may experiment on their ores with electric methods.

**LOS ANGELES—Sept. 16**

The Luning Mining District, Mineral County, Nev., embracing Luning and its copper prospects, is continuing to develop in spite of the demoralized copper market. The development is due to the perfecting of the leaching system which will treat the ores of this region by cheap methods. It has been indicated that ore can be treated profitably with copper at 7c. This taken with the fact that the problem of saving the gold and silver has been solved, makes the outlook for the future of the camp a bright one.

The plant for leaching copper ore installed by the Wagner-Azurite company has overcome the neutralization of the acid by the lime content of the ore and is a success. This company is still sinking and is in a high-grade sulphide deposit that will average  $4\frac{1}{2}\%$  copper and is 43 ft. wide.

The Luning Idaho Mining Co. in continuing its working tunnel, has just cut some stringers indicating the proximity of the ore on which the shaft is sunk. Last month this tunnel cut 18 ft. of high-grade copper ore, carrying some silver, probably the best showing in the camp at this depth. This property lies to the south of the Giroux ground where a revival in development has taken place; this means much for the camp, as the company has been reorganized and a large sum of money raised to develop the property.

The Alameda Mines, controlled by Spokane capitalists, is getting ready to begin work on large holdings to the south of Luning. The position of this ground and the large size of the deposits of low-grade copper, with the fact that there is ample water, makes the erection of a leaching plant on this property a possibility in the near future. There is a rumor to the effect that the company is perfecting plans for a plant along the lines of the Nevada Douglas plant at Yerington.

The numerous other properties of this section are all beginning to look up because of the possibilities of leaching. The Luning conditions are particularly adapted to the leaching process, not only for the oxide ores, but for the sulphides; while it should also be possible to save the gold and silver economically. Salt is procured at a moderate figure at Sodaville, 12 miles distant, and for roasting, the coal at Coaldale can be obtained at a low price. From the sulphide ores which would necessarily have to be roasted, undoubtedly sufficient sulphuric acid could be obtained to carry on the leaching. Thus the essentials for this process can be procured economically. Finally there is water in abundance.

**SILVER CITY, N. M.—Sept. 16**

The Hanover Mining District, in the Santa Rita section of Grant County, will probably double its output during the coming year, the causes being the acquisition of sulphide-zinc claims by the Empire Zinc Co., which should cause the construction of an ore-treatment plant, the blocking out of bodies of carbonate ore in the company's old workings, the demand for the high-grade iron ore from the Brockman, Bessemer and Penrose holdings, and the development of several large copper and zinc properties. The Hanover is the only district in this section that has not been seriously affected by the European conflict. Shipments of zinc and iron ore continue.

**JOPLIN—Sept. 18**

New Interest in Prospecting has been shown throughout the district following the revival in ore prices. A good deal of activity has developed in the old Belville camp west of Joplin. A company has just completed the sinking of a shaft into ore on the B. M. Robinson land, where at a depth of 110 ft. one of the old-time runs of soft ground ore has been found. The drilling showed ore from 110 to 136 ft. and the shaft is now down into 12 ft. of high-grade blende. On the Crazy Horse lease another good strike of ore has been made but at a much shallower level. Here at a depth of 90 ft. ore of excellent quality was found in soft ground. The shaft is down and drifting is under way. On the Geronimo L. & Z. Mining Co. tract drilling operations have recently developed some good ore from 90 to 135 ft. in soft ground. On

a part of the ground still shallower ore was found and this has been leased out to small operators who are now sinking shafts. Here on three tracts in an old camp there are ready for production several leases which will add materially to the output within a very short time.

In the same camp but a considerable distance northward, O. W. Sparks, of Galena has developed a run of ore on what is known as the Locke tract. Out of seven holes put down five showed good ore. An old shaft on the ground was utilized and a drift started out at the proper level to intercept the run. This has been carried far enough to show that the ore is good and another shaft is now being opened up to get ventilation. Preparations are now being made to build a mill on the lease.

Interest is also being taken in the drainage of old tracts, and the working of lower levels, particularly in the old Galena camp where two such ventures are now under way. The old Luscombe Forty just west of the city has been taken over by a company of men which is now pumping out the ground preparatory to handling it at much lower levels than previously. Drilling has shown ore to exist 40 ft. below the floors of the old working level at 100 ft. and with the present price for ore this can be worked profitably. One company on an adjoining tract did this all spring and summer, even with the prevailing low prices paid for concentrates. Still another concern is planning the drainage and working of the New Century tract farther southwest. Both of the old tracts have been heavy producers at the upper level with ores handled by hand jigs or small mills. With larger plants and with much better equipment the new operators feel that there is a chance of profitable operations in the heart of this old camp during the next few years.

There have been renewed rumors of the drainage of the Homestead tract at Carterville, but no definite announcements have as yet been made. This is the tract which F. C. Wallower has tried so long to get under way, without having been able to get the cooperation of adjoining land owners.

In the Miami field activities are noted on every hand. Along Tarr Creek some remarkable strikes have been made and effort is being exerted to get plants upon the new prospects before the winter season sets in. So far only Barnes & McConnell have got their mills done. Frickleton, Marcum & Onstott who have opened up what is acknowledged as the richest deposit in that field are now seeking a mill to move upon their lease. While developing their shaft and doing the preliminary drifting, sufficient ore was placed upon the dumps to mill out 800 tons of clean concentrates, according to the estimates of all those who have examined the property. About half of the ore is lead and the other half blende and both are of high grade. It is estimated that the ore will carry from 25 to 35% lead and zinc. While sinking the shaft and doing the drifting the company has continued its drilling operations. Hole No. 11 has been completed and every hole has shown ore at the 220-ft. level, while seven of them have shown ore at the 125-ft. level which is the one at present being opened up by drifting. The company has a 40-acre lease.

On the Chubb land still farther north Amos Freeman, of Joplin, has developed a property to the point where a mill is required. A plant has just been purchased and will be moved at once. This mill will be located upon what is known as the Tarr Creek group.

Southwest of these leases lies that of Thos. Goodwin who has just completed a milling plant; this is now turning out its first concentrates. This mine is also developing its upper level first. Still farther southwest, almost at the end of the camp, O. W. Sparks, of Galena has brought a mine to the point where a mill is needed and one will be erected within the next 90 days. The mine is well opened up and hand jigs have been used during development work. Besides these properties there are a number of drill rigs at work over the field, especially in the northern end of the camp. Some good strikes have been made and the area of productive territory has been extended about three miles north of the early limits of the Hattenville camp.

