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Electric Shovels in Lapland

By L. E. Ives*

SYNOPSIS—The Luossavaara-Kirunavaara company operates the world's greatest iron mine, north of the Arctic Circle. The ore is mined largely from an openpit with mechanical shovels. The equipment includes three electric shovels, one of which was made in this country by the Bucyrus Co. Electricity is obtained from a large hydro-electric plant. Electrical connection system and automatic controllers for shovel motors furnished by Cutler-Hammer Co. Brief description of generating station, ore handling, transportation and deposits.

A remarkable undertaking is that of the Luossavaara-Kirunavaara company, which operates iron mines 80 miles north of the Arctic Circle in Sweden and uses electric energy on a large scale. American machinery and American methods are largely employed in these operations.

The Kiruna iron-ore deposits are in a remote and desolate country, 170 miles from Lulea, a port on the Baltic Sea, and 90 miles from Narvik, the present shipping port for the ore, on the northern coast of Norway. The distance from Stockholm to Kiruna is about 1000 miles.

The climate is severe, the winter lasting from the beginning of October to the last of May, with an average yearly temperature of 29° F. There are huge falls of snow and the temperature frequently goes to —30 degrees.

Kiruna is a clean, well laid-out city, with macadamized streets and good sidewalks, splendid schools and churches, and a population of about 10,000 people. When the mines were opened, there were no permanent settlements in the vicinity, and it was necessary for the company to build up a town and attract labor from the south.

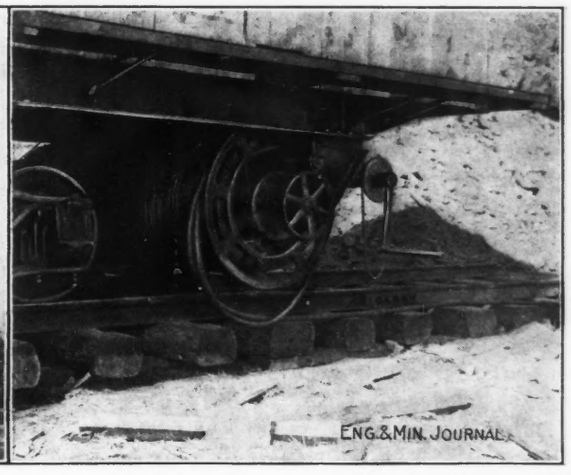
The Deposit

The mines lie on a plateau about 1000 ft. above the sea. The iron mountains reach a height of about 800 ft. above this plain. The only timber in the district is birch; the tree-line is below the mountain tops. The Kirunavaara ore deposit commences in Luossajarvi and continues toward the south, as far as is known, with a length of somewhat more than 3⅛ miles.

At the top of the mountain ridge, which constitutes a large part of the deposit, where the boundaries of the ore are well known, the horizontal width averages about 300 ft., and the thickness, at right angles to the hanging and foot walls, is approximately 240 ft. The greatest depth yet found is about 1700 ft. under the ridge of Kirunavaara, and the horizontal area, calculated from careful surveys, is about 440,000 sq.yd. Luossavaara mountain has not been mined as yet, but on Kirunavaara there are at present seven levels from which the ore is being extracted, either by hand labor, or with shovels, steam or electrically driven.

The ore is hard and requires considerable blasting, but it is pure and low in sulphur, phosphorus, etc. Two shifts

Near View of Bucyrus Electric Shovel



Electric-Cable Reel under Rear of Shovel

Note—From information furnished by the Cutler-Hammer Co., Milwaukee, Wis., and the Bucyrus Co., South Milwaukee, Wis.

*Chicago editor, "Engineering and Mining Journal."

are employed and mining is carried on the year round. Permanent level tracks and some portions of the inclines are covered with snowsheds, to keep the tracks clear in the winter. The ore is loaded by shovels into dump cars which bring it to inclined chutes discharging into hoppers at the foot of the hill; there the ore is loaded into railroad cars and conveyed to the port for shipment.

Shipment

The annual output is approximately 4,000,000 tons, soon to be increased to 6,000,000 tons. The ore goes principally to Germany to be used by Krupp, some being shipped to England and the United States. Part of the ore for German Baltic Sea points is shipped to Lulea, a port several hundred miles east of Narvik and connected with the latter by railroad, but most of it goes to Narvik.[1]

Between Kiruna and Narvik, the railroad crosses the mountain divide, at a high altitude. The operation of freight trains across this divide is extremely difficult because of the low average temperature which makes it hard to procure water for the locomotives, and to keep up steam. For this reason, it was decided to electrify the road from Kiruna to Narvik. This is now nearly done and electrically operated trains will run in a short time. The power is obtained from Porjus Falls, south of Narvik.

Power Generation

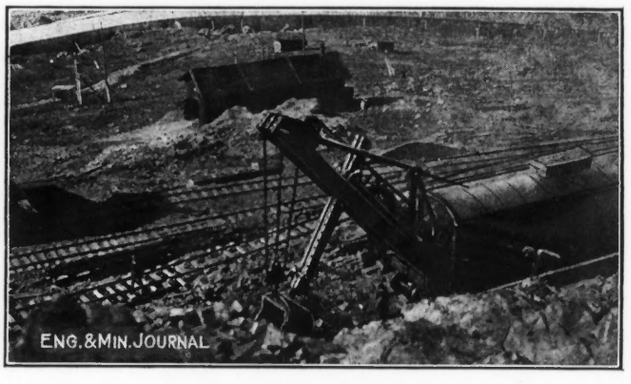
Porjus Falls is one of the great water-power resources of Sweden. The head obtained is approximately 150 ft. and the total available power is estimated at 320,000 hp., of which 160,000 hp. is developed. The power station is interesting in many ways. It is built below the water line of the tailrace and blasted out of solid rock, the roof being about 50 ft. below the surface of the ground. This was done for protection against the low temperatures and to permit the use of horizontal instead of vertical waterwheels. It was feared that the deep shafts necessary with vertical wheels would lead to freezing of the water in the winter.

The power generated at this station is brought to Kiruna on two lines at a tension of about 70,000 volts. One of these lines, with two-phase current, supplies the substation of the railroad company, and the other, with three-phase, supplies power for the mines. It is estimated that the mine demand will average about 60,000 hp.; the remainder is to be used by the railroad. At present, the mining company operates a steam-power station which supplies three-phase current to the mines. In the future, this station will be a standby.

The Shovels

The equipment of the mines includes three electric shovels and one steam shovel, all of about 100-ton size with 3½-cu.yd. dippers. Two of the electric are of German manufacture, while the latest is a 100-C Bucyrus. The steam shovel is also a Bucyrus. The Bucyrus electric is equipped with a 225-hp. hoisting motor, a 115-hp. swing motor and a 140-hp. thrusting motor. It is designed to operate on a 440-volt, three-phase, 25-cycle circuit. Power is supplied from the central station through 2200-volt, three-phase, underground cables to a number of substations in the mine. These consist of small buildings, protected against the flying stones from blasting. Inside of the buildings are one or more overload oil switches, and in some cases a step-down transformer to supply low voltage for the lighting circuits. From such an oil switch assembled with ammeter, voltmeter and disconnecting switches in an ironclad cabinet, another underground cable goes to plugging stations along the track on which the shovel is to run. The shovel may be connected to these plugging stations through a flexible cable, which is carried on a cable reel shown in one of the illustrations.

The plugging stations, specially designed for the company by the Cutler-Hammer Mfg. Co., Milwaukee, Wis., are arranged so that the oil switch in the substation cannot be closed unless the cover is on the plugging station, or the movable half of the plug on the shovel cable. As all the plugging stations on the main circuit are connected in parallel, they must all be closed before the oil switch in the power house can be closed. This prevents a man from touching the high-tension terminals in the plugging station and also indicates whether or not the plugging stations are being left open and exposed to the weather and to blasting. It is similarly impossible to remove the plug or the cover from the plugging station unless the oil switch in the substation is opened first.



Shovel at Work
Snowsheds over tracks in background.

The Motor Controllers

In the rear of the shovel are installed transformers, which step the power down to 440 volts for the motors. All motors are operated by Cutler-Hammer controllers of the series-relay type. A number of double-pole clapper switches operate the primary circuit and similar switches controlled by series relays, control the resistance in the secondary circuit of the motor. The hoist and thrust motors are also equipped with "jamming" relays, which reinsert resistance in the rotor circuit when the torque on the motor becomes too high, as when the shovel strikes solid rock or is subjected to too great a load. This prevents the motor from being stalled with the rotor short-circuited, which would cause the torque of the motor to decrease rapidly and which might also burn it out. This shovel was installed in 1913; its operation is so satisfactory that two more of identical design have been ordered from the Bucyrus company.

The controller described is the only type so far proved successful for shovel operation. During the trials on the first shovel, comparisons were made with a shovel of another make, employing the ordinary drum-type control-

[1]We do not know what effect the war may have had on these shipments.—Editor.

lers, and it was shown that the shovel with the improved controller could easily handle twice as much material as the other. They were comparable both in size and weight. The automatic controller also enables the use of comparatively unskilled labor for the operation of the shovel, which is not possible with the drum type. The automatic feature prevents the frequent opening of circuit-breakers, whereas continual trouble of this kind was experienced with the other type.

The shovel motors are a heavy and substantial mill type. Air-operated thrust cylinders have proved satisfactory. Air is supplied by a separate, automatically controlled, motor-driven air pump, with necessary tank and piping. The shovel weighs 112 tons in working condition and has proved itself more efficient and more economical to operate than the German machines.

Handling the Ore

The shovels load the ore into 12-ton side-dump cars, which are hauled in trains of five cars each by Orenstein-Koppel 12-ton, 90-hp. switching locomotives to the scales and breaker, which are situated side by side. The jaw breaker was supplied by the Power & Mining Machinery Co. It has a capacity of 500 tons per hr., and probably weighs about 150 tons.

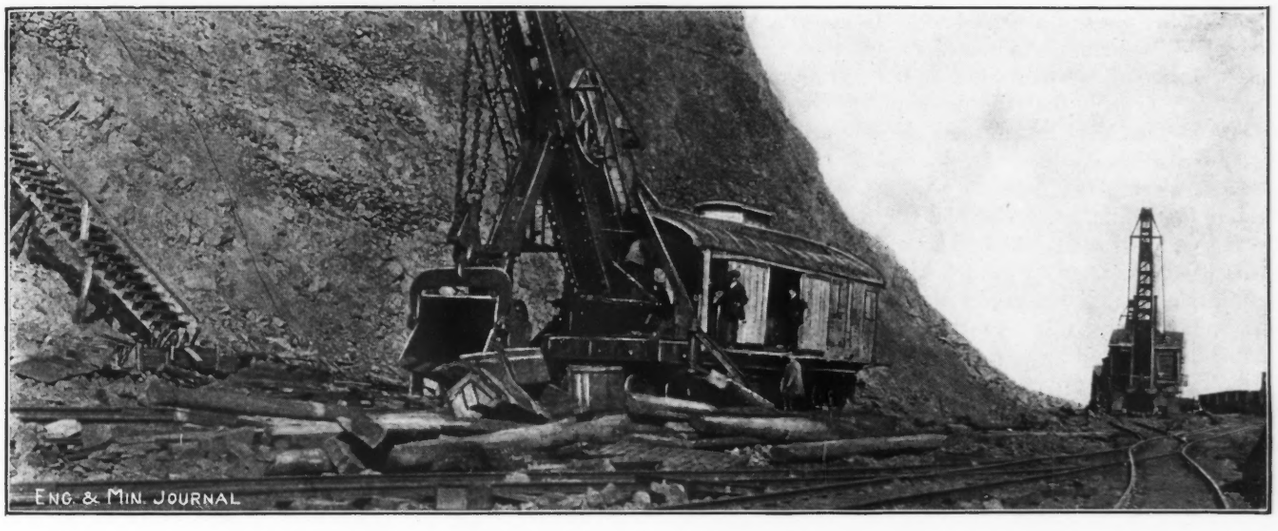
There are now in use in the mine 700 dump cars of 2-, 3-, 5- and 12-ton capacity; 15 electric locomotives of 125- and 250-hp. capacity, and eight 12-ton steam switching locomotives, all of the latter having been supplied by Orenstein-Koppel. Nine of the electric machines were built by the Allgemeine Elektricitäts Gesellschaft, of Berlin, Germany; five by Nya Forenada Elektriska Aktiebolag, of Ludvika, Sweden; and one by the Deutsche Machinen Fabrik, of Magdeburg, Germany.

A passenger incline, about 2000 ft. long and rising at an angle of about 30°, is used to handle the workmen. The upper station is at the fifth level. Another electrical incline lowers ore from the fifth level to the hoppers, situated over the steam railroad tracks. This is handled by two 195-kw. machines, which operate either as motors or generators, according to the position of the load on the incline. The time that the machines are working as motors is perhaps not more than 10 to 15 sec., while the generating period lasts for several minutes.

The company operates a complete sawmill for furnishing all of the mine lumber, the machinery in the mill being all electrically driven.

The ore shipped to the port of Lulea is stored in stockpiles, since the port is open for only five months of the year. When required, it is loaded out by two Bucyrus 70-ton shovels, three 95-C Bucyrus shovels and one Vulcan shovel, all steam driven. At Narvik, two Bucyrus 95-C steam shovels are used in stockpile work.

The immediate direction of the company is in charge of Dr. Hj. Lundbohm, assisted by Thure Lindbohm and E. and Axel Dahleen.



ELECTRIC SHOVELS IN THE PIT

Bucyrus in foreground; German machine in background.

Volcanic Spat

By Cutler B. Whitwell*

The incident related here recently came to my notice. It needs no embellishment and indeed has been given none. It may serve as a warning to those investors who engage questionable engineers to examine and report on mining property.

The story is of the examination of a gravel mine in the early stage of development. The total of drifts and crosscuts would not require over four days for sampling.

The examining engineer belonged to that variety which looks upon the hard and seasoned practical miner with an air of superiority, and shows signs of impatience and annoyance if the latter ventures to intimate that he has acquired a little knowledge of mining. I was quickly made to realize that my presence, but nothing more, would be tolerated. Like his pipe he carried his swagger with him at all times. With an expression of ennui, probably intended to indicate that it was a beastly bore for a man of his superior intelligence to bother with such a small property, he suffered himself to be lowered underground to commence work.

In order to make certain that everything would be right,

*Mining engineer, Nevada City, Calif.

in case the ground had been prepared for his coming, he removed volumes of gravel from the places he expected to take his samples the following day. With this great show of caution, he ruthlessly left these nice, clean faces to the tender mercies of the night shift, while he reposed in peaceful slumber at the town hotel. However, at the end of several days everything was in readiness to collect the samples and start panning. After watching the foreman pan a moment, he removed the pan from his horny hands. The foreman, having only worked in the gravel mines of California about 20 years, had not been educated to the technicalities of panning. He was accustomed to run a pan of dirt down in 5 or 10 min. The new method required 45. He was informed that this insured the saving of every minute particle of gold. After patiently watching the new method for 15 or 20 min., he plucked up courage to bet his instructor that he had allowed a color to slip over the pan. This was answered by an almost imperceptible nod of the technical head and a scarcely audible "Oh, no, impossible!" However, the pupil grabbed several handfuls of gravel from the professor's tailings and proceeded to pan in his own natural way, while the professor flashed him sidelong glance of marked disapproval. What balm to the foreman when two small colors appeared in the pan. He turned, only to discover that the expert had found important business elsewhere.

By the time he had panned down his first lot of samples, it was very evident that the development work was proceeding a great deal faster than the engineer could collect and pan his samples. At the end of 10 days it was, therefore, deemed advisable to stop all work of development in the mine, otherwise the engineer would have a life job on his hands. Accordingly a telegram was sent to the head office for advice. While waiting for a reply to this telegram, the engineer lost his pipe. All hands were immediately called on deck and informed of the terrible loss. There was no other pipe like it in the world. He could not work unless he had a firm grip on his pipe, so he stood around in a helpless sort of way, making one round trip after another through the pockets of his coat, vest and trousers. When the patience of the men seemed exhausted, the lost member of the trio was found lying on the ground. The next day orders were received to stop the advance of the drifts and allow the engineer to complete his work. By this time it became necessary to relieve the monotony. A piece of brass was, therefore, melted in the forge and carelessly dropped among some sulphides and bits of quartz. In trying to remove a piece of dirt from the cooling mass a hole was made in it, which asumed the shape of a natural blow-hole. The final result was a perfect imitation of a wash nugget, about the size and shape of a Blue Point oyster, with particles of quartz and sulphides adhering in a most unsuspecting manner. The specimen was placed in one of the sacks of gravel which the E. M. had laid out for panning.

The following day the engineer was watched by a committee of two. In due time he reached the sack containing the nugget. After panning laboriously for a half hour, he perceived it, for he suddenly ceased gyrating the pan, which was the secret of his great success as a panner, and removed the obstruction. He examined it minutely with his glass, turning it over and over and finally, with a cautious look in all directions, he slipped the treasure into his vest pocket. The committee of two shook hands and carelessly approached the innocent one who, in the meantime, had resumed his panning. No mention was made of the wonderful nugget.

That evening a few of the foreman's friends, having been enlightened, were invited to meet the E.M. informally downtown. In due course of time, the subject of nuggets was introduced. The foreman and his friends had seen some fine specimens and the E.M. seemed to be getting the worst of it, when suddenly, with a mysterious air, he produced from his vest pocket his newly acquired wealth carefully wrapped in tissue paper.

"You people talk about nuggets, but I want to tell you that here is a class of specimen which none of you have ever seen before." He passed it over for inspection. With little persuasion he condescended to tell the history of the specimen.

"This is a very rare specimen of what we call 'volcanic spat.' True specimens of volcanic spat are very rare, and this is one of the finest. The localities from which they come are few. This one was formed by being shot from a volcano and made to assume its flattened shape on striking the ground. I found it about two years ago near an old crater about 10 ft. below the surface. If you will hand me a piece of string I will show you something interesting."

Upon being handed the string, he passed it through the hole which, by chance, was in the center of a long edge, causing it to balance perfectly. Allowing the "specimen" to hang suspended, the engineer remarked: "Note how beautifully nature has placed the blow-hole, making a perfect balance and a wonderfully valuable specimen for a watch charm. I would not take $50 for that specimen."

The following day the engineer departed, with the firm belief that he had slipped one over in getting away with the "nugget." He seemed so elated that he made no bones about stating that his report would be very favorable. I expect to see that report. If it is as full of romance as his tale of the "volcanic spat," it should be accorded a place among the masterpieces of the world's greatest fiction.