**TORONTO—Sept. 19**

The Report of the Ontario Bureau of Mines for the first six months of the current year shows a falling off in mineral production. The total output was \$160,078 less than for the same period of the preceding year, but it is expected that the Porcupine mines will show an increased production in the immediate future. Silver showed a decrease in value of over \$600,000, but this was anticipated in view of the reduction at some of the mines and the smaller price received for bullion. While the nickel-copper mines showed an increase for the first six months, the present production is much less than formerly on account of the inaccessibility of the European markets.

# The Mining News

## ALASKA

**THE SEATTLE ASSAY** office received \$1,509,776 in gold bullion on Sept. 10, \$500,000 from southeastern Alaska, \$500,000 from Yukon River points, \$110,320 from the Iditarod, \$45,000 from Fairbanks, \$292,856 from Nome and \$61,600 from British Columbia.

**RUBY CREEK**—Union Construction Co., of San Francisco, is contemplating installation of dredge on their property in this district next spring. Walter Johnson making examinations.

**MIDAS** (Cordova)—Granby company hoped to have mine producing by mid-summer but delays in deliveries and poor metal-market conditions made this impossible. Probable limited operations will begin in late October or November.

**CHISANA**—Stated gold output for seasons will total \$400,000 by H. Waller, U. S. mineral surveyor. Charles Rang credited with taking out about \$40,000; Carl Whitham, about \$20,000; James Hamshaw, about \$150,000. Excitement caused by location of good pay on 11 and 12 Upper Bonanza; said to run about \$1.50 to the foot.

**BROAD PASS**—Reports of great strike continue. Several prospectors returned with samples said to assay high as \$250 per ton. Trail being constructed by Government engineers from Broad Pass to Susitna, and number of prospectors will go in for winter.

**ANDREAFSKI DISTRICT**—First gold of season to arrive in Seattle froh here came recently on steamship "Senator". Initial production of this, one of newest gold fields, came in poke containing \$8000 of coarse gold. Was mined on Disappointment and Wilson Creeks. Marshall City is shipping point for new diggings, of which little has been heard authentically as yet, though reports come that outlook for thriving camp is promising.

## CALIFORNIA

### Amador County

**SOUTH EUREKA** (Sutter Creek)—Sixty stamps dropping regularly. Reported dividends will be shortly resumed.

**SOUTH JACKSON** (Jackson)—Prospecting work on 350-ft. level shows encouraging results. Large orebody opened on south drift, value not yet determined.

### Butte County

**DYER** (Chico)—Installation of machinery purchased from a Forbestown mine completed. New Huntington mill nearly ready.

### Calaveras County

**HEXTER** (Mokelumne Hill)—Main tunnel now in 3100 ft. with 100 ft. of channel exposed. Air shaft being constructed to connect present workings with surface. Underground haulage will be electric.

### Eldorado County

**PACIFIC** (Placerville)—Grass fire threatened surface works, extinguished before much damage was done.

**TIP TOP** (Sunland)—Suit instituted by Reno, Nev., bank to recover \$5949 alleged due on promissory note given by mining company.

**BIG CANON** (Shingle Springs)—Operations resumed following temporary shutdown. Mine unwatered, development will proceed.

**BUMGARDNER** (El Dorado)—Strike reported from this former producer. P. J. Loveless and W. H. James recently purchased mine and started development work. Small mill installed and new pipe line contemplated. Old vein recovered at depth of 150 ft.

### Kern County

**PARLOW** (Loraline)—Last cleanup netted three bricks weighing 113 lb. gold and silver, valued \$15,000 to \$18,000. Result of 15 days' milling.

### Nevada County

**FOREST FIRES** menaced mining properties at Grass Valley but were checked in time. Mill at Osborn Hill mine partially destroyed. Loss of standing timber heavy.

**UNION HILL** (Grass Valley)—Work preliminary to reopening mine begun. Reported shaft will be deepened to 1000 feet.

**OLD TUNNEL** repaired by city of Grass Valley and used as sewer to carry off surface waters, turns out to be property of North Star. City will endeavor to recover costs from mining company.

### Placer County

**SPRING GARDEN CONSOLIDATED MINING CO.** (Forest Hill)—Closed down pending settlement of financial difficulties.

**MAGNESITE CLAIMS** near Towle will be developed by present owners. Raw material will be shipped for present but expected kiln will later be installed.

**SOUTHERN CROSS** (Towle)—Reported mine will be reopened. Surface works destroyed by fire several years ago; large outlay will be necessary to resume operations. Extensive surveys of workings completed.

### Plumas County

**ENGELS** (Keddie)—Permission given by California Water Power Commission to develop electric power in Lights Creek

for operating mine. Development work curtailed on account of smelting plants closing down. Trucks still hauling ore to Keddie where it is being stored.

### San Diego County

**OWENS CONSOLIDATED** (Julian District)—Shortage of water, which hindered milling operations, now overcome and company expects to resume work. Property equipped with ten-stamp mill.

### Shasta County

**MANGANESE ORE** reported discovered on ranch of T. P. Peterson adjoining property of Noble Electric Steel Co. at Heroult.

**GLADSTONE** (French Gulch)—Oscar Okerlund, miner, killed by descending skip, while trying to step across hoisting compartment of shaft.

**MAMMOTH COPPER CO.** (Kennett)—Smelting plant shut down, will make thorough cleanup of buildings and works. Additional cooling pipes to be installed in baghouse system.

### Tuolumne County

**OMEGA** (Jamestown)—Plaintiffs filed paper releasing defendants from judgment deeds and agreements in suit recently decided in favor of plaintiff. Parties are now to assume equally all indebtedness incurred in working property and each to be half owner.

### Yuba County

**BAC** (Brownsville)—Shaft being sunk. New hoisting equipment contemplated.

## COLORADO

### Boulder County

**BLACK CLOUD MILL** (Salina)—One unit of remodeled mill in satisfactory operation. Supply of ore sufficient to keep this running day and night. Rest of plant undergoing repairs will be in operation in near future.

### Clear Creek County

**DORIT** (Idaho Springs)—Main adit on Dorit vein advanced 1100 ft., will be continued another 200 ft. to intersect prominent crossvein.

### San Juan County

**BARSTOW** (Red Mt.)—Mill, shut down for past few weeks, has resumed operations.

**PRIDE OF THE WEST** (Silverton)—Recent developments encouraging; property has commenced to ship high grade to Durango.

**MAYFLOWER** (Howardsville)—Recent operations in Arastra Gulch encouraging. Some rich ore being produced from development.