Radium Extraction

R. Sternlicht, in *Chem. Ztg.*, 1914, Vol. 38, p. 49 (through *Journ. Soc. Chem. Ind.*), states that the working of pitchblende (average uranium content, 45%) at the Austrian State radium factory, Joachimstahl, by the Curie-Debierne method gives at most 80% of the radium present, and, at the French factory of Armet de Lisle, uranium mica, uranium ocher, carnotite and autunite, in part decomposed directly with hydrochloric acid, yield about 70% of their radium content. Ebler's method of reduction with calcium hydride is criticized on the ground of expense and because loss of radium is liable to occur through reoxidation of sulphide to sulphate. The Ulzer-Sommer method gives yields of 97 to 98% and has been carried out on the large scale. The separation of radium and barium is usually effected by fractional crystallization; Ebler's absorption method is said to be little used at present. The total world's output of radium (mostly used in pharmaceutical preparations and radiation apparatus) is estimated at seven to eight grams per annum.

Gold Production in the Transvaal in September is reported by cable at $14,510,340. For the nine months ended Sept. 30 the total was $139,088,430 in 1913, and $128,753,430 in 1914; a decrease of $10,335,000, or 7.4%, this year.

Modern American Rock Drills--III

By L. O. Kellogg

SYNOPSIS—Chicago Pneumatic Tool Co. has brought out ball-valve drill. Cochise Machine Co. and Wood Drill Works make spool-valve machines. Holman makes auxiliary-valve drill with ball tappets; unusual chuck and leather piston ring. McKiernan-Terry puts out unusual type with "corliss" valve.

The Chicago Pneumatic Tool Co. has recently put on the market a line of drills using a ball valve. The piston-drill model called the "Gatling" is illustrated herewith. The valve chamber is cast integral with the cylinder, the valve cage and the ball valve are inserted in this chamber from one end. The valve controls the inlet only: for exhaust, large passages are provided in the walls of the cylinder, which are alternately opened and

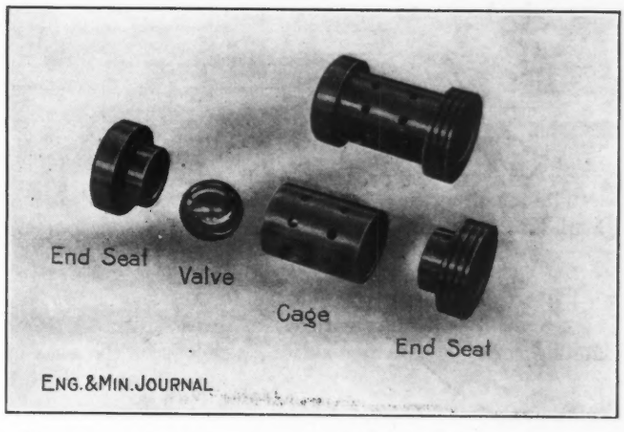
Chicago Pneumatic "Gatling" Model

closed by the piston head. The valve mechanism requires description in detail.

The component parts are shown in the illustrations. The valve itself is a hollow steel ball, 1¼ in. in diameter, weighing 2 oz. It has ⅛ in. of travel in the perforated cylindrical cage which is shown; the ends of the cage are reduced in section by plugs which act as seats for the valve. The radial perforations in the cage are open to live air at all times. With the ball seated against the left end of the cage, the air is permitted to pass out at the right end and through a port to the back of the cylinder, thus exerting a force to push the piston forward. The right half of the ball is under pressure and part of the left half also, all except that opposite the opening. As the piston moves forward, it finally passes the rear exhaust port. This exhaust area is greatly in excess of the inlet, consequently the pressure back of the piston drops with the outrush of air and the pressure on the right face of the ball drops also. The pressure on the left face of the ball is then sufficient to throw it over, and the live air supply is directed to the front of the cylinder, causing the piston to reverse and start its back stroke. The back-stroke movement is similar.

On the forward stroke, while a slight compression takes place, this amounts to only a few pounds and does not appreciably diminish the force of the blow. The forward motion of the piston closes the front exhaust port before the end of the stroke and there is thus a certain amount of air trapped in front of the cylinder, which aids in throwing over the ball. The piston is shown retracted so as to touch the back head. In practice, this position is not attained, since in the inclosed space behind the inlet ports air will be trapped and compressed, cushioning the return of the piston and giving it a start forward on its useful stroke. The valve permits a certain amount of short stroking. If the cylinder is fed forward, the piston will reciprocate as long as the rear exhaust port is uncovered by the piston head on its forward stroke, but if the exhaust port is not uncovered sufficient to reduce the pressure in the cylinder to atmosphere, the greater initial density of the entrapped air will result in the earlier reversal of the piston with corresponding increase in length of stroke.

The valve cage is held in the chamber by a screw plug, the forward end of which is hollow and perforated so as to allow the passage of the air to the rear-cylinder inlet



Chicago Pneumatic Ball Valve and Cage

ports. The plug has a projecting head notched at intervals so that a dowel from the back head can always be fitted to a notch when the plug is screwed to a seating, and thus lock it against rotation. There are inlets to the valve chamber on both sides of the valve itself.

The large ports for both exhaust and inlet air are a noteworthy feature. The exhaust ports are transverse slots covering a good-sized arc of the cylinder circumference, and bridged longitudinally of the cylinder, so that no single opening will admit a piston ring.

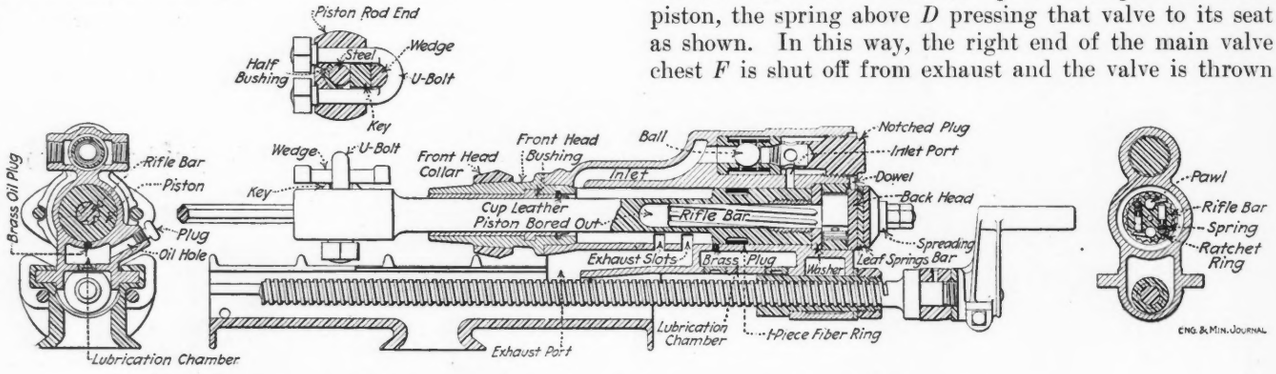
The parts of the front head shown in the assembled section, consist of a tapered collar clamping together the long tapered halves of the head proper and a long bush-

ing. The bushing is held to the head by a circumferential lug fitting a groove in the latter. A second groove provides a recess for the cup-leather packing which is used. As the tension comes on the through bolts, the taper of the head acts to bring all parts to a snug fit in the usual manner. The through bolts, holding together the front head, cylinder and back head, work against leaf springs at the back.

The rotation is of the outside-tooth type, the two pawls which are used being carried in the rifle bar itself. Slip under high stress is permitted. A five-flute rifle bar is used. The chuck is of the wedge type, and a half bushing to accommodate varying diameters and sections of steel is supplied.

For lubrication, a chamber is cast under the cylinder back of the exhaust port and is connected with the cylinder by a $^1/_{64}$-in. hole in a brass plug pressed into a hole in the casting. The oil escapes slowly to the cylinder through this hole, as a result of capillary action. This lubrication, it should be noted, does not reach the valve, but a ball valve does not require much lubrication.

The steel shell is of the one-piece type, i.e., without removable gibs, for the sake of lightness. The shell rods run the full length of the shell and pass through sleeves at the back for spacers.

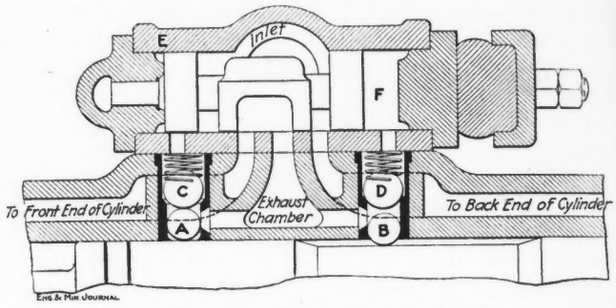


THE CHICAGO PNEUMATIC "GATLING," ASSEMBLED SECTIONS

The machine weighs 143 lb., has a 2¾-in. cylinder and a 6½-in. stroke.

HOLMAN DRILL

The Holman drill, introduced in America a few years ago, embodies some features of great interest. First among these is the valve action, which is of the auxiliary type, but different from others in use. It involves a main valve, which is a modified spool valve, and two sets of auxiliaries which are ball valves with ball tappets. A reference to the illustration will explain most of the features of the valve action. It represents the piston just

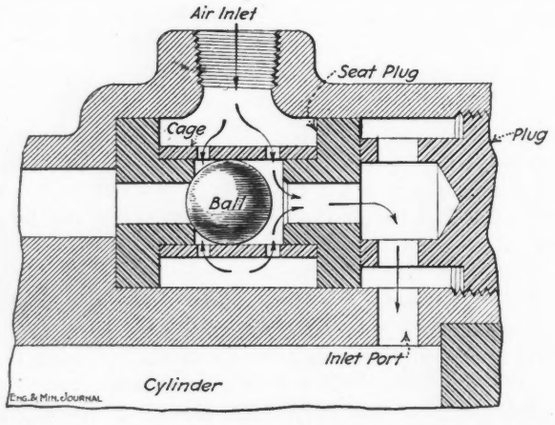


THE HOLMAN BALL-VALVE ACTION

started on its forward movement. The lower and smaller of the left-hand balls *A*, which is really a tappet, is lifted by the piston so as to lift the ball valve *C* above it against the pressure of the small spring and permit air to pass from the left end *E* of the main valve chest, past the ball *C*, and into the exhaust chamber. The right-hand tappet ball *B* is allowed to enter the spooled-out portion of the piston, the spring above *D* pressing that valve to its seat as shown. In this way, the right end of the main valve chest *F* is shut off from exhaust and the valve is thrown and held to the left. It will be noted that the spool valve is somewhat different from the typical spool valve, inasmuch as the two middle of the four spools are not continuous over the top of the valve, this part being cut off and horizontal partitions, as it were, being applied.

When the valve is at the left, as shown, live air is admitted to the port which carries it to the back of the cylinder, where it acts on the piston and throws it forward. Toward the end of the stroke, the tappet *A* is allowed to descend in the spooled-out portion of the piston, so that valve *C* is forced to its seat by its spring, shutting off that end of the spool valve from exhaust. At about the same time the tappet *B* is raised by the shoulder on the piston, and the valve *D* is also raised from its seat, so as to open the right end of the spool valve to exhaust. The valve will then throw to the right, and when the momentum of the piston has been overcome the return stroke will begin.

The valve balls are ⅞ in. in diameter, and the tappet balls are $^{9}/_{16}$ in., both of solid steel. A certain amount of rotation takes place whenever the balls are moved, so that the wear is not concentrated on any one point. Both sets of balls work in special seatings forced into the top of the cylinder. Since the spool valve is unsym-

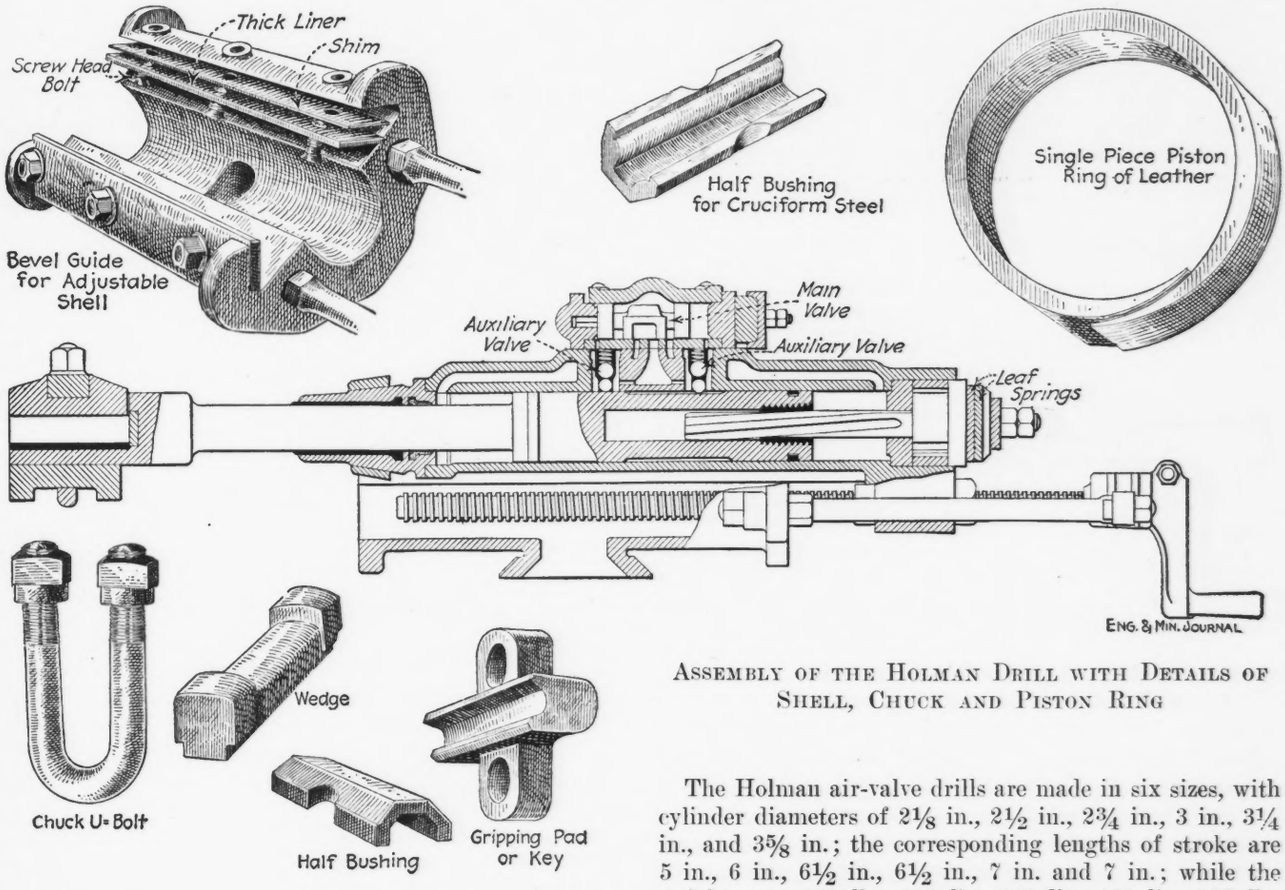


OPERATION OF THE CHICAGO PNEUMATIC CO.'S HOLLOW BALL VALVE

metrical, it is necessary that it be not allowed to rotate. For this reason, a squared end works in a square hole in one of the end plugs. The valve chest is closed with plugs which are kept to their seats by through bolts.

The piston head of the Holman drill is not unlike standard piston-heads, except that the piston rings are of leather instead of metal or fiber. They are of one piece and held out by leaf springs in the usual fashion. The leather is designed to decrease the wear on the cylinder walls and thus lengthen the life of the cylinder, before reboring is necessary.

the cylinder, and consequently the ways in the shell, are beveled instead of being rectangular, and the top of the inside of the shell way is lined with a rather thick piece of metal, held on by bolts having nuts outside and screw heads, well countersunk in the liner. When it is desired to take up wear, a shim is inserted between the liner and the gib proper, and the ways are thus brought to any desired degree of tightness. The studs or standards of the shell are of the short type, that is, they do not extend its full length. No special provision for lubrication is made.



ASSEMBLY OF THE HOLMAN DRILL WITH DETAILS OF SHELL, CHUCK AND PISTON RING

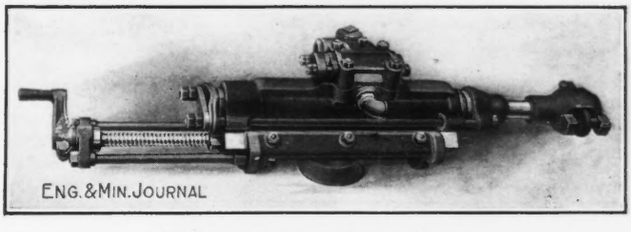
The Holman chuck is of great interest, as it differs from the standard chucks in this country. While it is of the wedge type, the wedge itself does not work against the key which bears on the steel. This key is on the other side of the chuck, and the half bushing is open on the side toward the key. The half bushing is notched on the sides and is held in the chuck by the U-bolt. There can also be furnished a special chuck made to take cruciform steel, as illustrated, a rather novel feature in piston-drill chuck design.

The rotation is of the type carrying the pawls in the rifle bar with the ratchet ring outside. It does not present features particularly different from standard design.

The front head consists of the outside collar with conical inner face, a split conical sleeve, a split bushing, and a cup leather. The through bolts holding the back and front heads to the cylinder work against two leaf-springs on the back head.

The shell, while it is of the fixed-gib type, is nevertheless designed to permit adjustment for wear. The lugs on

The Holman air-valve drills are made in six sizes, with cylinder diameters of 2⅛ in., 2½ in., 2¾ in., 3 in., 3¼ in., and 3⅝ in.; the corresponding lengths of stroke are 5 in., 6 in., 6½ in., 6½ in., 7 in. and 7 in.; while the weights are 100 lb., 140 lb., 180 lb., 250 lb., 295 lb.,



THE HOLMAN PISTON DRILL

380 lb., respectively. The valve action described, however, is applied only to the largest sizes.

McKIERNAN-TERRY CORLISS VALVE

On one of its piston-drill models the McKiernan-Terry Drill Co. has used a valve action so different from any other in common use that it deserves special description. It is a tappet-actuated rotary valve, called a "corliss" valve. This lies along the top of the cylinder, extending practically its full length. It is made in three sections

for convenience in fitting and machining, but acts as a unit, inasmuch as the ends of the adjoining sections are tongue-and-grooved together. The valve chest may or may not be cast as a part of the cylinder, depending on its size. Into each end of this chest is forced a

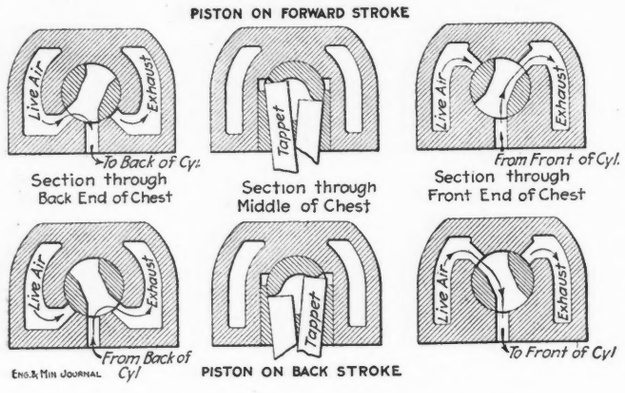
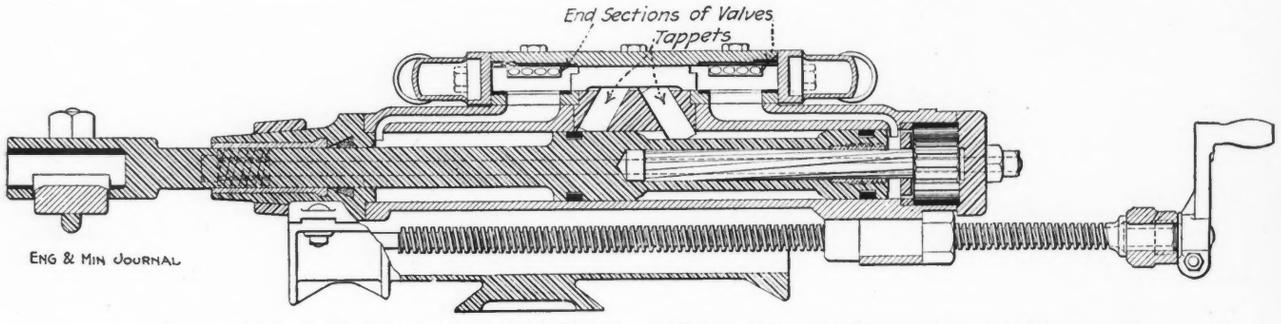


DIAGRAM OF CORLISS VALVE ACTION

The central portion of the valve does not have anything to do with the passage of the air, but merely receives the thrust of the tappets which effect the turning. These tappets work in a steel block machined to fit both the valve chest and the cylinder top; the tappets slide in two inclined slots, their lower ends being in a line along the top of the cylinder. The beveled ends of the spooled-out portion of the piston head strike the bottom ends of the tappets, which are thus forced up and strike alternately the sides of the center section of the valve. The lower part of the valve is made concave, so that a rounded edge is formed on each side. It is this edge which the tappet strikes. A blow on one tappet rotates the valve in one direction, and one on the other tappet rotates it in the other direction, the air pressure being thus alternately directed to the front or back of the piston and reciprocation established. The outline of the cross-section of this central portion is such that the angular velocity of the valve in turning is at a minimum at the beginning of movement and increases constantly until the movement is completed, thus reducing the shock of the

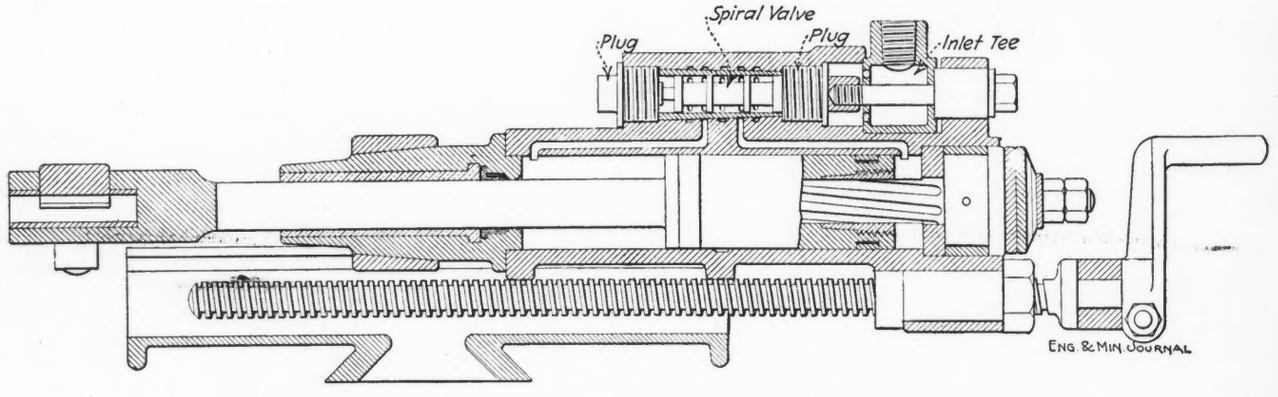


LONGITUDINAL SECTION OF THE MCKIERNAN-TERRY CORLISS-VALVE PISTON MACHINE

slotted bushing, the slots corresponding to slots in the chest, which communicate with live air, exhaust and the cylinder. The bushing is of hardened steel ground to a close fit on the valve. The two end sections of the valve, which work in the bushing, are slotted so that by turning, the slots establish communication between the exhaust and the cylinder or the live air and the cylinder, acting on the principle of the three-way valve. The cut parts of the bushing give a clear, sharp opening for inlet and exhaust. The valve is balanced by having the ports slotted through to the back of the valve, giving equal area on each side and reducing the friction of turning. The easier turning decreases wear and results in a longer life.

impact of the tappets and prolonging the life of the valve

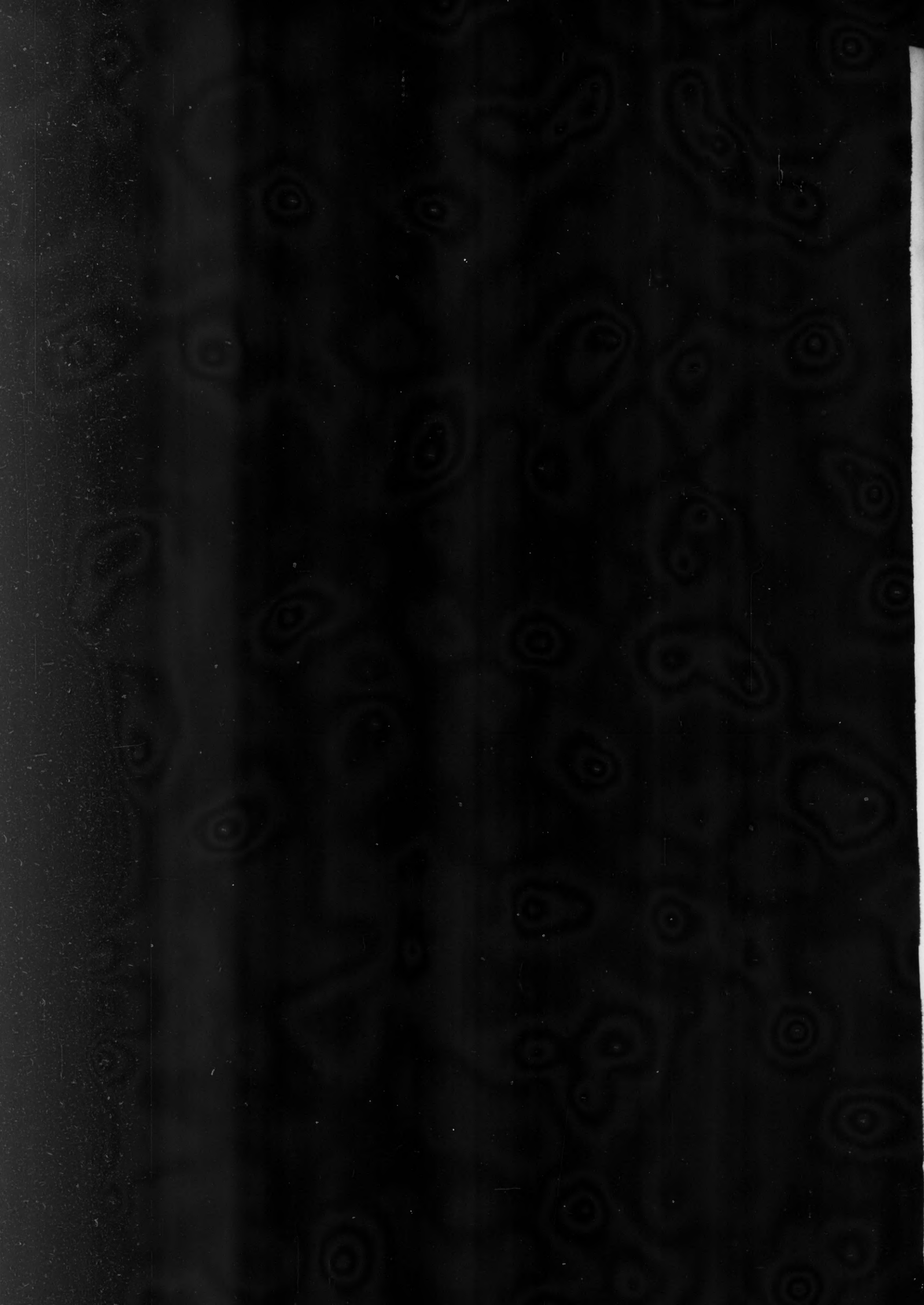
This tappet valve, like others, will not short stroke to the extent that fluid-actuated valves will, but the stroke can be reduced nearly 35% by feeding the cylinder forward until the piston just passes the operating point on the forward stroke. It is not so liable to breakage as many other types of tappet valves are, and is also balanced so as to be thrown with the greatest ease.



LONGITUDINAL SECTION THROUGH THE COCHISE PISTON MACHINE

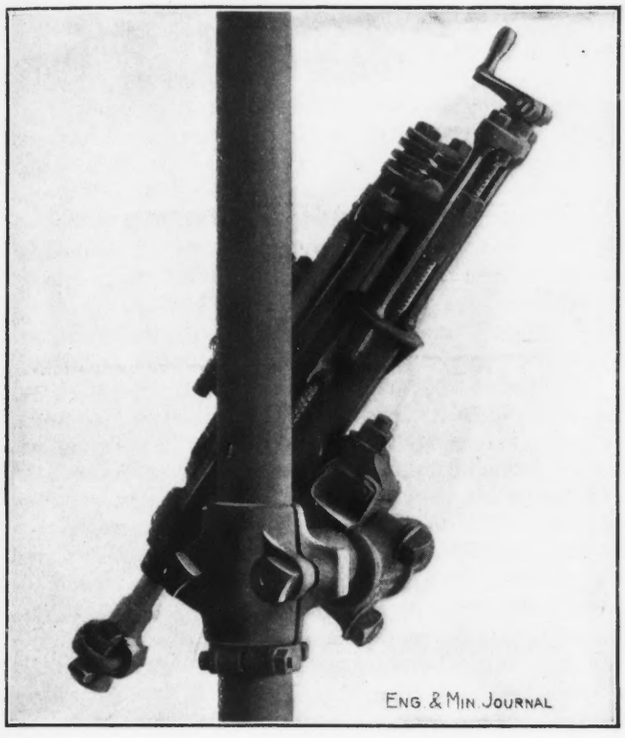
COCHISE DRILL

The Cochise Machine Co., of Los Angeles, puts out a piston machine using a four-spool valve without an auxiliary valve. The valve chest is cast with the cylinder.



At the back end is secured an inlet tee which can be revolved so as to bring the inlet on either side or on the top. This is shown in the drawing on top. The front end of the tee is perforated with small holes so as to act as a strainer and exclude foreign material from the valve or the cylinder.

The valve slides in a bushing and seats against screw plugs in either end. Side passages connect the inlet tee



THE WOOD PISTON DRILL

with the center of the valve chest and carry the air to this point. The drawing shows the inlet ports from the valve chest to the two ends of the cylinder. Other small ports connect the cylinder with the ends of the valve chest and serve to throw the valve when uncovered by the piston.

The construction of the front head is apparent from the drawing. The through bolts have helical springs at the front-head collar. The piston is not spooled out in the center, but is maintained at uniform diameter. It has two two-piece piston rings, however. The rotation has the ratchet teeth on the surrounding ring. The chest is of the usual type, with or without a wedge. The shell has adjustable gibs.

Lubrication is taken care of by a chamber connected with the inlet tee, whence the oil is fed automatically into the entering air.

The machine is built in three sizes: One with a 2½-in. cylinder and a 5-in. stroke, weighing 126 lb.; one with a 2¾-in. cylinder and a 6¼-in. stroke, weighing 159 lb., and one with a 3¼-in. cylinder and a 6½-in. stroke, weighing 220 pounds.

THE WOOD ROCK DRILL

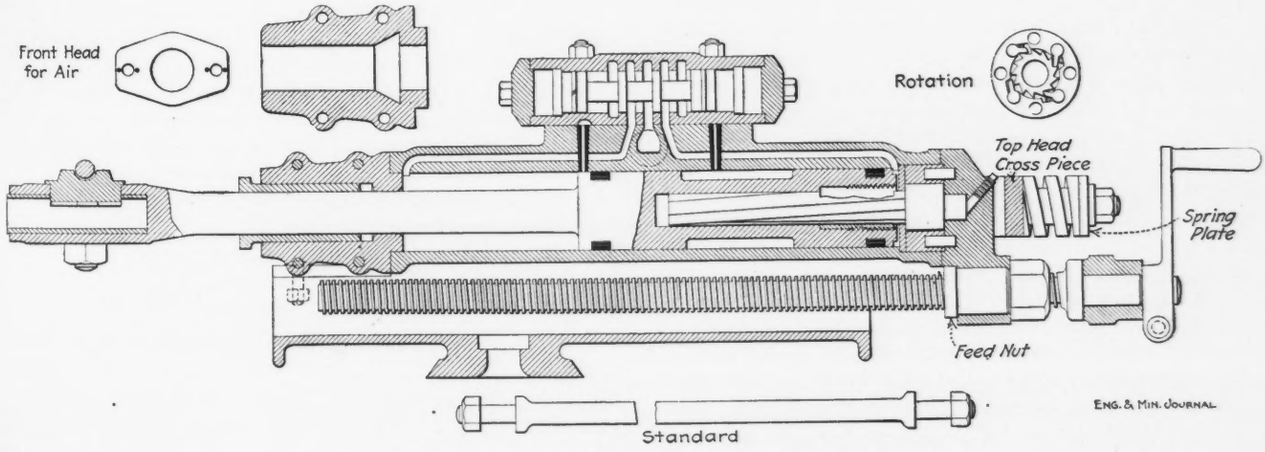
The Wood Drill Works makes a spool-valve piston machine. The general features of the machine are shown in the illustrations. The valve has four spools and is made as light as possible, so as to throw easily and with little shock. The rotation mechanism has the ratchet teeth on the bar, while the pawls are in a surrounding pawl holder. The rotation is positive, but a release is furnished when desired. The chuck bushing has an unhardened strip left in it, which can be sheared with a chisel when it is to be removed.

The side-rod springs are placed at the back and cross-pieces between the rods are used to keep them in alignment. The feed nut is applied to the back head instead of to the cylinder. The shell rods or standards are made with nuts on both ends, and the lower nut is held in a recess in the shell which prevents it from falling out and down the hole.

(To be continued)

Houghton Copper Co.

The 1913 report of the Houghton Copper Co., Winona, Mich., shows receipts of $50,483, all of which came from assessments, except $227. Expenditures and debts paid for the year amounted to $35,218, leaving a balance of $15,265 on hand at the end of the year. The total drifting for the year was 1331 ft. and a winze was sunk 98 ft. The shaft was also sunk 14 ft. Work was resumed again after the strike was ended.



THE WOOD ROCK DRILL, SECTION AND DETAILS

The Commercial Classification of Refined Copper*

SYNOPSIS—The characteristics of copper determine the field in which it may be used; for electrical purposes there is little choice between high-conductivity Lake and electrolytic copper. Low-conductivity Lake copper, really an alloy of copper with arsenic, has certain desirable properties for special uses. Casting coppers vary greatly. There are three general classes of impurities, the effects of which are discussed, as are also the physical defects of refined copper.

Any adequate classification of a material, such as copper, must take into account both the limitations of the metallurgical processes by which the material has been obtained and the needs of the manufacturing processes in which it is to be employed. The metallurgical methods depend upon the nature of the ores or other sources of supply and the manufacturing ones upon the ultimate uses of the finished product.

The world's copper supply comes from four main sources, sulphide ores, oxidized ores, native ores and scrap. Perhaps the chief chemical characteristic of copper is its affinity for sulphur and the largest deposits of copper ores consist of more or less complex sulphides. Near the surface these ores are frequently altered to oxides and carbonates by atmospheric influence and there are also large deposits entirely free from sulphur. Native copper ores where the copper exists as free metal, occur in various parts of the world in small quantities, but notably in the enormous deposits in the northern peninsula of Michigan, the source of the so called Lake copper.

Three General Processes of Ore Smelting

Metallurgically there are three typical processes for producing crude or unrefined copper from the ore, based on the general principles of oxidizing sulphides and reducing oxides: (*A*) Roasting, smelting and converting, (*B*) alternate oxidation and reduction, and (*C*) direct reduction of oxidized ores. (*A*) which is a strongly oxidizing process by which the great majority of the American production is made from sulphide ores, results in the almost complete elimination of impurities which have volatile oxides, including some of the worst enemies of refined copper, such as arsenic. Converter bar nearly always runs 99% copper plus silver, and is not likely to carry more than a few hundredths of a per cent. of any impurity but nickel. (*B*) is the old Welsh process, still used to some extent abroad, based upon the reaction between copper oxides and sulphides to eliminate sulphur as sulphur-dioxide gas and carried out in a long series of roasts and fusions in reverberatory furnaces. The removal of impurities is here imperfect, although they may be to a certain extent segregrated in a portion of the product, whence the origin of the "best selected" copper of Great Britain. (*C*) When the ores are wholly oxidized the copper may be recovered by direct reduction in a blast furnace and as this is a strictly reducing process, the resulting black copper seldom runs over 96%, due to iron and other impurities reduced.

*A paper by Lawrence Addicks, read at the American Institute of Metals, Chicago meeting, Sept. 11-15, 1914.

Except in the case of "best selected" and similar English coppers, all the products from the foregoing processes are given a further treatment or refining, which may be broadly divided into furnace or fire refining and electrolytic refining.

Fire Refining

Fire refining is based upon the scorifying effect of cuprous oxide upon base metals contained in a bath of molten copper. The crude copper is melted in a reverberatory furnace and air blown into the bath. Cuprous oxide rapidly forms and dissolves in the bath, the blowing being stopped at or before the saturation point. In this way oxygen is carried to all parts of the molten bath, and when there are any metals present which are more easily oxidized than copper, cuprous oxide is reduced back to copper and the oxide of the impurity is formed. If this oxide is not soluble in the molten copper, it will float to the surface where it may be removed by skimming. As copper stands high among metals in the order of nobility, the metallic impurities with the exception of the precious metals may be readily removed in theory. In practice, while elimination proceeds rapidly while considerable quantities of impurities are present, the rate diminishes until traces are reached which cannot be slagged off with any reasonable amount of scorifying. Therefore furnace refining is limited in its application to relatively pure crude copper unless a low-grade refined copper is contemplated. Less than $10 worth of silver and gold per ton will justify electrolytic refining.