**BROAD GAUGE MINING & MILLING CO.** (Silverton)—Company will resume development work on Broad Gauge, Mayflower and Belle of Shannon properties, located in Burns Gulch. A. A. Holloway, superintendent.

### Teller County

**GOLD BOND LEASING & DEVELOPMENT CO.** (Victor)—Company commenced sinking shaft on property of Gold Bond Con. Mines Co. on Gold Hill. Promising surface discoveries made.

**EL ORO MINING & MILLING CO.** (Cripple Creek)—Operations resumed at Eclipse shaft. New machinery installed and skip substituted for cage formerly in use. New railroad spur to company's ore house staked out.

**LAST DOLLAR** (Altman)—Development resumed on this Bull Hill property, now owned by Lews Gold Mining Co. Contract let for 200 ft. of sinking in main shaft and 200 ft. of drifting. Shaft now 1300 ft. deep, with 12 levels. Robert E. Cranston, San Francisco, consulting engineer; J. B. Page, local manager.

**ISABELLA** (Altman)—Promising orebodies opened on 550-ft. level of Empire State shaft after crosscutting 120 ft. in barren ground. At junction of Isabella No. 2 and Maloney veins, 5-ft. vein opened for 25 ft., which yields 4 to 5 oz. gold ore. Exploratory work now being carried on to locate junction of Isabella veins Nos. 2 and 4.

**ACACIA GOLD MINING CO.** (Victor)—Main shaft on South Burns mine, Bull Hill, will be sunk another 150 ft.; now 1110 ft. deep. Rich ore being developed on 11th level from northern extension of American Eagle's vein. Bottom level of South Burns shaft has been yielding ore said to average \$60.

## DISTRICT OF COLUMBIA

### Washington

**BILL FOR LEASING ALASKA COAL LANDS** taken up by Senate Sept. 22, to be pressed to passage; provides facilities for conducting leasing by competitive bidding. House also working on bill.

### IDAHO

### Coeur d'Alenes

**PINE CREEK ANTIMONY MINE** under lease to A. J. Brainard and associates, began operating this week. Shipped steadily for several years in early '90s, was equipped with smoke process for treatment. Much of crude ore was shipped

direct to Germany, while New York markets took balance. Mine will soon be in readiness for active shipments and should quotations be favorable it is thought several other antimony producers will be opened up in the Cœur d'Alenes.

**INTERSTATE-CALLAHAN (Wallace)**—Persistent rumors company is negotiating for large mill site at Enaville, drawn there by assurance of ample water supply from either North Fork or main Cœur d'Alene River. Possibility of branch railroad up Beaver Creek to the Sunset mines would make this feasible plan, for direct connection could be had from mine to mills and give outlet on main line of O.-W. R. & N. Stated several other Sunset properties have large tonnage zinc ores available for treatment, and with transportation would join list of shippers. At present Interstate-Callahan produces more than 300 tons daily without railroad facilities or sufficient water power to meet requirements in mill. Given these accommodations, stated mine could easily produce 1000 tons with sufficient ore blocked out to operate many years.

#### MICHIGAN

##### Iron

**HIAWATHA (Iron River)**—Due to burning slate in underground workings, found necessary to suspend production. Incident is fourth of kind recorded in district within recent years. Fires result from oxidation of pyrite in rock. Trouble at Hiawatha is in worked-out stope between sixth and seventh levels. Friction from slide in hanging held responsible. Work became impossible when gases spread throughout mine. Operations were suspended and attempt being made to confine trouble by sealing stope off from other workings. Similar fires previously recorded at Fogarty and Youngs mines, Iron River, and at Bristol, Crystal Falls, were not so serious as that at Hiawatha. Menace increases as operations in district attain greater depth.

#### MONTANA

##### Granite County

**COYLE (Haskark)**—Courtney Bros., leasers, reduced force; directing energies to development work pending return of normal conditions. Curtailment claimed due to uncertain condition of silver market.

##### Madison County

**EASTON (Virginia City)**—Forced to shut down. Cyanide supply cut off altogether; unable to secure the material elsewhere; lays off 100 men.

##### Silver Bow

**ANACONDA (Butte)**—Dividend cut from 75c. to 25c., payable Oct. 14; 75c. rate had obtained quarterly since October, 1912.

**BUTTE & SUPERIOR (Butte)**—Laying off of about 100 men during last few days explained by Manager Bruce as due to increased output of mine having passed capacity of mill, necessitating temporary curtailment to allow mill to catch up.

**PILOT BUTTE (Butte)**—Development work on 2400 level progressing steadily; has opened bodies of rich copper ore, which is being shipped at the rate of five to six cars per month. No curtailment of output necessary as yet, and regular crew of 45 men works seven days per week.

**NORTH BUTTE (Butte)**—General Manager John D. Pope announced that on Sept. 17 Speculator mine would resume operations after shutdown of nearly a month. Work would be started with about 500 men; more will be put on as soon as conditions improve. [Previous notice of resumption of operations at 90% capacity denied.—Editor.]

**TUOLUMNE (Butte)**—Affairs show improvement in last six months. Earnings from regular shipments high-grade ore more than paid for expense of development work on 2600-ft. level. From 25 to 40 cars of ore per month go to Washoe, and mine is working seven days per week with force of 115 men. Crosscut on 2600 level now in 100 ft. from station, expected to cut vein by middle of October.

**SILVER BOW MINE (Butte)**—This property of Anaconda company was to resume operations Sept. 3, after shutdown of several months. Output approximately same as that of Moonlight mine, recently closed on account of damage to hoist. With resumption of operations at Silver Bow, 12 of the 22 operating shafts of Anaconda company will be in commission again. About 30 men will be employed at Silver Bow.

**EAST BUTTE (Butte)**—Since complete shutdown, in compliance with general policy of curtailment, plans perfected for increasing mill and smelting plant capacity, as well as their efficiency. Of two blast furnaces, each 400-ton daily capacity, one to be enlarged to 800 tons. This, it is said, can be done with little additional expense for heat development, while labor cost for 800-ton furnace will be practically same as for 400-ton. The larger furnace will be used for regular work; the 400-ton for emergency purposes. Enlargement of concentrator, present capacity 300 tons per day, will be decided upon when copper market resumes normal conditions and when shipments from independent producers again become more regular. Pittsont shaft now below 1500 level being permitted to fill with water to 1200 level, where are large station pumps, and where water will be held pending resumption of operations.