Returning to the bath of molten copper, which has been skimmed clean, it is necessary to reduce the excess cuprous oxide dissolved, and no better way has yet been devised than the old Welsh process of covering the bath with a protecting layer of charcoal or low-sulphur coke and then forcing the butts of green trees or poles of hardwood beneath the surface by means of suitable tackle. The cuprous oxide is reduced in this way until a normal amount corresponding to an oxygen content of from 0.04 to 0.07% is left when the copper develops its best physical characteristics, the condition of the copper being followed by the appearance of the fracture of small buttons cast in a spoon, which is a sort of ductility test, and by the swell or depression of the surface of an ingot as it cools, which indicates the gas content. The copper is then cast, usually by machine.

Electrolytic Refining Following Fire Refining

When the copper is to be electrolytically refined it is first given a rough furnace refining and cast into anode plates, which are then electrolyzed in a strongly acid solution of copper sulphate. The same order of nobility applies, but the great preponderance of copper over the impurities is now an aid as it assists the selective action of the current in depositing only copper at the cathode. Silver and gold are also saved as they are insoluble in the electrolyte chosen and fall to the bottom of the tank as anode mud or slimes, to be separately refined and parted.

It is quite evident that copper entering an electrolytic refinery must entirely lose its identity and that the purity of the resulting cathode copper will depend upon the conditions under which electrolysis is carried out rather than upon the momentary quality of the day's anodes. Therefore it is not necessary to consider whether the input be converter bar, black copper or Lake "mineral" when buying electrolytic, but simply whether the product meets the accepted standards of quality for electrolytic copper.

Electrolytic cathodes generally run about 99.95% copper, much of the missing 0.05% probably being hydrogen. The metallic impurities generally total about 0.02%. Except for the fact that individual cathodes may vary more or less in impurity content, they are ideal material for brass making. Copper producers, however, have never encouraged the sale of cathodes, as there is apt to be some shrinkage in weight during shipment, owing to the comparative ease with which nodules or small pieces can be detached either accidentally or intentionally.

Melting is done in a reverberatory furnace and originally was an exact duplication of the fire refining already described. As the cathode copper is already pure, a simple melting is all that should be required, but molten copper is so susceptible to contamination that until recently the gases from combustion, iron in the rabbles, etc., were absorbed to a sufficient extent to require actual refining. At the present time large quantities of cathodes are being added to the molten charge during ladling and earlier, basic furnaces are being substituted for acid ones, thereby suppressing slag formation, and attention is being paid to keeping coal ashes from blowing over from the firebox, so that a true melting without refining is being approached. It is well known that cathode copper when drawn into wire will show an electrical conductivity some 2% higher than the same copper after a subsequent fire refining. This is probably due partly to the fact that chemical impurities in the cathode are chiefly present as a mechanical mixture due to adherence of anode slimes which are dissolved in the copper when melted, making a high resistance matrix around the copper crystals when the metal is cast and cooled; and partly to contamination during melting. It seems probable that the conductivity of perfectly pure, soft copper is in the neighborhood of 103% of the Matthiessen standard in common use.

Lake and Electrolytic Copper

Lake ores are low-grade native-copper deposits, which are mechanically concentrated to an 85% "mineral." This is melted and, after skimming off the slag formed by the remaining gangue, is given a fire refining as previously described. The Michigan mines are among the oldest, largest and deepest in the world. Thirty years ago, Lake copper was the standard of the industry. The surface ores were remarkably free from objectionable impurities and copper of the highest conductivity was readily produced. The first electrolytic copper to come on the market was of irregular character, due to lack of familiarity with the principles of this new process, and for a considerable time Lake copper was deservedly considered superior. With increasing depth, however, many of the mines showed increasing quantities of arsenic, and, indeed, all Lake copper may be considered as arsenical copper, although in some brands the arsenic is very low. The result was that electrolytic copper began to take precedence for electrical work, as its conductivity could be absolutely depended upon, and Lake began to fall back upon superior "working" qualities, a term which defied exact definition.

It is now generally admitted that high-conductivity Lake copper cannot be distinguished from electrolytic copper, while low-conductivity Lake is really an alloy of copper with arsenic, which has certain desirable properties for special uses. Nearly all the elements which markedly depress the conductivity when alloyed with copper are helpful in developing desirable mechanical properties, for example, phosphorus, aluminum and silica. High arsenical copper, running about 0.4% arsenic, has now a special market for making firebox plates in Germany, and uses are beginning to be found for the intermediate grades.

One of the large Lake companies maintains its own electrolytic refinery, and in this way recovers a small amount of silver and eliminates the arsenic, the product still being classed on the market as Lake, although it is equally electrolytic. The old prejudice in favor of Lake on general principles has now largely died out, but only with the contemporaneous retirement of the older generation of wire-mill managers. Lake copper should be clearly graded by arsenic contents into a series of alloy coppers, the class at one end competing with electrolytic on its own ground, and the other classes sold in competition with arsenical copper from other sources, a field which has only lately been properly appreciated.

Casting Copper

The last class of copper produced which we have to consider is that generally known as casting copper, a very loose term covering a multitude of sins. There are three main sources of casting copper: From converter bar or black copper from smelters, whose ore supply carries quantities of silver and gold insufficient to pay for refining; byproduct copper not up to standard electrolytic grade occasionally produced by refineries; and the result of smelting scrap reclaimed from all sorts of new and old work. The first is often of excellent quality, one well known brand being maintained at 99.80% Cu or better, and is generally comparable with English best selected. The second class is generally an arsenical copper and is not now often seen as the refineries are nowadays able to eliminate arsenic from the process in other ways. The third class is generally foul, but often suitable for common castings as the impurities help the founding, pure copper being a difficult metal to handle in a foundry. The copper contents may run below 99% Cu, however. About the one thing that can be said of casting copper is that neither a conductivity nor a ductility test is applicable in the nature of things.

Copper Used in Five Fields

Turning now to the uses for copper, they may be broadly classified as follows: (a) Wire and other shapes for electrical purposes; (b) sheets and plates for non-electrical uses; (c) copper castings, generally for electrical use; (d) in alloys, such as brass and bronze; (e) special purposes for which small quantities of alloyed impurities may be advantageous.

Electrical use immediately imposes a conductivity requirement which rules out everything but electrolytic and high-conductivity Lake, which, as before stated, are practically identical. Most of the electrolytic refineries figure on averaging about 100% soft in the electrical

conductivity of their outputs. Occasional lots may reach nearly to 101% and some may approach 99%, while 98.5% is the usual rejection limit, but it is unusual for a refinery to ship anything for electrical use which is below 99%. No distinction is made between cakes, wirebars and ingots, more than one shape often being cast from a single furnace charge, so that there is nothing to be gained by ordering wirebars and then cutting them up, when ingots are desired. Unless electrical use is specified, it is customary to allow an additional leeway of 1% in conductivity to the refiner, but he rarely needs this and prefers to maintain the higher standard, as copper is often resold several times before it comes into the hands of the actual user. As copper from a single furnace charge will carry practically uniform chemical impurities, shipments on an individual order should be filled from as few furnace charges as possible and all wire bars and cakes should be stamped with marks identifying these charges. The refiner will always consider complaints on a furnace-charge basis if they are of a chemical nature. If they are indefinite he will generally investigate what other customers received copper from the charge complained of, and in the absence of other complaints will demand a bill of particulars before giving the matter serious consideration. The conductivity of a furnace charge is generally determined at the refinery several times while the charge is being cast and this precaution, together with the ample margin above rejection limits which is maintained, have practically abolished conductivity complaints.

Three General Classes of Impurities

When the copper is not to be put to an electrical use conductivity is of no special value except as a certificate of the absence of more than a trace of a certain class of impurities. The refiner divides impurities into three classes; those that depress conductivity, such as arsenic and antimony; those that impair ductility, such as lead, tellurium and bismuth; and those which are of value if reclaimed, such as silver, gold, platinum and palladium. The elements which depress conductivity are kept within bounds by the conductivity test regularly made. Those which are of value if reclaimed will never reach quantities sufficient to affect the physical properties of the copper, as it would pay to re-refine any such copper. The remaining class, comprising elements which impair ductility, is more difficult to deal with. We know that bismuth, lead, tellurium and probably selenium make copper brittle even when present in very small quantities. We do not know, however, how to write a specification limiting these impurities as the presence of small amounts of other impurities will neutralize their bad effects. We do know that amounts of lead up to 0.005% have no perceptible effect in mill practice or in alloys. Double this amount shows mild effects. Lead is about the only one of the group ever met with in sufficient quantity to be of interest. As these elements are practically insoluble in copper, their effect on the conductivity is directly proportional to the amount present and consequently negligible.

It must be understood that an element like lead is always present in small amounts in refined copper and the mere fact of its presence as shown by a delicate qualitative test is no basis for complaint. It should be further borne in mind that the determination of the small quantities of impurities in refined copper quantitatively can only be done with even reasonable accuracy by a chemist who has had large experience in this particular work. A representative analysis of refined electrolytic copper would be somewhat as follows:

Conductivity (annealed)	100.0 %
Copper	99.93000%
Silver	0.00100%
Gold	0.00001%
Sulphur	0.00300%
Oxygen	0.04000%
Iron	0.00350%
Nickel	0.00400%
Arsenic	0.00200%
Antimony	0.00300%
Aluminum	0.00100%
Phosphorus	Trace
Lead	0.00200%
Bismuth	Trace
Selenium	0.00050%
Tellurium	0.00050%
Total	99.99051%

It will be seen that oxygen is the chief impurity. It has been pretty conclusively shown that too much oxygen makes the copper harder and affects the annealing temperature, the tensile strength of wire and the number of breaks in a wire machine. This may be due to some surface effect as the "set" surface of a wire bar has a greater oxygen content than the body of the bar and as the oxygen content increases it is possible that this oxidized layer becomes thicker. Another point about high oxygen is that it corresponds to low copper and to that extent is sold as copper. In brass making, the "set" or "pitch" of the ingot is of no consequence except when the most careful work is done when melting in the foundry to avoid further absorption of oxyyen. It is obviously useless to impose rigid conditions upon the refiner if the same conditions are not observed in the remelting and it is only at the largest and best equipped brass foundries that such conditions are even approached. When zinc is introduced into molten copper it acts as a deoxidizing agent forming zinc oxide. If the copper is kept at high pitch, this source of zinc loss and dirty brass can be greatly diminished and this fact has resulted in a demand for high-copper ingots.

It has therefore become a general custom to specify that the copper contents of refined copper shall not be less than 99.88%, which really means 99.90%, allowing 0.02% for assay variations. As this is a rejection point, the actual average content is expected to be between 99.02 and 99.94%.

When we come to casting copper, a greater leeway must be allowed, as already pointed out. In fact, except in considering the price charged for the material, copper contents have but little to do with casting copper. It is best to buy this material on the basis of known brands after finding what brands yield good results in the particular class of work and then insist upon uniform deliveries, judging the material by chemical analysis of the chief impurities.

Physical Defects of Refined Copper

The physical defects of refined copper are many. Practically all cast copper is porous, doubtless due to the discharge of dissolved gases as the copper cools.

This is analogous to the "piping" of steel ingots but is not so pronounced because copper is cast in a shallow mold instead of on end. These microscopic bubbles are doubtless the cause of roughness in wire. Then there is a class of defects inseparable from ladling, consisting of cold sets and splashes where the copper has run up on the mold and chilled before the main body of metal reaches that point. Then there is porosity or sponginess of the surface due to the mold being either too hot or too cold. Another

defect is raised edges on the set surface, generally due to slightly lowered pitch corresponding to excessive oxygen content of the copper. Should the pitch drop still lower, "nigger heads," or little black spots, will appear. These are the outlets of gas cavities extending some distance into the copper. On the other hand, should the oxygen content be too low, the surface of the bar rises and finally breaks open or "spews," an even worse condition.

Many of these defects are always present in more or less degree. Mechanically ladled copper can never be perfect. Specifications require that copper shall be free from mechanical defects, but a reasonable attitude regarding minor troubles on individual pieces is generally necessary to the peace of mind of a buyer. On the other hand, a refinery occasionally becomes careless in such matters and will send out some surprisingly bad work, so that careful, systematic inspection, combined with an attitude of friendly criticism, is the best way for a copper producer and a copper user to live together.

Working a Placer Deposit Underground

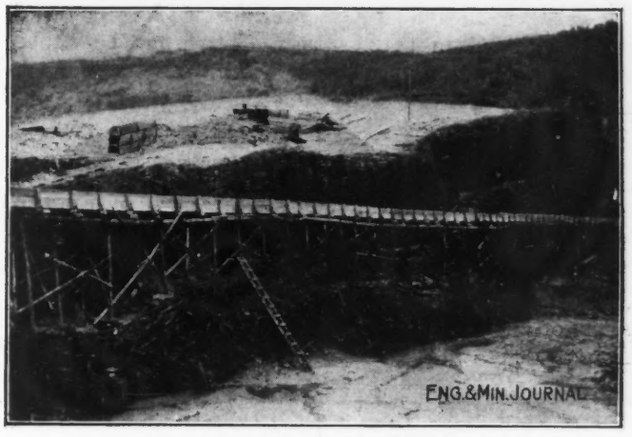
SPECIAL CORRESPONDENCE

About four miles from Dawson, Y. T., the Barnes tunnel is driven into the mountain on the east side of Bonanza Creek. At this point the gold-bearing gravel is cemented until it resembles a conglomerate, and being frozen, permits of regular room-and-pillar mining. The whole development is analogous to that of a coal mine, having air courses driven parallel to the main and cross entries, and a break-through every 50 feet.

Since the entire mountain is frozen, no timbering is necessary, except where a number of miners are working in one place, when the heat from their bodies and lights causes more or less spalling, and temporary timbers are set for safety. Also when pillars are being drawn the main haulway is safeguarded by posts set in the gob.

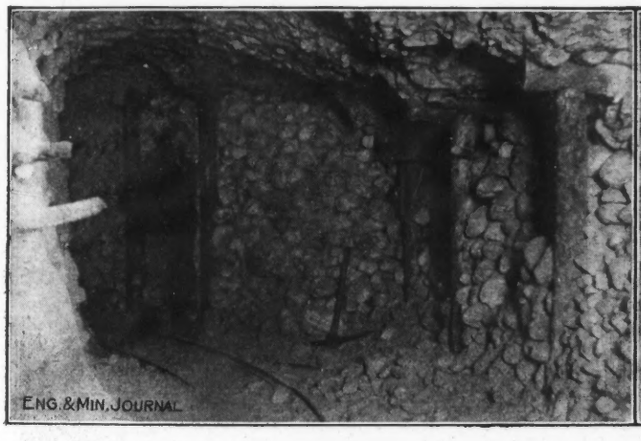
The excavation is carried about 6 in. below the top of the bedrock, and 5 ft. 6 in. of overlying gravel is removed, leaving 6 ft. clearance. The gravel and bedrock above and below this horizon carry no gold. A peculiar feature which may be noticed in entries where work has been stopped for some weeks is that the top and sides never squeeze, but the bedrock bottom will "puck" if the surrounding pressures remain constant.

The miners loosen the frozen material with heavy picks, fork out the large boulders, and load the fine gravel, containing the gold, into the cars. It is then wheeled out and dumped into a large pile under which the sluice boxes and riffles have been built. Water for washing is impounded in a small reservoir at the head of the gulch and the dump may be washed at such intervals during the summer as water may be available.

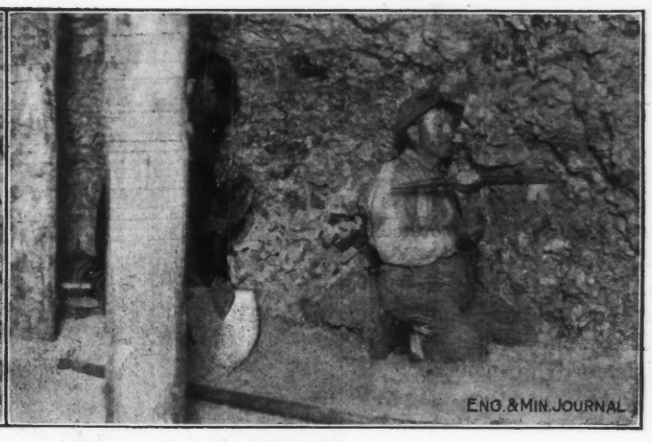


CRIBBING TO PROTECT ADJOINING CLAIMS FROM TAILINGS AND TO PRESERVE WATER RIGHTS

The mine was developed by Alfred Barnes, of Dawson.



LARGE BOULDERS USED FOR GOBBING IN BARNES TUNNEL



MINING FROZEN GROUND WITHOUT BLASTING OR THAWING

The average cleanups during the past 18 months have been about $2 per cu.yd. The mine is operated throughout the year but as water can only be obtained or used during the five months of open season, the year's cleanups are made during that period.

Explosives in the United States

"The Production of Explosives in the United States during the Calendar Year 1913," has just been published by the U. S. Bureau of Mines. The total production of explosives, according to the figures received from manufacturers, was as follows, in pounds:

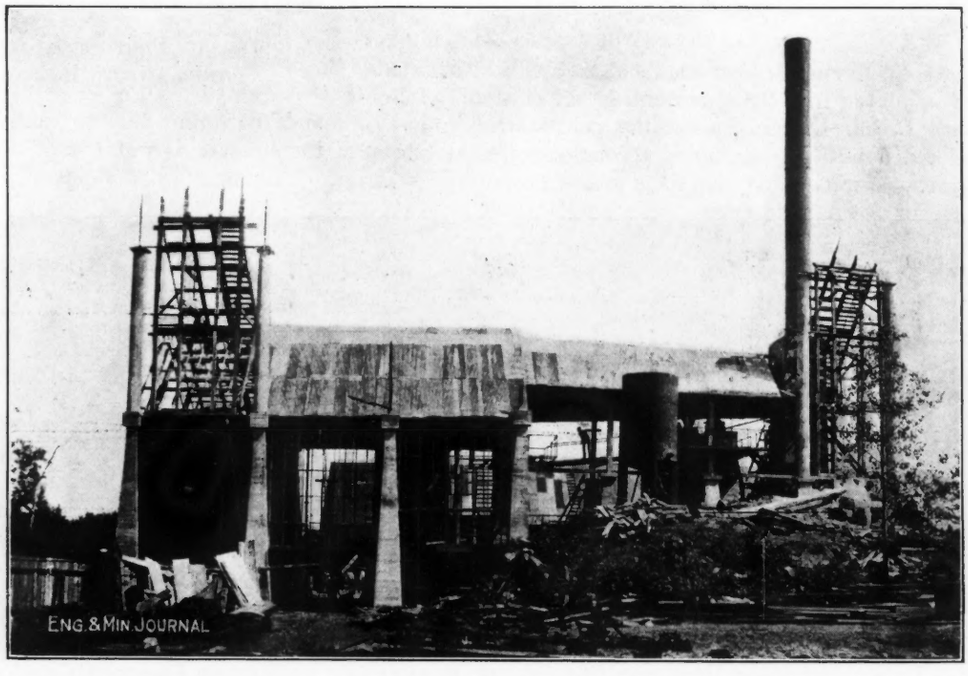
	1912	1913	Changes
Black powder	230,293,369	194,146,747	D. 36,146,622
High explosives	234,469,492	241,682,364	I. 7,212,872
Permissible explosives	24,630,270	27,685,770	I. 3,055,500
Total	489,393,131	463,514,881	D. 25,878,250

In 1902, only 11,300 lb. of permissible explosives were used in coal mining, whereas in 1913 the quantity so used was 21,804,285 lb. The quantity of permissible explosives used in the United States in 1912 represented about 5% of the total quantity of explosives produced, and in 1913, 6%. The total amount of explosives used for the production of coal in 1913 was 209,352,938 lb., of which about 10% was of the permissible class, as compared with 8% in 1912. The use of permissible explosives in coal mining has had gratifying results, and few serious accidents can be attributed directly to their use.

New Metals Process Company

SPECIAL CORRESPONDENCE

Experiments were conducted by J. T. Jones, Iron Mountain, Mich., some time ago, with the Jones furnace and Jones step process. The original furnace consisted solely of a long tube which pitched slightly and revolved slowly. This was lined with heat-resisting material of some sort. The ore and fuel were fed into the upper end at constant speed and the metallized product was taken out of the lower end. Subsequent treatment separated the metallic iron from whatever gangue there was. The principal difficulty with this furnace, or rather with its operation, lay in the inability to secure a lining material that would withstand the cutting action of the ore and fuel as it revolved at the high temperature that was necessary to produce the desired results. All sorts of linings were tried without success. Some of these would stand up satisfactorily to about 2000° F. However, it was necessary to reach 3000°, and the range between 2000° and 3000° destroyed the lining. These conditions led to further experiments, which were conducted in Salt Lake City. As a result of these, some important changes have been made in the process, and are being embodied in an experimental plant, which is being erected on a rather large scale, at Marquette, Mich., by the New Metals Process Co. The company itself has the financial backing of J. M. Longyear, of Marquette, Mich., the well known operator in the Lake Superior district. The construction work is in charge of Arthur J. Jones, assistant engineer.



PLANT OF THE NEW METALS PROCESS CO., MARQUETTE, MICH.

The feature of the plant now under construction, which differs entirely from the original furnace, is the vertical stack to be used, which forms a second step in the process of reduction. The long revolving tube is retained, and is 60 ft. long, 6 ft. in diameter, and pitches ¾ in. in 1 ft. It will be lined with a special firebrick and will make a complete revolution in two minutes. It rests on concrete piers at a considerable height from the ground, and will be rotated by electrically driven machinery. The ore and the fuel, which in this case will be cord wood, will be fed into the upper end of this tube, having been raised by mechanically operated skips. The lower end of this skiproad terminates in a pit in the stockhouse, into which the ore is brought by railroad cars which dump from a trestle on to the concrete floor, and the ore is then shoveled from the floor into the skip. The revolving tube retains this mixture of ore and fuel, and in traversing the tube it is heated up to approximately 2000° F. At this juncture it reaches the lower end of the tube and is dumped into the top of the vertical stack.

This stack is not unlike a small blast furnace or cupola in general appearance. It is 30 ft. high from the base to top, 12 ft. diameter, and the lower 24-ft. section is lined with firebrick, with a special block at the bottom. The stack is provided with tuyeres, and at this point the furnace is water-jacketed. A most interesting feature, also, is the fact that only natural draft is to be used through these tuyeres, no blower being employed; further, that although the draft will enter at the tuyeres, the interior design of the stack is such that the latter is really a downdraft stack. In this stack, the product of the revolving tube is heated from 2000° to 3000° F. By having a stationary furnace at this step in the process, it is claimed the difficulty of excessive wear on the lining has been overcome. The product of this stack, which is metallized ore and gangue, is pulled out at the bottom into water carriages, and the contact with the water breaks up the material. It will then be hoisted by bucket elevator to two of a set of four steel storage tanks, from which it will feed by gravity to a crusher. The crusher product will also be raised by bucket elevator to the remaining two tanks. From these it will feed by gravity to electro-magnetic separators which will separate the metallized iron from its gangue, which consists of silica, sulphur, phosphorus, etc. It should be remembered that these constituents are mechanically and not chemically combined.

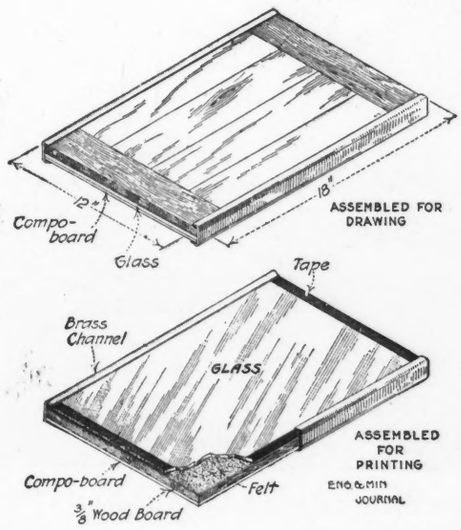
Details of Practical Mining

Portable Combined Blueprint Frame and Drafting Board

By Frederick W. Foote*

Many engineers engaged in examination work have felt the need of tracings and blueprints to accompany their reports and often have had to wait to make them until a place was reached where there were facilities—with inconvenience to themselves and loss of valuable time.

To eliminate this trouble I devised an outfit which I have found serviceable. It is light and compact, fitting in a suitcase, and performs well the work required of it. It consists of a drawing board, 12x18 in., built with end cleats rather than back cleats; a piece of "Compo" board; a piece of clear glass of the same dimensions; and two channels of brass, 18 in. long and of the desired thickness.



Manner of Assembling for Drawing and for Printing

The drawing board is ⅜ in. thick. If made up of several narrow strips and held together by the end cleats, the danger of warping is greatly reduced. One side is dressed for drawing and the other side is covered with felt. The glass is bound on the edges with adhesive tape to prevent chipping and lessen the danger of cracking where the channels come in contact with it. The channels are of sufficient depth to accomodate the board, glass, "Compo" board, a reasonable amount of tracing cloth, drawing paper and blueprint paper, the latter being kept in a black-lined to protect it from the ligth.

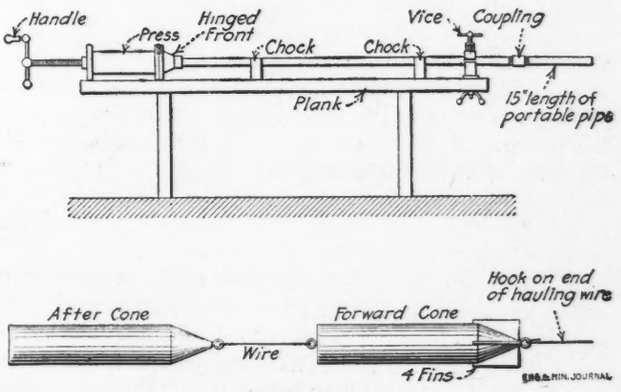
The drawings show the outfit assembled with the glass inside, for use as a drawing board; and also with the glass outside for blueprinting. Thus assembled, it can be set up in any window-sill in the sun and the blueprints washed in the bathtub if the engineer is in a hotel or in a hand basin if he is in the field. The whole outfit may be made for a dollar or so; if it does not have to be carried in a suitcase, the size may be altered as desired.

*Mining engineer, University Albemarle County, Va.

Lining Pipe with Cement

Cement-lined wrought-iron pipes, because of their freedom from interior corrosion and stoppage, have been used for water service to some extent for many years. Recently, a company has been organized in Boston to line pipe on order, either taking pipe supplied to it or furnishing the pipe itself. This fact is of interest on account of the possible application of the cement-lined pipe to mine uses. The procedure in lining the pipe is described in *Engineering News*, Oct. 8, as follows:

A screw-piston press 5 in. in diameter and about 18 in. long, mounted on one end of an 18-ft. plank, is used to force the mortar into the pipe. The forward head of the press cylinder is hinged to swing open; it has a central hole threaded for 2-in. pipe (other sizes are accommodated by use of bushings). The cylinder head is swung open, the cylinder filled with mortar, and the head closed and locked. The pipe to be lined is then screwed into the hole in the cylinder head. By forcing the piston ahead, the cement is then shoved out into the pipe. After this the pipe is unscrewed and moved along into a vise at the front end of the plank. A coupling is set up on the forward end, with a portable length of pipe about 15 in. long screwed into it as far as another pipe would be fitted, usually about six threads; this keeps the threads clear of mortor for connecting the length of pipe to another length.



Apparatus Used in Lining

A stiff wire is now pushed through the cement in the pipe, from the front end, and a pair of tapered mandrels pulled through the pipe by means of this wire, to core out the bore of the pipe. The mandrels are short lengths of brass pipe with tapered front end, fastened together by a loose wire. The outside diameter of the mandrels is ¼ in. less than the inside diameter of the pipe. The forward mandrel has four longitudinal fins, at 90° intervals, to center it in the pipe, while the rear mandrel

is smooth and, following through the bore made by the first mandrel, finishes it to shape and surface. The result is a smooth ⅛-in. lining of cement mortar.

After inspection, the pipe is laid away for the mortar to harden. The short length of pipe at the point is unscrewed, but the coupling is left on. All tees, elbows and other fittings are also lined with cement mortar, so applied as to give an interior surface continuous with that of the pipe, giving minimum friction at the joints.

Sabulite--A New Explosive

Mention was made in the JOURNAL, Oct. 3, p. 631, of trials by the Anaconda company in Butte of a new Belgian explosive, sabulite.

Sabulite was developed from the ammonium-nitrate powders. Aluminum powder with ammonium nitrate and a nitrated hydrocarbon seemed promising, but the high cost, low density and danger of aluminum powder prevented its successful use on a commercial scale. Eventually calcium silicide was adopted instead of aluminum powder. Calcium silicide is completely unaltered when exposed to the atmosphere, has a crystalline structure and is obtained in gray compact masses with metallic luster. In the manufacture of sabulite it is used in the form of a fine powder. The amount of heat developed during its combustion approximates that of aluminum and the heat is utilized to a surprising extent during the explosion. Calcium silicide and nitrate of ammonia, if used alone, would develop great quantities of heat, but the volume of gases given off would be small, which would detract from the power. To overcome this, a nitrous combustible in the form of trinitrotoluene is introduced. This might be replaced by one of the nitrated naphthalenes or anything to produce the same effect. The valuable properties of sabulite, however, lie in the calcium silicide.

In its present form, sabulite gives off large volumes of gas on explosion, generates great heat and has a high velocity of detonation. Therefore it should not only have a great effect when the rock is hard and compact, but should also work well when lifting power rather than shattering effect is required.

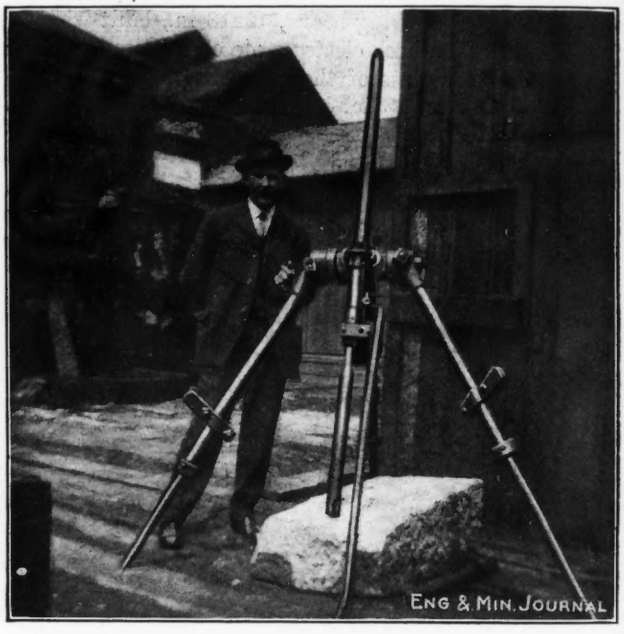
The powder is a simple mechanical mixture of the three ingredients. The sensitiveness of the ammonium nitrate to moisture is, to a considerable extent, overcome during the process of manufacture, the explanation appearing to be that its molecules become enveloped by a film of trinitrotoluene, which protects them from moisture.

The tests carried out in Butte, both as regards breaking ground and as regards safety, are stated to have been successful. These tests demonstrated that the powder cannot be exploded by heat. A cartridge was placed on a fire and, after melting, it burned slowly. Another cartridge was demolished by means of a red-hot poker without explosion. Powder was placed on an anvil and repeatedly struck with a chisel and a hammer without explosion. Some of the powder was placed on a rough piece of granite and drilled into without explosion. A high-power rifle bullet was fired through a cartridge, cutting it in two, but not exploding it. Most important of all, there are no noxious fumes given off by its explosion.

In Using Slings whether rope or chain, avoid kinks (N. F. A. Safety Buletin, June 1, 1914). Provided racks for storage so as to keep the slings convenient and save wear and tear. Have extra sets in order that there may be others available while defective slings are being repaired.

Follow-Up Drill and Detachable Bit

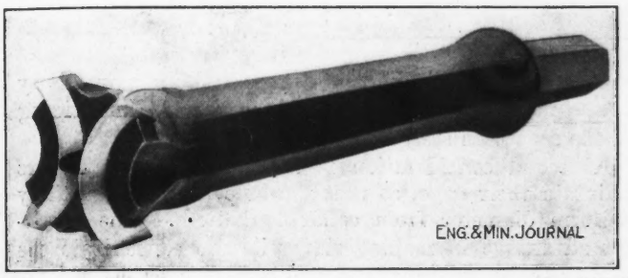
There is shown in one of the accompanying illustrations a rock drill invented by the late J. D. MacDonald of Butte. It is of the hammer type and has its drilling cylinder so constructed and of such a diameter as to follow the bit into the hole. This, of course, practically eliminates the use of drill steel; an exceedingly resistant detachable bit consisting of cutters and socket or holder is attached at the end of the cylinder, the holder receiving the blows of the hammer and having a motion not unlike that of an anvil block. This bit suffers little or no diminution in gage, so that the hole maintains a practically uniform diameter from collar to bottom and there is always room for the cylinder therein. The drilling cylinder itself is attached to a piece of hollow drill steel at the rear end and receives its air through this. This piece of drill steel in turn is attached to a plunger working in a feed cylinder and thus the drill is fed forward against the rock in about the same manner as a stoper is. The bit is mechanically rotated while drilling. The drill has only 11 parts, weighs 40 lb., has a 3-lb. hammer and a 3-in. stroke. The hole drilled is 2½ in. in diameter. The drilling speed varied from 1⅛ to 2 in. per min. in hard Butte granite, when the machine was properly mounted. The air consumption was only 28 cu.ft. of free air per min. The air consumption and weight of hammer are too small for so large a hole and experiments are now under way toward increasing the size of the air inlet and the weight of the hammer, and drilling a smaller hole.



THE FOLLOW-UP DRILL MOUNTED ON A TRIPOD

There would be many advantages in a machine of this kind when perfected, but most of these inhere in the use of the detachable bit. For this reason, the possibility of using such a bit with standard machines at once suggests itself. A trial was made in Butte last summer with a Leyner machine, using the same bit as that used on the machine described, and the results obtained are of interest. The bit itself is shown in the accompany-

ing illustrations, which, however, show it attached to plugger steel, not to Leyner steel; it consists of a holder in which two cutters are held. The holder is fastened to a piece of hollow Leyner steel. Its shape is shown in the picture; a central longitudinal hole carries a plug and spring with a projecting pin. The arc-shaped cutters are slipped into the holder from the side with the pin depressed; when the pin is allowed to spring out, it enters the cylindrical hole formed by the two grooves down the center of the cutters and thus locks the cutters against slipping laterally. The ribs along the back of cutters hold them against slipping longitudinally. Two sets of cutters are shown here, differing, however, only in detail of design. They are of chrome steel and are reversible, that is, each cutter has two cutting edges. The plug and spring can be taken out and replaced easily with



A Bit Complete with Holder and Cutters

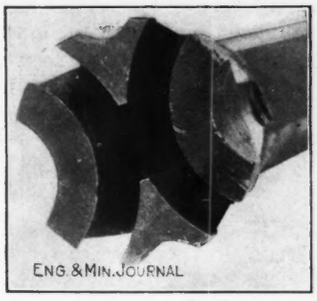
a pair of pliers. The spring is made a little larger than the hole in the holder so that when compressed it is held in place while the cutters are being removed or changed.

For the test, holes were drilled in hard blocks of Butte granite forming an old engine foundation west of the Mountain View mine at Butte. The tests were conducted by starting with a receiver full of air at 80 lb. gage pressure and running until the pressure fell to 70 lb.; it was calculated that the machine used the equivalent of 1880 cu.ft. of free air during this 10-lb. drop in pressure. The machine used was a practically new No. 18 Leyner with an 8-lb. hammer, a 3-in. stroke, and a 2½-in. diameter of cylinder. The holder was tapped on regular Leyner hollow steel with a light hammer; the joint had a slight taper. When it became necessary to substitute longer steel or to change or turn the cutting edges, the holder had to be forced off the old steel and driven on the new. The spring device was not designed to work with this type of steel. This accounts for the long delays. A soft steel pin, having a hole drilled in the center to pass water through the holder, was used for holding the cutters instead of the regular hard-steel pin. This finally battered out of shape and while a second hole was being drilled, the regular solid pin had to be substituted. As a result, practically no water reached the bottom of the second hole for the last 9½ in. of drilling. After drilling, the holder showed practically no signs of wear. The holes were 2½ in. in diameter from collar to bottom. Table I gives the detailed results of the cutter tests. Table II compares these results with the results of drilling, using ordinary Leyner steel.