#### NEVADA

**DEPOSITS OF BARITE** known in Clark, Elko, Mineral and Nye Counties. Present decline in imports of mineral may make western deposits valuable.

##### Clark County

**MINING ACTIVITY IN SEARCHLIGHT CAMP** confined chiefly to leasing on old mines. Charles W. Lund and Walter Wells have leases on Searchlight M. & M. Co., in northern part of camp, and are operating mill on ore from this mine and from adjoining Blossom mine, also under lease. On Pompelli, north of Blossom, J. R. Mendenhall has improvised cyanide plant with canvas tanks working on small lot of tailings.

The Parallel is leased to B. S. McCready, and ore being milled in Spokane mill. The Cyrus Noble is idle. Duplex is being examined by George Coulton, one of owners, with view to resuming development. Probable some tests of ore for special treatment will be made. Ore above 700 level contains copper silicate ore and lead carbonate with gold and silver. New York Searchlight Co., formerly operated by W. W. Hurt, has ceased operations entirely. The Quartette is developing from East shaft on 600 level. Reported that plans for rebuilding of mill burned last winter are being considered. Property was recently purchased by parties represented by Jones & Miller, of Searchlight. Attempt to recyanide tailings failed owing to presence of copper in them. Charles W. Lund is leasing on the Good Hope, adjoining the Quartette. William Darst interests, of Salt Lake City, have taken working bond on Sam Yet's property on Fourth of July Mountain, east of Searchlight. This is gold prospect. The ten-stamp mill will be rehabilitated for test.

**DORAN & ZENZEN (Jean)**—Stebbins dry concentrator installed at this large prospect. Ore carries silver and a little lead. Ore mined in development is sorted for high grade; remainder is screened, rich fines going to Stebbins table and coarse to dump.

**POTOSI (Goodsprings)**—Shipments zinc carbonate ore going forward at rate of 800 tons per month. Empire Zinc Co., now owning property, has begun construction of experimental roasting plant. Expected grade of zinc may be considerably raised and freight rates diminished by roasting.

**BOSS (Goodsprings)**—Reported ore from this property contains platinum in commercial quantities; assays of 7.32 oz. per ton said to have been obtained. Carload of medium grade shipped to Murray plant of the A. S. & R. during August returned in excess of \$4500, with no allowance for platinum. Car ran 8.75 oz. gold and 5.02 oz. silver. Under management of O. J. Fisk, active campaign of development being maintained, and considerable ore now ready for shipment.

##### Elko County

**FLAXIE (Jarbidge)**—Mill tests completed and stated mill to cost \$35,000 will be built. Power will be generated at Bear Creek.

**BLUSTER (Jarbidge)**—Test runs being made by General Engineering Co., Salt Lake City, to determine best milling process. Cyanide plant may be built.

##### Esmeralda County

**TALMAGE MINES CO. (Goldfield)**—A 2-ft. shoot high-grade gold-silver ore struck in southwest drift from shaft.

**YELLOW TIGER (Goldfield)**—Shaft unwatered to point below 700-ft. level, and this level cleaned out and repaired. Development work now under way. Compressor and machine drills will be installed at once.

**FLORENCE (Goldfield)**—Stoping being done above north drift on 150-ft. level in ore assaying \$30 to \$60 per ton, and in "big stope" on 250-ft. level. Raise being lifted from 350-ft. level to open shoot of good-grade ore which was being mined by underhand stoping. Winze from 280-ft. level in Wheeler lease ground in milling-grade ore and raise will be lifted from 530-ft. level to connect with winze.

**JUMBO EXTENSION (Goldfield)**—Due to change in character of ore, shipments to Goldfield Consolidated will be reduced from 100 to 45 tons, and shipments to Millers sampler increased from three cars to ten cars per month. Ore assaying over \$20 gold and less than 1% copper will be smelted, and that under \$20 gold and over 1% copper, concentrated.

##### Humboldt County

**RECENT GOLD PLACER DISCOVERIES** made on Leonard and Tepee Creeks in northern part of county. Gold-bearing veins also discovered near Leonard and Cove Creeks.

**MOONLIGHT MINE (Unionville)**—This old silver property will be reopened and development work started at once; not worked since early '70s.

**BUCKSKIN NATIONAL (National)**—Shoot of good-grade ore opened in development work. Hatch lease, on portion of company ground, will drive 700-ft. tunnel.

**ROCHESTER-LINCOLN CONSOLIDATED MINES CO. (Rochester)**—Flunkey No. 2 claim purchased for \$37,000, according to report. Extensive development work on both properties will be done.

**NATIONAL (National)**—New machinery installed, improvements and increase in capacity of milling plant being made, new two-compartment shaft being sunk on high-grade ore-shoot recently discovered in north-south vein.

**SEVEN TROUGHS COALITION (Seven Troughs)**—New electric pump installed and giving satisfaction; 6-ft. exhaust fan will also be installed, bad ventilation having necessitated discontinuation of stoping. Sinking of winze being continued.

**GREEN ANTIMONY MINE (Mill City)**—Stated mine and furnace in Bloody Cañon will be operated again, owing to rise in price of antimony. Considerable quantity of antimony has been held in stock.

**ROCHESTER MINES CO. (Rochester)**—Excavating for foundations of new custom mill half completed and work on retaining walls started. Thought mill will be completed by Jan. 1, 1914. Estimated 100,000 tons milling-grade ore developed in district; Codd lease credited with 50,000 tons, assaying \$10 to \$20; Four J lease with 20,000 tons, assaying \$15 per ton, and mine dumps with 20,000 tons.

##### Lander County

**RUBY SILVER MINE (Battle Mountain)**—Concentrating plant in Lewis Cañon finished and in operation. Crew of 20 men employed.

##### Lincoln County

**PRINCE CONSOLIDATED (Pioche)**—Option obtained on 35% of stock of Virginia Louise. Company already holds 20% of this stock. Virginia Louise adjoins end line of Prince Consolidated, and 465-ft. shaft, recently sunk, opened two ore-shoots thought to be continuation of the worked on Prince Consolidated.

**GOLD CHIEF MINING CO. (Callente)**—Mill running steadily; 150 tons of \$5 gold ore treated daily. Mine worked

through 450-ft. incline shaft. Large tonnage low-grade gold ore developed and considerable work under way on 200- and 300-ft. levels. Crosscut on 200-ft. level opened oreshoot 10 ft. wide, assaying about \$5.