TABLE I—RESULTS OF DRILLING TEST WITH DETACHABLE BIT

	Actual Drilling Time Min.	Inches Drilled in Actual Drilling Time	Inches per Minute of Actual Drilling Time	Delays to Succeeding Period Min.	Total Distance Drilled Inches	Total Inches Drilled per Minute of Elapsed Time (Delays Included)
Hole No. 1						
First period	1.5	3.0	2.0	0.5	3.00	2.0
Second period	3.0	7.0	2.33	3.0	10.00	2.0
Third period	6.5	15.0	2.31	6.5	25.00	1.53—
Fourth period	6.0	13.25	2.21	....	38.25	1.42—
Hole No. 2						
First period	5.0	9.25	1.85	2.75	9.25	1.85
Second period	5.0	10.875	2.175	9.00	20.125	1.58
Third period	5.0	9.625	1.925	....	29.75	1.11+

The first hole was a wet hole, 7° from the horizontal, and was drilled in four periods. The first stop was made to examine the cutting edges, which were found in good condition. The second stop was made to reverse cutters and change the length of steel from a starter to a second. The soft-steel pin was found slightly battered. The third stop was made to put in a new set of cutters and change to the third length of steel. The holder was found in satisfactory condition. When the hole was bottomed, the first cutting edges of the second set of cutters were dulled, but were in good shape. It will be noted that three sets of cutting edges were used, or one and a half cutters. The cutters were afterward used for drilling several feet in the Colorado mine at a speed of 1⅛ in. per min. It is thus evident that for each pair of cutting edges, 12½ in. would be drilled, or for each pair of cutters, 25 inches.



The Holder without Pin or Cutters

The second hole was a dry hole, also 7° from the horizontal. The first stop was made to put in a new set of cutters and change steel from starter to second. The second stop was for the purpose of turning the cutters. The holder was found in good shape, but it was necessary to remove the soft pin and complete the drilling with a solid pin, so that, as before stated, no water reached the face.

In regard to Table II, it will be noted that while progress was slower using the cutters than when using the regular Leyner steel; on the other hand the number of

TABLE II—COMPARISON OF DRILLING WITH DETACHABLE BITS AND WITH ORDINARY STEEL

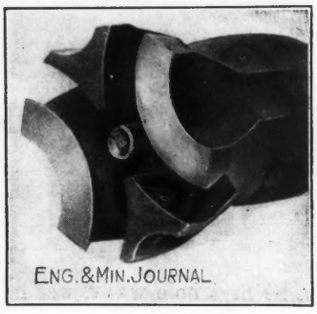
Machine and Steel	Total Depth of Hole In.	Actual Drilling Time Min.	Diameters Collar	Diameters Bottom	Diameters Average	Average Cu. In. of Rock Cut per In. of Hole Drilled	Total Cu. In. of Rock Cut from Hole	Per Minute of Actual Drilling Inches of Hole Drilled	Per Minute of Actual Drilling Cu. In. of Rock Cut	Total Number of Pieces of Steel or of Single Cutters Used	Inches of Hole Drilled per Piece of Steel or per Single Cutter	Cubic Inches of Rock Cut per Piece of Steel or per Single Cutter
Leyner No. 18 with MacDonald cutters	38.25	17.00	2.5	2.5	2.5	4.9088	187.76	2.25	11.04	3	12.75	62.59
Leyner No. 18 with MacDonald cutters	29.75	15.00	2.5	2.5	2.5	4.9088	146.04	1.98	9.74	3	9.92	48.68
Leyner No. 18 with regular Leyner steel	61.00	18.70	2.125	Under 2.00	2.0(?)	3.1416	191.64	3.26	10.25	10	6.10	19.16
Small Leyner with regular Leyner steel	197.00	48.15	.....	....	1.5(?)	1.7672	348.13	4.09	7.23	20	9.85	17.41

The second hole was a dry hole, also 7° from the horizontal. The first stop was made to put in a new set of cutters and change steel from starter to second. The second stop was for the purpose of turning the cutters. The holder was found in good shape, but it was necessary to remove the soft pin and complete the drilling with a solid pin, so that, as before stated, no water reached the face.

In regard to Table II, it will be noted that while progress was slower using the cutters than when using the regular Leyner steel; on the other hand the number of

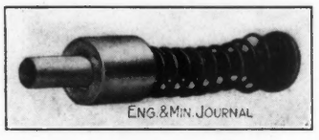
cubic inches of rock broken per minute was much greater. The service got from the small light cutters, as compared with that got from the ordinary steel, is most impressive. The distance drilled per *single* cutter is about 30% more than that per piece of steel. The difference in performance, taking into consideration the cubic inches of rock removed, was many times greater.

It would be unsafe to predicate too much, of course, on a single test like this; but on the other hand, the device is probably not nearly so well developed as it is capable of being, and when its full efficiency is obtained, a still more favorable showing would be made.

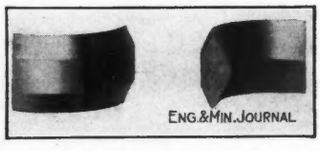


THE HOLDER WITH PIN IN POSITION

There are several points in connection with the use of such of these detachable bits that merit consideration. The first that will occur to anyone is, of course, the saving in the transportation of the steel. The cutter is small and light. The miner going on shift, can fill his pockets with as many as he is likely to need, and then bring back his dull cutters along with any that are left over, in order to check out, thus guarding against their being thrown into the ore. The lengths of steel become part of the machine equipment, to be kept with it along with wrenches, etc. The cutters are not dressed again; they are most available at Butte for precipitating copper. When got in quantities they cost 3c. per pair. Assuming that a pair is good for 25 in. of hole, the steel cost per foot becomes approximately 1½c. This cost would probably be slightly reduced for cutters giving a smaller hole. It is calculated that a round trip for a piece of steel from mine to shop and back in Butte costs from 12 to 15c.; this includes the labor of collecting the dulled steel, transporting it to the blacksmith shop, the cost of sharpening and the loss in that process, together with the high loss of steel which disappears in the filling underground. There are other indeterminable costs which would largely increase this figure. The cost of the holder must, of course, be considered. One of these drilled 60 ft. and was still in good condition thereafter. They cost about $1 to $1.50 each. Assuming that this cost is about equivalent to the indeterminate costs on the length of steel, a piece of ordinary steel to equal the cost of the cutters would have to drill about 9 ft. for every sharpening, which it will not do, even if slow and inefficient work with dull steel be permitted.

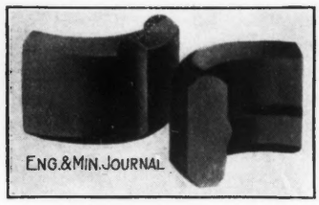


PLUG, PIN AND SPRING



ONE FORM OF CUTTER

The direct cost, furthermore, is not the only point to be considered. It is a baffling problem for the underground superintendent in Butte, as elsewhere, to get enough sharp steel to his miners. A machine man seldom has enough steel for a shift, and spends valuable time getting what he has. He uses dull steel far beyond the point of economy, and the net result all around is a serious decrease in the footage drilled per man per shift. It will be noted in Table II that under test conditions the No. 18 Leyner used 10 pieces of steel to drill 61 in. and the small Leyner used 20 pieces in 197 in. There are few mines in Butte where a machineman does not count himself as being in great luck if he can get eight pieces of steel to drill his stope round. Again, the handling of the long lengths of steel is difficult and dangerous work for both the miner and the tool nipper. Miners are hit by falling steel, and riding on the cage with steel is always hazardous.



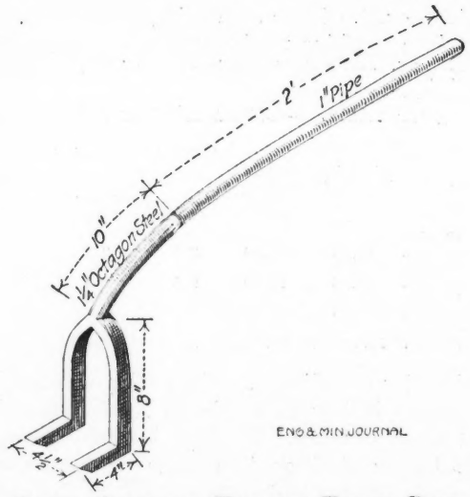
LATEST FORM OF CUTTER

A second consideration is the fact that the cutters maintain their gage, so that the hole is of substantially uniform diameter from collar to bottom. The resultant advantage in making it possible to concentrate the powder at the bottom of the hole is manifest.

For the information on which this article is based, the JOURNAL is indebted to Marcus L. Hurley.

Rail and Tie Holder

In laying or repairing mine tracks, it is not always possible to have the rails resting upon all the ties before spiking, due to the unevenness of drift and crosscut floors. To overcome the difficulty of spiking under such conditions, the tool shown in the accompanying illustration was devised. One end of a 2-ft. length of 1¼-in. octagon drill



LEVER FORK FOR HOLDING TIE TO RAIL

steel was split for 1 ft. and shaped into a fork, the end of each prong for a length of 4 in. being bent forward at a right angle; the other end of the drill steel was drawn out so that it would just slip into a piece of 1-in. pipe; this pipe serves as a handle and lever. By placing the fork over a rail and slipping the prongs under a tie, the latter may be held up firmly against the rail while being spiked.

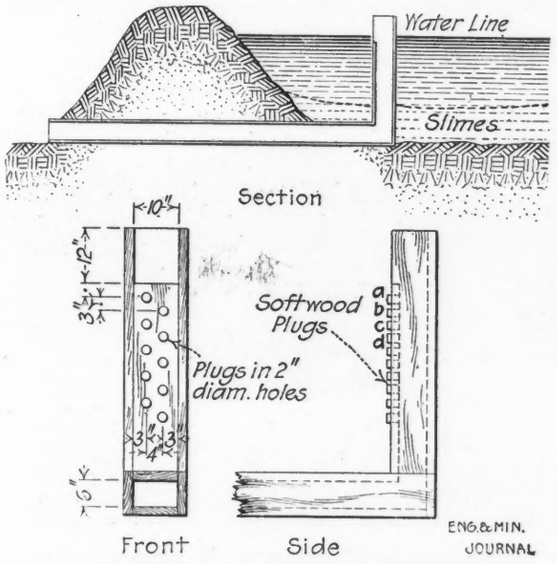
Details of Milling and Smelting

Increasing Capacity of Slimes Ponds

By Thomas H. Tulloch*

The arrangement described here was found to increase the capacity of small slimes ponds where it was desired to settle the slimes and cake them for shipment by drying in the sun. This arrangement makes the slimes available for treatment or shipment much sooner than would be the case in large ponds, and is an advantage where lack of room, topography or convenience in rehandling make it desirable to use as small an area as possible, and where it is not practicable to build settling tanks.

A box, the front and side elevations of which are shown in the diagram, is built of 2x10-in. lumber. This box is used as an overflow and is put in the retaining-wall of the dam as shown in the diagram. The box should be placed as far as possible from the intake and about 10 ft. from the edge of the bank. The feed is turned into the pond and after filling it, is not diverted until the submerged stream of settling slimes has raised to such a point that there is a loss of slimes in the overflow. The feed is then diverted to another pond. As the slimes in the first pond settle, the clear water is drawn off by successively removing the plugs *a, b, c,* etc., until no further settling of the slimes takes place. The plugs are then put back, the feed turned into the pond again and the operation repeated. This alternate filling of the pond, settling of the slimes and decanting of the clear water is continued until it is no longer possible to get a clear overflow. The feed is then diverted to other ponds, all clear water drawn off the surface and the slimes dried by evaporation until they can be handled. The slimes are then removed for treatment or shipment and the pond is ready for the feed again.



Method of Draining Slimes Ponds

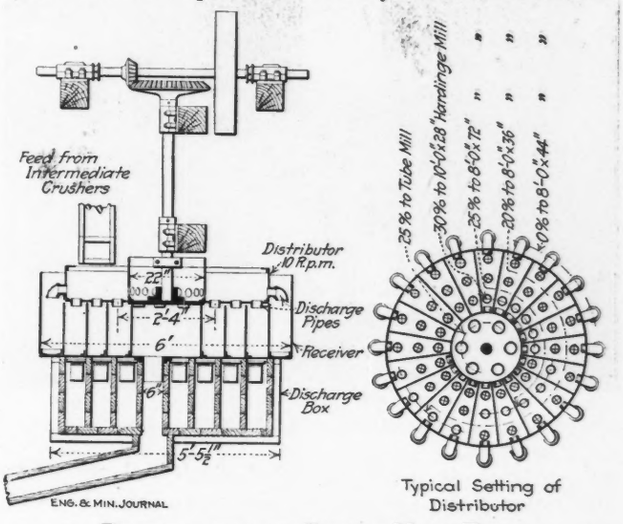
This method entails little loss of slimes and, due to the successive settling and decantation of the water, the solids settle compactly and dry quickly. Rectangular ponds with the intake and overflow at opposite ends give the best results. The maximum depth should not be over 3 feet.

*San Diego, Calif.

Distributor for Regulation of Feed to Pebble Mills

By P. S. Huntington*

In all mill work it is necessary to know the weight of ore which is being handled by any given unit. In modern mills this is usually obtained for each unit by means of a weighing machine which automatically weighs the ore to be treated as it passes on a conveyor belt from the mill bins. In case the feed is afterward divided for treatment in several various types of machines, as frequently occurs in experimental work on a large scale, it is necessary to employ a distributor to apportion such amounts as may be required, to the various machines.



Distributor for Pebble-Mill Feed

To meet such a requirement the distributor shown in the accompanying sketches was designed and installed at the test mill of the Inspiration Consolidated Copper Co. It takes the product from intermediate wet crushers and distributes it to five pebble mills, or any less number, depending on the nature of the test being run. Being made up of 20 radial compartments it is possible, by plugging the discharge pipes, to vary the feed to any machine 5% of the total. Then, knowing the weight of the main ore stream for any given period, it is a simple matter to ascertain the amount of ore handled by each machine for that period. A 5% variation, based on the normal ca-

*Construction department, Inspiration Consolidated Copper Co., Miami, Ariz.

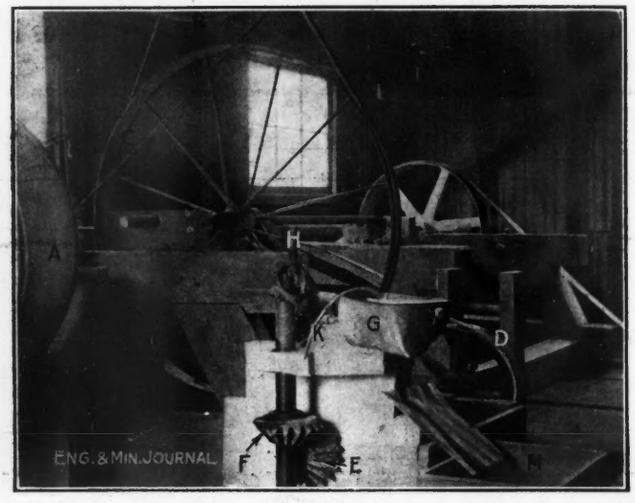
pacity of the test plant, has been found to permit of a feed regulation amply close for all experimental purposes. A typical setting is shown in the drawing.

A chart, showing the numbers and sizes of the mills, together with their respective settings, given in terms of discharge pipes left open, is kept posted near the distributor, so that the men in charge can always know just what proportion of the total feed each machine is handling. This distributor was devised by H. Kenyon Burch, chief engineer, and Dr. Rudolph Gahl, metallurgist, of the Inspiration Consolidated Copper Co.

A Home-Made Automatic Sampler

By Percy E. Barbour*

A home-made automatic sampling device which was made from scrap material and cost almost nothing, was devised by R. C. Coffey, superintendent of the Uwarra mill, at Candor, N. C., and gave satisfactory results. The sampler was to cut the stream of ore from the inclined-



Automatic Sampler Installed

belt conveyor, the discharge end of which is shown in the illustration at *A*. The sampler was driven from the head-pulley drive shaft, and the necessary speed reduction was obtained by the pulleys *B*, *C* and *D*. Pulley *D* operates a short shaft carrying at the other end a bevel gear *E*, which meshes with the bevel gear *F*, from which several teeth were chipped away, as can be seen at the point of the arrow. This vertical shaft had two arms at right angles, one carrying the sampler *G* and the other having its end turned up about 4 in., like a crank, at *H*. Any desired speed can be obtained by proper pulleys; in this case the device took a sample every 12 minutes.

The sample collector *G* was an old 8-in. elevator bucket with holes punched in both ends to take the arm. The bucket was free to swing on this arm, and was counterweighted so that it would hang upright except when being tripped. A piece of small rod iron was bent as shown at *K*, fastened to the back of the bucket with two jamb nuts, and projected over the bucket, acting as a dumping cam. This engaged a pin, not visible in the photograph, and slowly rotated the bucket on its arm as the arm passed over the sample box, shown at *M*. As soon as the tripping stud was passed, the counterweight righted the bucket ready for its next cut. All of this is, of course, simple enough. The clever trick about the device was that which gave the quick cut necessary for a fair sample.

The vertical end of the arm *H* had a cord and spring attached to the framework behind it. This cord and spring were constantly in tension. When the slowly revolving bevel gear *E* went out of mesh with the equally slowly revolving gear *F*, owing to the teeth being chipped away, the spring cord in tension gave the arm, and hence the vertical shaft and the bucket, a sudden and quick rotation through an arc from which the teeth had been chipped away and brought the bevel gears into mesh again. This sudden swing of the bucket through the ore stream gave the quick cut necessary for a fair sample.

This sampler cuts the ore stream from side to side, which is not the theoretically proper way to take such a sample, but at this point the ore stream is narrow and the cutting is done quickly, and the results proved satisfactory in the case, the taking of a mill-head sample for a 50-ton plant.

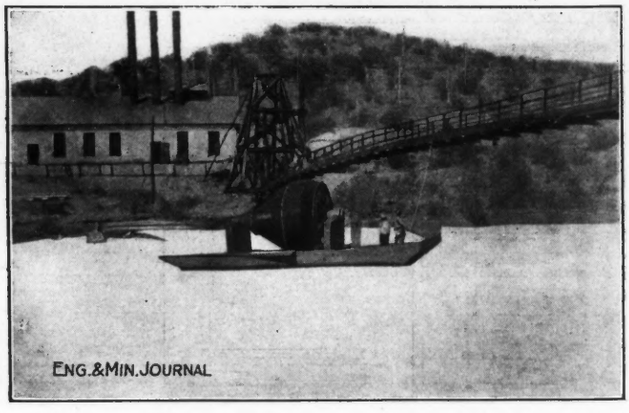
The sampler was quickly and crudely made out of junk, but worked well and suggests a home-made sampler which could be well made in any machine shop at small cost.

*Mining engineer, 887 Middle St., Bath, Maine.

Transporting a Hardinge Mill across the Gila

By A. L. Flagg*

The accompanying illustration shows the method of transporting an 8-ft. x 22-in. Hardinge mill across the Gila River, in Arizona. The bare mill weighed 10,000 lb. The boat was made of rough lumber, 2x12-in. It was



Transporting a Hardinge Mill across the Gila River, Arizona

16x24 ft. over all, 2 ft. deep at the back and 3 ft. deep at the front. When loaded it drew 11 in. of water. At the time the mill was taken across, the surface velocity of the river was approximately 7 ft. per sec. The river was very muddy, carrying about 33% solid matter. A small contractor's hoist was used to draw the boat and cargo across the river. The time for the trip was 1 hr. 40 min. The river is 250 ft. wide, but to avoid rocks the boat was taken upstream about 200 ft. and then drawn straight across.

*Mining engineer, Kelvin-Sultana Copper Co., Kelvin, Ariz.

The Assayer and Chemist

Volumetric Estimation of Mercury

By J. E. Clennell*

The methods in general use for estimating mercury volumetrically depend on titration with either potassium iodide or a thiocyanate.

Iodide and Thiocyanate Methods

The iodide method, on which I have made numerous experiments, has the disadvantage that the finishing point is somewhat uncertain. The solution may be standardized in various ways. Thus we may use a mercuric-chloride solution of known strength and note the point (a) where addition of the standard iodide first produced a permanent turbidity, (b) where the precipitation of mercuric iodide is complete, ascertained by an external indicator, or (c) where the precipitate, on continued addition of iodide, finally dissolves.

The last point is preferable, though no sharper than the others, because a larger volume of the standard solution is used and hence the percentage error in the determination resulting from a given error of observation in the titration is less. Some writers recommend adding the mercuric solution to the iodide instead of *vice versa,* but there appears to be no marked advantage so far as sharpness in the finishing point is concerned, and the method has obvious disadvantages where the amount of mercury is not approximately known beforehand.

In Seamon's modification (cf. A. H. Low, "Technical Methods of Ore Analysis," 5th Edition, p. 183, quoted from "Manual for Assayers and Chemists," p. 112), an external indicator is used consisting of starch liquor, and nitric acid containing nitrous acid is added to the liquid to be titrated. Apart from the objections to the use of all external indicators, the results which I obtained by this method were unsatisfactory and appeared to vary with the amount of nitrous acid present, with the degree of dilution, rate of titration, and other conditions. Only a rough approximation was obtainable by any form of the iodide method.

The thiocyanate method of L. L. Krieckhaus (A. H. Low, *loc. cit.*, p. 181) is probably more accurate, but was discarded for the present purpose as it necessitates conversion into mercuric nitrate by a tedious process of reduction with stannous chloride, washing, settling, etc., finally dissolving the precipitated mercury in nitric acid and titrating with thiocyanate as in Volhard's method for silver. Several hours are required for the entire operation.

Cyanimetric Method

The following cyanimetric method appears to be not only rapid, but at least as accurate as any method, gravimetric or volumetric, hitherto described.

A method, due in its original form to Hannay, is described in Sutton's "Volumetric Analysis" (8th Edition, p. 269) with modification by various workers, in which potassium cyanide is used for the direct titration of mercury in pure mercuric compounds. In that process, dilute ammonia is used as an indicator and it is necessary to neutralize the solution exactly with potassium carbonate and hydrochloric acid, add ammonia to produce a slight turbidity, and titrate with cyanide till the solution just clears. The method appears to require rather careful manipulation and regulation of the amount of reagents used.

In the process detailed below, which I worked out in the laboratory of the Nipissing Mining Co., Cobalt, Ont., the mercury is determined by indirect titration with cyanide; an excess of cyanide is added and the excess determined by silver nitrate. There is no necessity for exact neutralization of the solution; an excess of alkali is added in all cases, and this may be varied within reasonable limits without affecting the result.

Ammonia appears to affect the result, and its presence should be avoided.

Preparation of the Solution—Mercury compounds soluble in hydrochloric acid (50% by volume) are dissolved by agitation and gentle warming with that acid (0.5 gram of mercuric oxide, HgO, is readily dissolved in the cold by 5 cc. of 50% HCl).

Compounds insoluble in HCl are dissolved by *aqua regia,* using a mixture of equal parts of 50% HCl and 50% HNO_3. The mixture may be boiled for 30 seconds or more without appreciable loss of mercury, and this is necessary to eliminate free chlorine.

The acid solution, filtered if necessary, is then made distinctly alkaline by addition of caustic soda. Enough must be added to change the color of the precipitated oxide from reddish-brown to orange-yellow.

The Titration—Standard potassium cyanide, say about 1% strength, is then run in from a burette until the precipitate entirely dissolves to a colorless liquid. It appears best to add about 5 c.c. of the cyanide solution beyond this point. The excess of cyanide is then titrated with standard silver nitrate, after addition of about 10 c.c. of a 1% potassium-iodide solution as indicator. The relative strength of the cyanide and silver nitrate must, of course, be carefully determined.

The amount of silver nitrate used in this excess titration is then deducted from the silver-nitrate equivalent of the total amount of standard cyanide used. The difference is the equivalent of the mercury present.

Reactions Involved

The mercuric oxide formed by addition of alkali to the mercuric solution is dissolved thus:

$$HgO + 4\,KCN + H_2O = K_2Hg(CN)_4 + 2\,KOH$$

The results obtained by the titration correspond closely to the reaction:

$$K_2Hg(CN)_4 + AgNO_3 = Hg(CN)_2 + KAg(CN)_2 + KNO_3$$

i.e., half the cyanogen of the double salt is estimated in the silver-nitrate titration.

*Metallurgical chemist, Oakland, Calif.

Thus if we use a silver-nitrate solution containing 6.52 grams $AgNO_3$ per liter

1 c.c. $AgNO_3$ = 0.00769 gram Hg

Standardizing—Instead of using this theoretical number, the silver-nitrate solution may be standardized empirically on a mercury salt of known composition. Thus 0.5 gram of mercuric chloride or mercuric oxide may be taken. In the latter case the oxide is best dissolved in 5 c.c. of 50% HCl and made alkaline with about 30 c.c. of 5% NaOH. Run in 1% KCN until the precipitate dissolves and a perfectly colorless liquid is obtained; add 5 c.c. more KCN; about 35 c.c. will be required altogether. Then add 10 c.c. of 1% KI and titrate with standard $AgNO_3$. Using the solution referred to above, 1 or 2 c.c. will be required.

It seems preferable to use the silver nitrate rather than the cyanide as the standard solution, as the former is less liable to undergo change of strength on keeping.

The end point is marked by the appearance of a yellowish turbidity of silver iodide. Sometimes a white turbidity may appear earlier, but this is faint and indefinite and should be disregarded.

Application of the Method to Samples of Impure Oxide

When a mixture of mercuric and mercurous oxides is treated with 50% HCl, the mercuric oxide dissolves, and insoluble mercurous chloride is formed by the reaction:

$$Hg_2O + 2\ HCl = Hg_2Cl_2 + H_2O$$

In cases where metallic mercury, mercurous and mercuric compounds are present, the mercuric compounds are alone dissolved by dilute HCl and may be determined separately after filtering and washing. A grayish residue remains consisting apparently of Hg and Hg_2Cl_2, which blackens on addition of ammonia.

To obtain the total mercury, the following method is often applicable: 0.5 to 1 gram of the sample is treated with 5 to 10 c.c. of saturated bromine water, then with 5 c.c. of 50% HCl, boiled for about 30 seconds, and a few drops of KI added. If any iodine is liberated, boiling is continued until fresh addition of KI gives no liberation of iodine. All the mercury will now be in solution and in the mercuric condition. Excess of NaOH is then added, and the solution cooled and titrated as usual. It is essential to remove the excess of bromine, otherwise on addition of NaOH a hypobromite is formed, which reacts with cyanide thus:

$$NaBrO + KCN = KCNO + NaBr$$

and more cyanide is consumed than is equivalent to the mercury, so that the value obtained for the latter would be too high. A solution of iodine in potassium iodide may be used instead of bromine, the excess of iodine being boiled off before adding NaOH.

Separation of Interfering Metals

In cases where other metals, such as copper, nickel or zinc, are present, which would react with cyanide, they may be readily eliminated by utilizing the insolubility of mercury sulphide in moderately concentrated nitric acid. The metals are precipitated in acid solution by H_2S, the precipitate filtered and washed free from chlorides, and digested with warm 50% HNO_3. The residue, after washing to remove copper, etc., is treated with HCl and HNO_3, heated to boiling for about 30 seconds, diluted, filtered to remove sulphur, and the filtrate made alkaline with NaOH and titrated with KCN as usual. When lead is present it is preferable to boil the original H_2S precipitate with 50% HCl, which readily dissolves PbS, leaving HgS unaffected.

Iron in the ferric state does not interfere with the method except by obscuring the end point with $AgNO_3$. When present with mercury in a solution with HCl, add 5 c.c. 50% HNO_3 and boil before neutralizing with NaOH. On adding the cyanide, a precipitate of ferric hydroxide appears, which is insoluble in excess of KCN. This must be filtered off and washed before titrating the excess KCN with $AgNO_3$.

Effect of Varying Conditions

The following tables illustrate the method of working and the degree of accuracy which is obtainable by this method of titration. The same silver-nitrate solution was used throughout, but the cyanide solution was made up approximately and the exact standard determined for each series of tests.

Constants assumed. 1 c.c. $AgNO_3$ = 0.005 gram KCN = 0.00769 gram Hg = 0.008305 gram HgO.

Solutions used:
(A) Mercuric chloride, 5% $HgCl_2$.
(B) Caustic soda, 5% NaOH.
(C) Potassium cyanide, 0.97 to 0.98% KCN.
(D) Potassium iodide, 1% KI.
(E) Silver nitrate, 0.652% $AgNO_3$.

EFFECT OF VARYING QUANTITIES OF MERCURY

1 c.c. KCN = 1.94 c.c. $AgNO_3$

(A) $HgCl_2$ Taken c.c.	(B) NaOH Added c.c.	(C) KCN Added c.c.	(D) KI Added c.c.	(E_1) $AgNO_3$ Required for Excess c.c.	(E_2) $AgNO_3$ Corresponding to Hg c.c.	Mercury Hg Present gram	Mercury Hg Found gram
1	10	4	5	2.95	4.81	0.0369	0.0370
2	10	6	5	2.05	9.59	0.0738	0.0737
3	10	8	5	1.40	14.12	0.1107	0.1086
4	10	10	5	0.65	18.75	0.1476	0.1442
5	10	14	5	2.85	24.31	0.1845	0.1869
7	10	18	5	1.55	33.37	0.2583	0.2566
9	10	22	5	0.70	41.98	0.3321	0.3228
10	10	25	5	1.40	48.10	0.3690	0.3699
15	15	36	5	0.65	69.19	0.5535	0.5321

The numbers in the sixth column are calculated from the formula $E_2 = 1.94\ C - E_1$. The numbers in the last column $= E_2 \times 0.00769$.

The results show that with a pure mercuric-chloride solution the method is sufficiently accurate for practical purposes, for quantities of mercury ranging from 40 to 500 milligrams.

In order to test its applicability to mercuric oxide, a sample of pure oxide was prepared by precipitating pure mercuric chloride with caustic soda, filtering, washing with hot water till free from alkali and chlorides, and drying in the steam oven. A second sample was taken after further drying in the oven for several hours.

TITRATION OF PURE MERCURIC OXIDE

Amount taken 0.5 gram.
Dissolved in 5 c.c. 50% HCl, excess NaOH added and titrated with KCN.
1 c.c. KCN = 1.952 c.c. $AgNO_3$.

Sample No.	KCN Added c.c.	$AgNO_3$ (E_1) c.c.	Required (E_2) c.c.	Mercury Found gram	Mercury Found %	HgO %
1	32	2.80	59.66	0.4588	91.76	99.10
2	33	4.00	60.42	0.4646	92.93	100.36

EFFECT OF ADDING BROMINE OR IODINE AND BOILING

Test No.	$HgCl_2$ 5% c.c.	HCl 50% c.c.	Bromine Water Added c.c.	$\frac{N}{10}$ Iodine Added c.c.	KCN Added c.c.	Ag NO_3 Required E_1 c.c.	Ag NO_3 Required E_2 c.c.	Mercury Indicated gram
1	15	5	..	..	36	0.8	69.76	0.5365
2	15	5	5	..	36	0.6	69.96	0.5380
3	15	5	5	..	36	1.45	69.11	0.5314
4	15	5	..	5	36	0.6	69.96	0.5380

1 c.c. KCN = 1.96 c.c. $AgNO_3$

REMARKS ON TABLE NO. 3

Test No. 1. After addition of HCl, added excess NaOH and titrated without boiling.

Test No. 2. Added 5 c.c. saturated bromine water, then 5 c.c. 50% HCl, and added KI in small portions, boiling and

adding more KI until further addition no longer caused liberation of iodine; then excess NaOH, cooled and titrated.

Test No. 3. Added 5 c.c. saturated bromine water, then 5 cc. 50% HCl, boiled for some time, then added a drop of KI, which gave no evolution of iodine, then excess NaOH, cooled and titrated.

Test No. 4. Added 5 cc. $\frac{N}{10}$ iodine, then KI till a precipitate of $HgCl_2$ began to appear. Boiled off excess of iodine, added excess NaOH, cooled and titrated.

EFFECT OF VARYING AMOUNT OF ALKALI

1 c.c. KCN = 1.972 c.c. $AgNO_3$

Test No.	$HgCl_2$ 5% c.c.	NaOH 5% c.c.	KCN .986% c.c.	$AgNO_3$ E_1 c.c.	$AgNO_3$ E_2 c.c.	Mercury Indicated gram
1	15	5	36	0.7	70.3	0.541
2	15	10	36	0.7	70.3	0.541
3	15	15	36	1.1	69.9	0.538
4	15	25	36	1.7	69.3	0.533

The amount of mercury indicated diminishes with increased additions of alkali, but the effect is only noticeable with excessive amounts.

EFFECT OF VARYING AMOUNT OF ACIDS

1 c.c. KCN = 1.962 c.c. $AgNO_3$

Test No.	$HgCl_2$ 5% c.c.	HCl 50% c.c.	HNO_3 50% c.c.	NaOH 5% c.c.	KCN .981% c.c.	$AgNO_3$ E_1 c.c.	$AgNO_3$ E_2 c.c.	Mercury Indicated gram
1	15	2	..	15	36	0.3	70.33	0.5408
2	15	5	..	30	36	0.45	70.18	0.5397
3	15	10	..	60	36	1.1	69.53	0.5347
4	15	..	2	20	36	0.8	69.83	0.5370
5	15	..	5	50	36	1.15	69.48	0.5343
6	15	..	10	80	36	0.75	69.88	0.5374
7	15	5	5	80	36	2.25	68.38	0.5258
8	15	5	5	70	36	1.1	69.53	0.5347

REMARKS ON TABLE NO. 5

In Test No. 7 the alkali was added direct to the cold mixture; in No. 8 the solution was boiled for 30 sec. before adding alkali, then cooled before titrating.

EFFECT OF VARYING AMOUNT OF CYANIDE

1 c.c. KCN = 1.956 c.c. $AgNO_3$

Test No.	$HgCl_2$ 5% c.c.	HCl 50% c.c.	NaOH 5% c.c.	KCN .978% c.c.	$AgNO_3$ E_1 c.c.	$AgNO_3$ E_2 c.c.	Mercury Found gram
1	10	5	40	25	0.85	48.05	0.3695
2	10	5	40	26	2.4	48.46	0.3727
3	10	5	40	27	4.2	48.61	0.3738
4	10	5	40	28	5.7	49.07	0.3773
5	10	5	40	29	7.6	49.12	0.3777
6	10	5	40	30	9.5	49.18	0.3782
7	10	5	40	40	28.95	49.29	0.3790
						Theor.	0.3690

These results show a slightly increasing value of mercury indicated for increasing excess of cyanide added. For the most exact results it is therefore best to determine approximately the amount of cyanide required by a preliminary experiment, then repeat the test, using only a slight excess of cyanide.

In the estimation of copper by a method devised by me and based on a similar principle, a similar effect was obtained with increasing quantities of cyanide ("Cyanide Handbook," p. 412).

EFFECT OF BOILING

1 c.c. KCN = 1.938 c.c. $AgNO_3$

Test No.	$HgCl_2$ 5% c.c.	HCl 50% c.c.	Time Boiling seconds	NaOH 5% c.c.	$AgNO_3$ E_1 c.c.	$AgNO_3$ E_2 c.c.	Mercury Indicated gram
1	20	10	0	40	1.5	95.40	0.7336
2	20	10	30	40	1.5	95.40	0.7336
3	20	10	60	40	1.75	95.15	0.7317
4	20	10	120	40	1.65	95.25	0.7325

The results show that the volatilization of mercury salts by boiling under the conditions of the test is practically negligible. It is seldom necessary to boil more than 30 seconds.

In a future paper, I hope to be able to describe certain important practical applications of this method. Thanks are due to the Nipissing company for facilities accorded in carrying out the work.

Magnesia in Magnesites

Mayerhofer's method has been found inaccurate, but gives good results when carried out in the following manner, according to H. Udowis-Zewski (*Chem.-Ztg.*, p. 949, 1914). Five grams of magnesite are decomposed by heating with *aqua regia* on the water bath, the solution is evaporated to dryness, the residue heated for half an hour at 180° to 200° C., treated with hydrochloric acid on the water bath, filtered from silica, and made up to one liter. Forty cubic centimeters of the solution (or 20 c.c. with burnt magnesite) are treated with 5 c.c. of strong sulphuric acid and 100 c.c. of ammonium-citrate solution (100 grams of citric acid and 333 c.c. of ammonia, of sp.gr. 0.91 to 1 liter), cooled to 1° to 2° C., further treated with 20 c.c. of 10% sodium-phosphate solution and 15 c.c. of strong ammonia, the mixture shaken vigorously for 5 minutes, and allowed to stand for 2 hours in ice water; the precipitate is filtered off, washed with dilute ammonia (1:3), and dissolved in hydrochloric acid, the solution again precipitated with ammonia, allowed to stand for half an hour in ice water, the mixture shaken for 5 minutes, filtered and the precipitate washed with ammonia, dried, ignited and weighed as $Mg_2P_2O_7$.

Resistance of Platinum to Hot Nitric Acid

In a recent investigation of the atomic weight of selenium, Jannek and Meyer made the statement that 10 c.c. of halogen-free nitric acid, distilled through a platinum condenser, yields 0.00228 grams of non-volatile residue. This led Baxter and Grover to a new investigation of this problem (*Journ. Am. Chem. Soc.*, June, 1914), their conclusions being as follows:

That pure nitric acid is without effect on pure platinum. Any large residues may be attributed either to the use of vessels of impure platinum, to inefficient cleaning of the platinum vessels, or traces of hydrochloric acid in the nitric acid. New platinum vessels should always be cleaned before use, either by fusion with pyrosulphate or sublimation of ammonium chloride from the vessel or both.