#### Lyon County

BLUE JAY (Yerington)—Good-grade ore stoped on 100-ft. level and shipments being made. Whip used to hoist; automobile replacing customary horse.

#### Mineral County

WHEELER MINE (Pine Grove)—Lessees treating old tailings in concentrating plant at Pioneer mill site; good recovery made.

AURORA CONSOLIDATED (Aurora)—Mill treating 200 tons per day, will be operating to capacity within 60 days, it is stated. Construction work being hastened and all building will be finished before heavy snowfall. Crew of 150 men employed.

#### Nye County

ANTIMONY NORTH OF TYBO, in Hot Creek district discovered, it is stated.

OFFICE OF "TONOPAH BONANZA" BLOWN UP Sept. 22; three sticks of powder under job printing plant. Corner of building blown off; adjoining garage wrecked; windows block away broken. Bonanza took active part in labor trouble, favoring Federation against I. W. W.

MERCURY MINES CO. (Ione)—Shipment made of 42 flasks of quicksilver from final cleanup. Plant will be operated again in six weeks, it is stated.

MONITOR BELMONT MINING CO. (Belmont)—Control of principal mines of district obtained and corporation formed. Mill being built and power line of Nevada-California Power Co. will be extended from Manhattan. Belmont was prominent silver camp 1864-5, credited with production of \$15,000,000. Had one time 10,000 population.

#### Storey County

CROWN POINT-BELCHER (Virginia City)—Hoisting of ore at Jacket incline delayed on account of breaking of cable; new cable being installed. Milling plant operating steadily.

### SOUTH DAKOTA

#### Lawrence County

TITANIC (Carbonate)—Shaft work suspended, announcement made company will drive long adit from westward to open and drain entire territory of company.

TROJAN (Trojan)—Company engaged in building small town. Among improvements under way are commodious hotel and number of small dwellings, all for employees. Work hastened in effort to complete before winter.

WASP NO. 2 (Flatiron)—An 18-ton locomotive and equipment of dump cars purchased from U. S. reclamation service, having formerly been used on Belle Fourche irrigation project, will be employed in hauling debris away from steam shovel used in stripping ore.

BRANCH MINT (Galena)—J. D. Hardin, in circuit court at Deadwood, given verdict of \$3500 against McKay & Graham for malicious destruction of personal property. This regarded as opening round of litigation in which Hardin is suing to secure title to property under his lien of \$440,000, which he claims should be satisfied before bondholders be allowed to foreclose on mortgage bonds. Other suits pending will be heard this month.

BISMARCK (Flatiron)—Operations suspended at mine and mill after operating 18 months. In statement at recent meeting of stockholders manager F. B. Hitchings said 79,036 tons of ore mined during year ended July 31 averaged \$1.453 per ton; for 7 months ended July 31 average was better, or \$1.52 per ton; 42,880 tons were treated in that period for recovery of \$55,113.40, or average of \$1.285 per ton. Costs for entire year averaged 69.4c. for milling and 55.9c. for mining, total of \$1.253. From January to July mine was operated at profit; for rest of year loss was sustained. For these reasons, and because exploration did not hold out encouragement for higher-grade, work was stopped. Stated that company sustained net loss on operations, of \$150,000.

### UTAH

#### Juab County

GOLD CHAIN (Mammoth)—Operations will be resumed shortly.

MAMMOTH (Mammoth)—Ore carrying bismuth, gold, silver, and copper opened lately in drift on 600-ft. level, and is being developed.

YANKEE CONSOLIDATED (Eureka)—Zinc ore being mined on upper levels by lessees. Work on company account being done on 200- and 1700-ft. levels.

COLORADO (Silver City)—August royalties amounting to about \$2000 received from lessees. Beck Tunnel adjoining also being worked under leasing system.

IRON BLOSSOM (Silver City)—In August some reduction made in copper-ore shipments. Earnings said to be sufficient to meet dividend requirements. Twelve cars shipped week ended Sept. 11.

CENTENNIAL EUREKA (Eureka)—Reported 12 men imprisoned by cave on 1600-ft. level. Hope of rescue early given up but latest news stated tapping was heard and extraordinary efforts were being made to reach victims.

EAGLE & BLUE BELL (Eureka)—Shaft sinking from 1550 to 1700 level in progress, expected work will be completed by end of October. Shipments for week ended Sept. 11 were reduced to four cars, owing to trouble with cable.

CHIEF CONSOLIDATED (Eureka)—New ore carrying silver with some gold recently opened on 1000- and 1600-ft. levels. Strike on 1600 of especial interest, being several hundred feet away from other known orebodies and on main oreshoot. Zinc ore being mined in several places in neighborhood of lead stopes.

### Plute County

HOMESTAKE (Marysville)—Good milling ore opened, carrying silver and copper, with a little lead and gold. High-grade streak 10 in. wide. Tunnel is in 300 ft. N. M. Nielson, of Richfield, manager.

BULLY BOY & WEBSTER (Marysville)—One hundred-ton concentrating mill in Bullion Cañon recently destroyed by fire. Some insurance, not enough to cover loss. Mill worked on a small scale by lessees, treating gold-silver ore from property.

### Salt Lake County

NATIVE COPPER (Alta)—Two feet silver-lead ore cut recently in 400-ft. tunnel. Property in Peruvian Guich southwest of South Hecla.

OHIO COPPER (Bingham)—Fields flotation process to be tried in mill at Lark. Equipment to treat 50 tons per day expected to be in operation soon.

CARDIFF (Brighton)—Lower tunnel now in 2350 ft. following limestone-quartzite contact. Will unwater winze sunk in ore from upper workings. During August progress of 85 ft. was made.

WASATCH MINES (Alta)—The 150-ton mill and transformer plant destroyed by fire Sept. 7. Orebins and other buildings not damaged. Origin of the fire uncertain, but believed to have been caused by wearing off of insulation from one of power wires. Five cars of ore shipped recently. Development being done on ore opened short time ago on tunnel level near No. 3 shaft, and in Garfield workings.

SOUTH HECLA (Alta)—At annual meeting reports on financial and physical condition of the property were read. Showed company shipping 50 to 100 tons daily during summer months, while curtailment going into effect Aug. 1 resulted in reduction to about 30 tons. Development opened much ore. Summer operations successful, and cash balance sufficient to carry company through winter months. Some shipments will be made during winter. There is eight-mile haul to loading station. Following directors were elected: G. H. Watson, H. C. Edwards, Herman Bamberger, V. Burman, T. Coughlin, E. Storer, D. W. Harrow. G. H. Watson is manager and in charge of operations.

### WASHINGTON

#### Ferry County

REPUBLIC CONSOLIDATED MINES CORPORATION (Republic)—Properties consisting of the Lone Pine, Pearl and Surprise mines, recently acquired under bond from defunct Republic Mines Corporation have passed into control of new company being organized by West Virginia capitalists, J. L. Harper and local associates; holdings taken over under three-year bond for \$200,000, initial payment of \$10,000 already made. New company also will take over cyanide mill and reduction works of the San Poil Consolidated, and transfer will be made immediately, consideration, \$185,000, bond to run for four years; Spokane & Eastern Trust Co. has been made trustee of money derived from the royalty and bond payments, and will disburse it pro rata to creditors of the San Poil until outstanding indebtedness is liquidated. In addition the new syndicate is negotiating for Last Chance and several other properties at Republic.

### WISCONSIN

#### Lead and Zinc

McMILLAN MINING CO. (Milwaukee)—Incorporated for \$100,000 to operate in Hazel Green district.

FIELDS MINING CO. (New Diggings)—Company equipping new property with 600-ton plant; orebody known to be large, as much as 60 ft. thick.

WILKINSON (Burton)—Mine has been shipping 300 to 400 tons of pyrite weekly to acid works, is showing extensive zinc ore in lower workings.

ALDERSON (Platteville)—Shaft sunk by Chas. Kistler penetrated 8 ft. of rich sheet ground that will make 50% concentrate, it is believed. St. Rose mill being wrecked for removal.

### CANADA

#### Ontario

McKANE (Swastika)—Claims optioned to Harry Cecil, of London.

COBALT LAKE (Cobalt)—Work of draining Cobalt Lake will proceed at once.

KERR LAKE (Cobalt)—Operations resumed Sept. 7 with practically full staff of employees.

HOLLINGER (Porcupine)—Directors voted \$10,000 to the patriotic fund for relief of soldiers' families.

McINTYRE (Schumacher)—Additional unit of mill gone into operation bringing capacity up to 300 tons.

NIPissing (Cobalt)—Hydraulic operations for past season uncovered several new veins of value uncertain up to this date.

LITTLE PET (Porcupine)—Mine opened short shoot of remarkably rich ore on 50-ft. level. Company producing approximately \$6000 per month.

CASEY COBALT (Cobalt)—After curtailing production at outbreak of war, mine is resuming with two-thirds force, operating 10 drills in place of 15.

BAILEY (Cobalt)—Protective committee organized to safeguard interests of shareholders are opposing proposed sale for debt on ground that it is move to wipe out stockholders' interests.

TECK-HUGHES (Kirkland Lake)—Harry Keys in charge of operations under Nipissing option. Another vein found running parallel to main vein, 60 or 80 ft. to south. Crosscut being driven to it on 75-ft. level.



# The Market Report

## METAL MARKETS

NEW YORK—Sept. 23

The features of the week have been further steps toward the restoration of conditions of equilibrium in the copper market, a breaking of the deadlock in spelter and a further softening in the tone of the lead market.

The committee of the London Metal Exchange has fixed the following prices for August, upon which average contracts may be based in the absence of the usual quotation: Lead, £20 9s. 9d.; spelter, £29; electrolytic copper, £62 10s., per long ton.

### Copper, Tin, Lead and Zinc

**Copper**—A noteworthy exportation of copper continues. This is partly due to copper going out on old contracts and partly to copper that is being shipped abroad on consignment. However, there is developing some new demand from England and Italy. The French demand is stagnant. Germany would buy a good deal of copper if it could be delivered to her, but there is a serious hitch about that. In the meanwhile, American mills are taking a good deal of copper, although there is considerable difference of opinion as to their present manufacturing rate. Some estimates are 70% of normal; others only 40%. There is also a great difference among producers in their ability to dispose of their production. Some report deliveries approximating their present production, but most report deliveries short thereof. We summarize all reports in the judgment that the deliveries are still far below the production at the curtailed rate, and that while the trade is working toward the condition of approximate equilibrium, we are still materially distant therefrom. With the increasing volume of business, conditions are very erratic and uncertain. Some sales of round lots have been effected during the week at 12c., delivered, usual terms.

The American Smelting & Refining Co. is making final settlement at 12.34c. per lb. for the copper in ore, matte, etc., that it received in August, upon which it advanced 10c. per lb. pending final settlement.

Exports of copper from New York for the week were 4548 long tons. Our special correspondent gives the exports from Baltimore at 847 tons copper.

Base price of copper sheets is 17½c. per lb. for hot rolled

and 18½c. for cold rolled. Full extras are charged and higher prices for small lots. Copper wire is quoted at 13¼@14c. per lb. for carload lots at mill.

**Tin**—There has been a considerable demand from consumers, but relatively little business has been done. It is hard to do business, owing to the reluctance of sellers to contract for future deliveries owing to the dangers of transportation in the Indian Ocean, where a German cruiser has been capturing British ships. The conditions have produced a firmness in the tin market here.

**Lead**—A good deal of nervousness has been exhibited in this market, and there has been a distinctly softer tone. As well as we can determine the facts, real consumption continues good and the bulk of the demand being supplied on contracts, there is no strong motive for reducing prices. On the other hand, the relatively small competitive market seems to be oversupplied and some producers have been more anxious to have money than lead. The offering of some lead for resale by previous buyers has also been disturbing. In St. Louis, transactions have been made during the week at 3.65c. In New York, the A. S. & R. Co.'s price has remained unchanged at 3.90c., but outsiders have offered freely at 3.85c., and there have been distinct intimations about possibility of doing business at 3.80c., which of course would be the St. Louis parity.

**Spelter**—The expectations of a renewal of demand from England, which we indicated last week, failed to be realized. The fact is that English buyers obtained a supply that had been in stock at Rotterdam, which became available at about £23½@24, or 5.10@5.20c. Cut off from immediate possibility of selling for export, several producers began to feel vigorously for the market among domestic consumers, who for several weeks had been conspicuous by their absence. As the offerings approached 5c., they became interested, and at 5c. a business of some thousands of tons was done, both for early and for distant shipments.

### Other Metals

**Aluminum**—A quiet market continues and quotations are unchanged at 20@20½c. per lb. for No. 1 ingots, New York.

**Antimony**—The market has been dead for the past week, with no sales reported. Prices are purely nominal, somewhere around 10c. per lb. being asked for ordinary brands. Stocks are reported low, and any revival of demand would probably cause a reaction upward.

**Quicksilver**—Business has been rather slow, and prices are unchanged at \$75@80 per flask of 75 lb., New York. Stocks here are low. There is no London quotation.

### Gold, Silver and Platinum

**Silver**—The market has been very erratic, owing to the irregularity of the orders. It is reported that some small buying for India has taken place this week, which has accounted for the rise to 24¼d. in London.

Official prices of silver in London for the week were: Sept. 17, 24d.; Sept. 18, 23½d.; Sept. 19, 23¾d.; Sept. 21, 23½d.; Sept. 22, 24½d.; Sept. 23, 24¼d. per oz. sterling silver.

**Platinum**—There is no change to report. The market is absolutely quiet, with very little business doing. Dealers appraise values at about \$50 per oz. for refined platinum and \$57@58 per oz. for hard metal.

### Zinc and Lead Ore Markets

JOPLIN, MO.—Sept. 19

The letter of Sept. 12, delayed in transmission, shows high price of blende, \$48; assay base, \$44@46; metal base, \$43@44; calamine, \$25@26; average all grades, \$43.08; lead base, \$46; average all grades, \$45.90. Shipments, 7,962,680 lb. blende, 748,810 lb. calamine, 1,737,850 lb. lead ore.

PLATTEVILLE, WIS.—Sept. 19

Letter of Sept. 12, delayed in transmission, shows base price of zinc ore, \$45@46; lead ore, \$45. Shipments were 3,628,740 lb. zinc ore, 141,000 lb. lead ore, and 257,700 lb. sulphur ore. Deliveries to separating plants, 3,496,080 lb. zinc ore.

### DAILY PRICES OF METALS

NEW YORK

Aug. Sept.	Sterling Exchange	Silver, Cts. per Oz.	Copper		Tin		Lead		Zinc	
			Electrolytic, Cts. per Lb.	Cts. per Lb.	Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	
17	4.9575	52½	*	†31½	3.80		3.65	5.25	5.10	
					@3.90			@5.35	@5.20	
18	4.9300	51½	*	†31½	3.80		3.65	5.20	5.05	
					@3.90			@5.30	@5.15	
19	4.9525	51½	*	†31½	3.80		3.65	5.15	5.00	
					@3.90			@5.25	@5.10	
21	4.9375	51½	*	†31½	3.80		3.65	5.15	5.00	
					@3.90					
22	4.9525	52½	*	†31½	3.80		3.65	5.15	5.00	
					@3.90					
23	4.9550	53	*	†31½	3.80		3.65	5.15	5.00	
					@3.90					

\*No quotations. †Nominal.

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

Some current freight rates on metals per 100 lb., are: St. Louis-New York, 15c.; St. Louis-Chicago, 6c.; St. Louis-Pittsburgh, 12½c.; Chicago-Baltimore, 10c.; Chicago-New York, 13½c.

## IRON TRADE REVIEW

### NEW YORK—Sept. 23

The markets are still quiet. There is a general expectation that a demand upon us will be the ultimate result of the great war, but the time has not come yet.

Domestic business is still in suspense on account of the unsettled state of the financial markets. Matters are gradually getting into shape, but the process is slow. Meantime buyers are cautious, and do not want to be committed far ahead.

### PITTSBURGH—Sept. 22

There has been a further decrease in steel and pig-iron buying and the market is more stagnant than at any time for years. Steel men are not prepared to make any prediction as to when a turn for the better is likely to occur. The average rate of steel production is now but little over 50% of capacity.

England has placed an embargo upon galvanized sheet exports, for reasons not stated and not easily guessed. It seems doubtful therefore whether there will be much buying against inquiries recently made by English sheet mills for 125,000 tons of sheet bars. On the other hand the sheet export market may be stimulated. On the whole the iron and steel export market is not opening up to any extent.

The Carnegie Steel Co. is this week operating at 62% of capacity, but this is a better showing than is being made by the majority of mills, since some of them are not operating at over 50%. The Republic bessemer plant is reported down this week, after having operated full last week.

Strictly new buying in steel products is extremely light, and specifications against old contracts have been decreasing, so that current bookings are less than shipments.

The large steel mills at least are holding prices very firmly. In several instances they have passed dividends, to husband cash resources, and they are likely to pursue an equally conservative course as to sales, avoiding any business that does not assure at least a slight profit. Bars, plates and shapes are generally held at 1.20c. Sheets are a shade weaker, some mills selling at 1.90c. and 2.90c. for black and galvanized respectively. Tinplate is back to the old level of \$3.40, after the pig tin scare.

**Pig Iron**—The market is altogether stagnant, and shipments on regular contracts are lighter. Prices seem to be well maintained so far as can be ascertained at former levels: Bessemer, \$14; basic, \$13; malleable and No. 2 foundry, \$13@13.25; forge, \$12.50@12.75, at Valley furnaces, 90c. higher delivered Pittsburgh.

**Ferromanganese**—The market seems to show a slight declining tendency, as while English makers still quote \$85, Baltimore, for forward deliveries there is re-sale material offered sometimes at \$75. The Carnegie Steel Co. states that it is not offering ferromanganese, but will sell at a fair figure to any mill that would otherwise have to stop production.

**Steel**—A sale of 1000 tons of sheet bars has been made within the past two weeks at \$21, maker's mill but another sale of a larger tonnage went through lately at \$22. The large mills state that their minimum prices are \$21 for billets and \$22 for sheet bars. Rods are \$26, Pittsburgh.

### COKE

The New Jersey Zinc Co. has closed a contract with W. Harry Brown, operating the Alicia plant, for coke requirements of its two spiegel stacks at Palmerton, Penn., the full requirements being 10,000 tons monthly; but only one of the stacks is now in operation. The contract is for two years, the price to be determined monthly on a ratio with the current price of pig iron. The market is quotable as follows: Prompt furnace, \$1.65@1.70; contract furnace, \$1.75@1.85; prompt foundry, standard brands, \$2.25@2.35; ordinary 72-hour coke for prompt shipment, \$2@2.25; standard foundry coke on contract, \$2.35@2.50, per net ton at ovens.

## CHEMICALS

### NEW YORK—Sept. 23

The general market is still much disturbed and unsettled by the war conditions and interference with foreign trade.

**Arsenic**—The market is quiet, with little business. Quotations are nominal at \$4.50@5 per 100 lb. for both spot and futures.

**Copper Sulphate**—Domestic orders are fair, but nothing is doing for export. Prices are unchanged at \$4.50 per 100 lb. for carload lots, and \$4.75 for smaller parcels.

**Nitrate of Soda**—Business is very dull and prices remain nominal at 1.95@2c. per lb. for both spot and futures.

**Pyrites**—Imports at Baltimore for the week included 7116 tons pyrites from Hueiva, Spain.

### PETROLEUM

Exports of mineral oils from the United States in August were 63,606,427 gal. For the eight months ended Aug. 31, the total exports were 1,314,449,269 gal. in 1913, and 1,493,731,331 gal. in 1914; an increase of 179,282,062 gal., or 13.6% this year.

Shipments of crude oil from Tampico, Mexico, to the United States during June, 1914, totaled 1,062,062 bbl., or 86,156 bbl. less than in June of last year. The decline is the result of disturbed political conditions.

### NEW CALEDONIA ORES

Exports of ores from New Caledonia for the six months ended June 30 are given by the "Bulletin du Commerce" of Noumea at 41,396 tons nickel ore, 920 tons cobalt ore and 39,789 tons chrome ore. Exports of metals were 1849 tons nickel matte.

### COPPER SMELTERS' REPORT

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

	April	May	June	July	August
Alaska shipments	1,279,537	585,387	1,114,758	2,879,396	3,122,756
Anaconda.....	22,900,000	23,500,000	23,800,000	.....	.....
Arizona, Ltd.....	3,570,000	3,092,000	3,742,000	3,300,000	.....
Copper Queen.....	7,562,723	8,388,203	7,613,719	7,817,318	.....
Calumet & Ariz..	5,450,000	5,495,000	4,630,000	5,940,000	.....
Chino.....	5,926,591	5,496,875	5,486,419	.....	3,045,045
Detroit.....	1,790,926	2,105,034	2,129,100	1,966,526	.....
East Butte.....	1,178,000	1,179,762	1,215,323	.....	.....
Giroux.....	45,948	429,553	425,000	.....	.....
Mason Valley....	862,000	916,000	950,000	.....	.....
Mammoth.....	1,850,000	1,750,000	1,725,000	1,950,000	1,975,000
Nevada Con.....	4,880,043	4,959,589	4,483,175	.....	.....
Ohio.....	610,518	625,000	605,000	.....	.....
Old Dominion....	2,779,000	3,302,000	2,937,000	2,962,000	.....
Ray.....	6,089,362	6,300,847	5,941,567	.....	3,200,000
Shannon.....	1,012,000	1,056,000	1,049,227	1,084,000	960,000
South Utah.....	247,641	55,394	62,990	.....	.....
Tennessee.....	1,370,800	1,336,950	*710,800	.....	.....
United Verde*..	3,000,000	3,100,000	2,900,000	.....	.....
Utah Copper Co.	12,739,757	13,208,483	12,870,063	.....	7,978,250
Lake Superior*..	13,000,000	12,500,000	16,000,000	.....	.....
Non-rep. mines*.	8,000,000	8,200,000	8,000,000	.....	.....
Scrap, etc.....	2,500,000	2,500,000	2,500,000	.....	.....
<b>Total prod.....</b>	<b>108,644,846</b>	<b>110,082,077</b>	<b>110,891,141</b>	<b>.....</b>	<b>.....</b>
Imp., bars, etc..	17,043,191	19,081,487	23,885,521	.....	.....
<b>Total blister... Imp. ore &amp; matte.</b>	<b>125,688,037</b>	<b>129,163,564</b>	<b>134,776,662</b>	<b>.....</b>	<b>.....</b>
<b>Total Amer....</b>	<b>136,088,159</b>	<b>139,750,070</b>	<b>143,934,202</b>	<b>.....</b>	<b>.....</b>
Arrivals-Europe†	17,299,520	13,558,720	19,040,000	.....	.....

\* Shut down 10 days for repairs.

† Does not include the arrivals from the United States.

Company	Assessments			Amt.
	Delinq.	Sale	Oct.	
Argenta, Ida.....	Sept. 1	Oct. 3	\$0.0005	
Best & Belcher, Nev. (post.)	Sept. 25	Oct. 16	0.05	
Black Bear, Ida. (post.)	Oct. 1	Nov. 1	0.01	
Carney Copper, Ida.	Sept. 21	Oct. 21	0.00225	
Cedar Creek, Ida.	Sept. 10	Oct. 10	0.003	
Chaiona, Nev.....	Oct. 3	Oct. 21	0.0025	
Columbine, Colo.	Sept. 15	Oct. 20	0.02	
Copper Plate, Ida.	Aug. 29	Oct. 3	0.002	
Davis-Daly, Mont.	Oct. 15	.....	.25	
Duluth, Ida.....	Sept. 5	Oct. 3	0.001	
Emerald, Utah.....	Sept. 15	Oct. 10	0.0033	
Honolulu, Ida.....	Sept. 15	Oct. 12	0.0025	
Idaho-Nevada, Ida.	Sept. 7	Oct. 1	0.001	
Lead King, Ida.....	Oct. 1	Oct. 16	0.0005	
Liquidator, Ida.....	Sept. 12	Oct. 12	0.002	
Lucky Swede, Ida.....	Sept. 19	Oct. 19	0.001	
Monarch-Pittsburgh, Nev. (post.)	Sept. 14	Oct. 19	0.01	
Orange-Manhattan, Nev.	Sept. 12	Oct. 10	0.01	
Reindeer-Queen, Ida.	Sept. 21	Oct. 21	0.002	
Rescue Fula, Nev.	Sept. 10	Oct. 15	0.01	
Royal Copper, Ida.	Sept. 3	Oct. 3	0.001	
Royal Mining, Ida.	Sept. 23	Oct. 19	0.0015	
Saltsee, Ida.....	Sept. 1	Oct. 1	0.002	
Silver Pick, Nev.....	Sept. 14	Oct. 19	0.01	
Snowshoe, Ida.....	Sept. 19	Oct. 19	0.005	
Snowstorm, Ida.....	Sept. 12	Oct. 3	0.003	
Tar Baby, Utah.....	Sept. 3	Oct. 5	0.005	
Tonopah Gipsy Queen, Nev.	Sept. 2	Oct. 17	0.01	
Treasure Vault, Ida.	Sept. 15	Oct. 12	0.02	
Tuscumbia, Ida. (post.)	Aug. 20	Oct. 1	0.002	
Umatilla, Nev.....	Sept. 3	Oct. 8	0.01	
Utah Metal, Utah.....	.....	Oct. 1	0.05	
Valentine, Ida.....	Sept. 12	Oct. 12	0.001	