Ink for Labeling Reagents

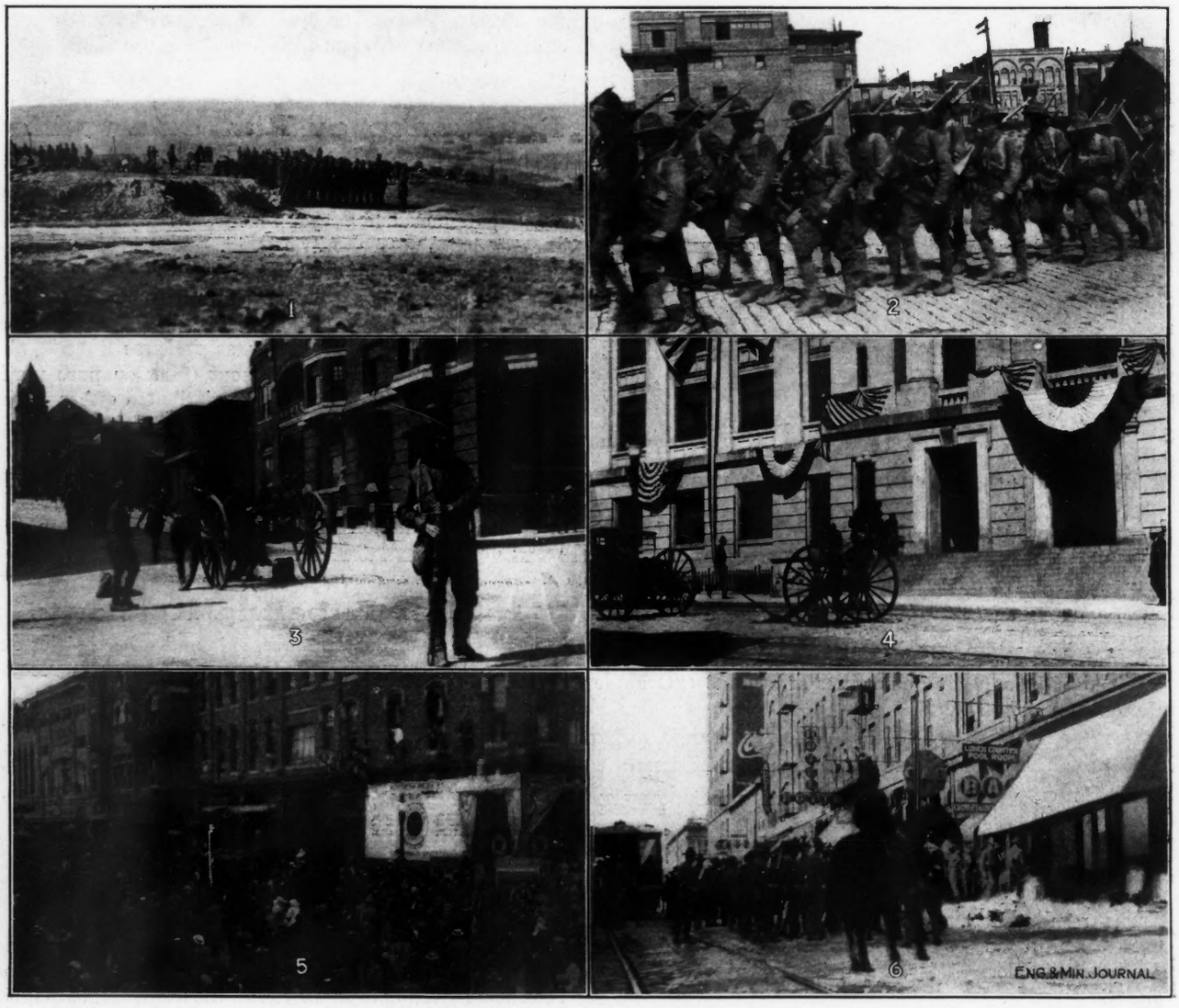
For writing on labels of reagents and other bottles exposed to laboratory fumes, the following ink is recommended by the *Chemical Trade Journal*: 20 grams shellac are dissolved in a hot borax solution (30 grams in 400 c.c. water) and filtered while hot. To the filtered liquid the following solution is added: Aniline black, 8 grams; tannin, 0.3 gram; picric acid, 0.1 gram; ammonia, 15 grams, water, 10 grams.

Selenious Acid in Sulphuric Acid

To detect minute traces of selenious acid in sulphuric acid, E. Schmidt recommends dissolving a few milligrams of codeine phosphate in 10 c.c. of the suspected sulphuric acid (*Arch Pharm.*, p. 161, 1914). With even so little as 1:1,000,000 of Se: H_2SO_4, a distinct green coloration appears, which changes to a deep blue green in about 15 minutes.

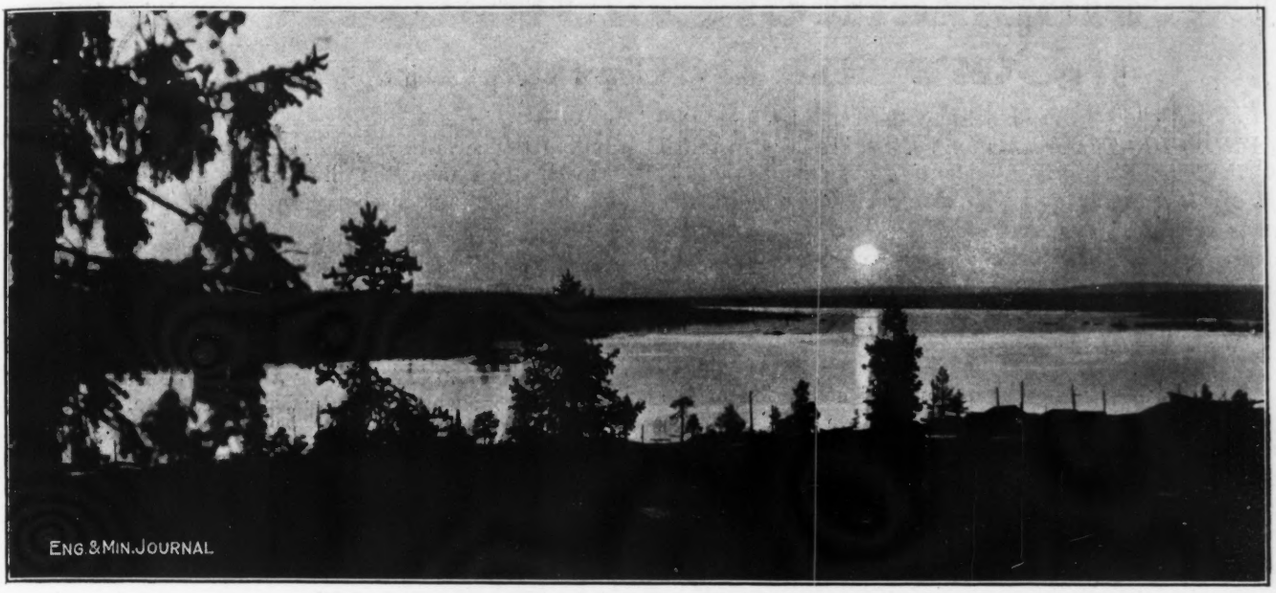
Photographs from the Field

OUTCROPS OF ROCK ASPHALT IN THE HILLS NEAR SUNNYSIDE, UTAH



BUTTE UNDER MILITARY RULE

1. Troops upon arrival at the mines.
2. Marching through Butte streets.
3. Guard lines with Gatling guns.
4. Silver Bow Court House, military headquarters.
5. Breaking up miners' union parade on Labor Day.
6. Destroying liquors of an unruly saloonkeeper.



PORJUS LAKE ABOVE THE FALLS, MIDNIGHT SUN SHINING
Tracks in foreground lead to power-plant site.

PORJUS FALLS, ONE OF THE GREAT WATER POWERS OF SWEDEN
Power generating plant to the right. The total power is estimated at 320,000 hp., of which about 160,000 hp. is now developed. The power is utilized in the iron mines and railroad of the Luossavaara-Kirunavaara Co., in Lapland.

Development of Continuous Counter Current Decantation--II

By Herbert A. Megraw

SYNOPSIS—The decantation system has been installed at the Tom Reed mill, supplanting a filter installation. It effects a saving over that method. Power and water costs are less. The Gold Road mill has had a similar experience, its new installation effecting a saving of $0.60 per ton over the operation of the filter plant. The system is applicable to copper hydrometallurgy, and is being studied by some copper companies.

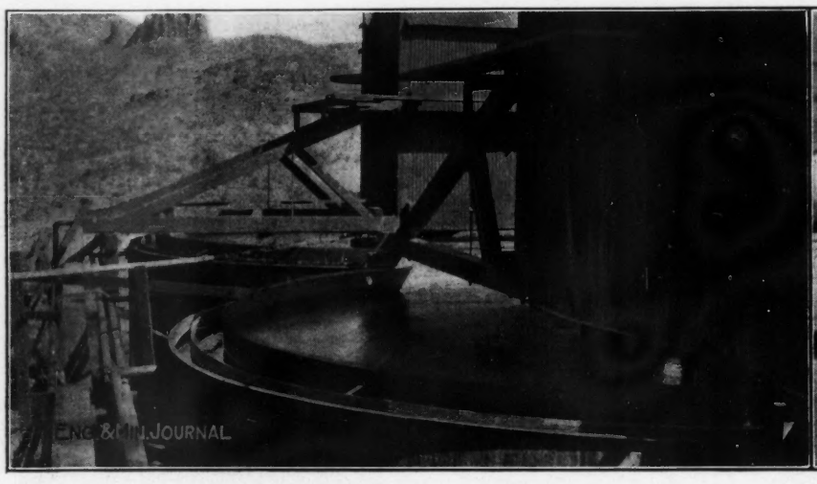
Taking up now another example of utilization of the counter-current decantation principle, we have the Tom Reed mill, at Oatman, Ariz. This plant formerly used a 48-leaf vacuum-filter plant, but in view of the possible economies by the use of counter-current decantation, it changed the plant and put the filter out of commission.

Installation at Tom Reed Mill

The present installation consists of five 30x10-ft. Dorr thickeners and one 22x18-ft. tank. The operators say that the difficulties in the use of this plant are of minor importanee, the principal one being that the regulation of the amount of solution drawn off for precipitation and the amount of water added at the final stage were rather diffieult to gage. This trouble was finally overcome by installing a meter for the solution to be precipitated and a float-valve arrangement for the water and barren solution taken into the plant. This apparatus has already been described in the Journal. The principle is the maintaining of a constant, or practieally constant, head whereby the flow of solution is easily approximated. The overflow from No. 1 thickener is collected in an old agitation tank before clarification. It is clarified by pumping through ten 3x10-ft. filter leaves. The leaves are washed by a hose once a week. For the sake of convenience in running to the tailings pond, one of the agitating tanks formerly used with the filter plant is allowed to fill, and the whole tank discharged at once.

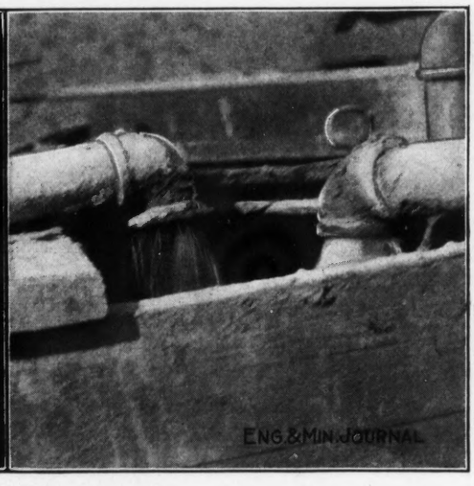
Air Lifts for Pulp Transfer

In this mill the pulp and overflows are transferred by means of air lifts, which have occasioned no trouble whatever. Nor is there any trouble in keeping the underflow of proper density between stages. The average gravity of discharged pulp for a period of three months has been 1.55, which, for the Tom Reed ore, represents 56.3% solids and 43.7% solution. The cyanide loss in the system is slightly higher than when using the filtration plant, but the net extraction is the same. For the last three months it has averaged 96.2%. The cyanide loss is, in figures, 5c. per ton of ore treated more than the corresponding loss when using the filtration plant. This difference is much more than offset by the difference in power cost of the two systems. The loss of water per ton of ore treated is slightly less than when using the filter plant, amounting to about five tons on a basis of 140 tons treated daily.



Foam Rings on Thickener

12 in. above and 12 in. below surface of contents.



Thick Pulp and Solution

Mixed in air-lift box.

The accompanying table shows the assays from the plant giving the values of the overflow solution and of the underflow thickened pulp when working along normal lines. The underflow assays represent the total value discharged from the different thickeners, and the results are obtained by the pulp and its contained solution being evaporated to dryness without decantation or filtering.

ASSAYS OF PULP AND OVERFLOW

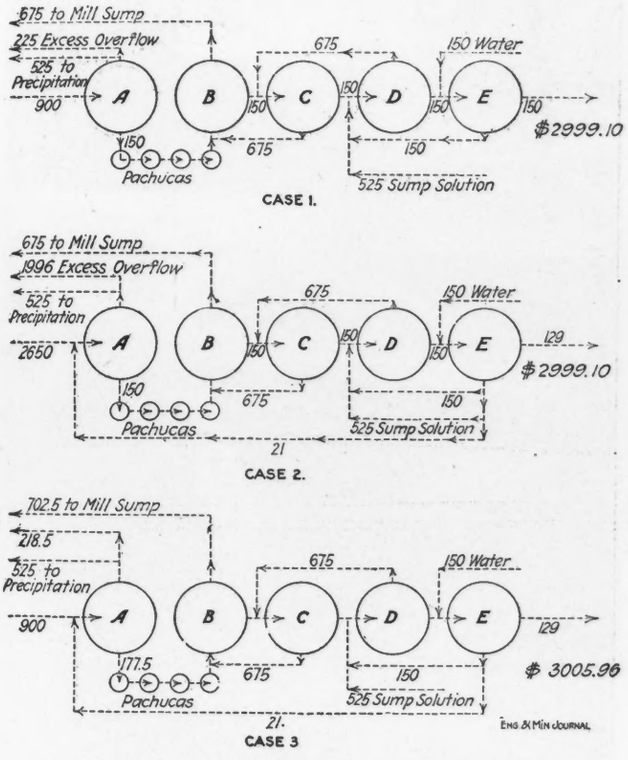
Thickener No.	Thickened Pulp Ounces Gold per Ton	Overflow Solution Ounces Gold per Ton
1	0.82	0.38
2	0.22	0.22
3	0.04	0.02
4	0.03	0.01
1	0.96	0.16
2	0.28	0.14
3	0.08	0.06
4	0.05	0.02
5	0.03	0.01
1	1.68	0.38
2	0.40	0.32
3	0.14	0.12
4	0.10	0.06
5	0.07	0.03

*This is the sixteenth of a second series of articles by Mr. Megraw. It deals with the comparative details of cyanide practice, discussing points of possible improvements. Preceding articles of this series appeared in the issues of Sept. 6, Oct. 4, Nov. 1, Nov. 15, Dec. 20, 1913; Jan. 31, Mar. 7, Mar. 21, Apr. 25, May 23, June 20, July 25, Aug. 29, Sept. 12 and Oct. 17, 1914. The next article will deal with "Combined Cyanide and Other Processes," and will appear in the issue of Dec. 5, 1914.

In order to relieve the No. 1 thickener from handling so much solution, and also to save one air lift, the overflow from No. 2 thickener is piped directly to the mill sump, where it is mixed with the excess overflow from thickener No. 1 and thence it is pumped to the battery tank. The same result is accomplished as if the flow from No. 2 were carried directly to No. 1 and the flushing of No. 1 thickener with excess solution is avoided.

Methods of Continuous Flow

The accompanying diagrams show the three methods by which this plant is, or may be, handled. In the first case, it will be noted that 150 tons of water are added to the final thickener and 150 tons of overflow taken off directly, another 150 tons going with the tailings. In

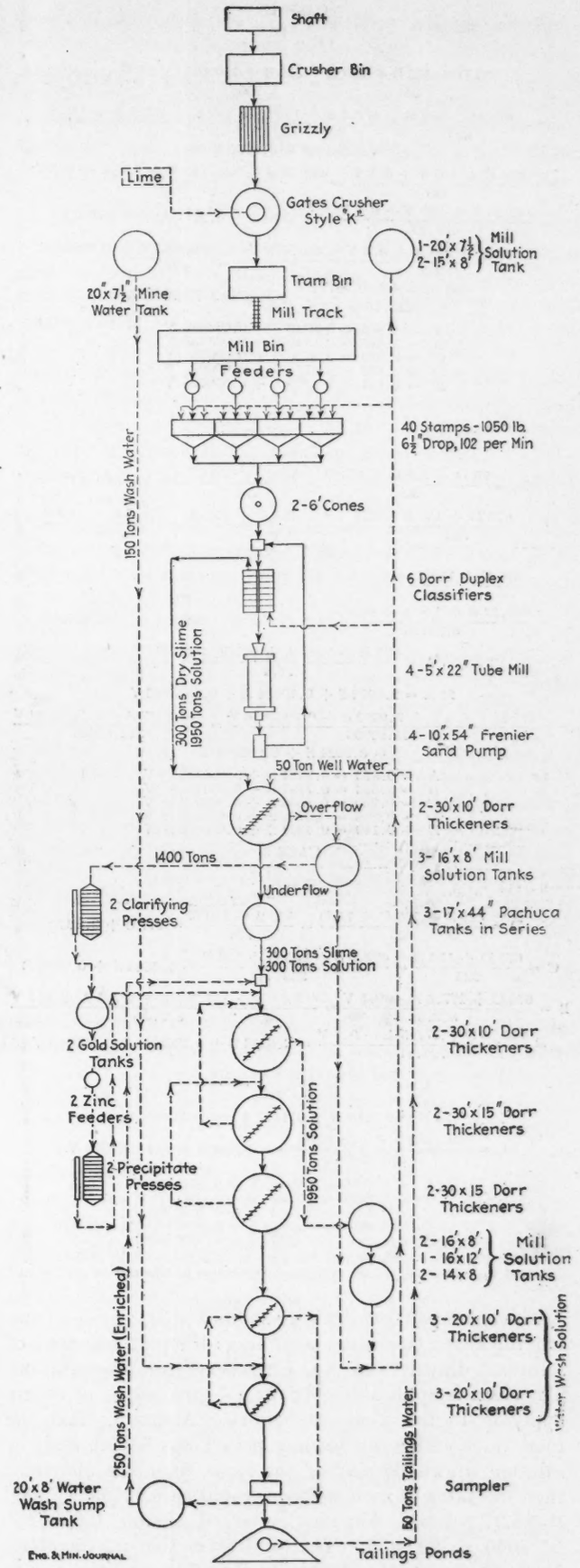


Three Arrangements of Solution Flow

the second case, while 150 tons of water are added to the final thickener, only 129 go with the tailings, the rest going back to thickener No. 1. In the third case, the same thing takes place, but there is a difference in the inflow and outflow from thickener No. 1. These differences are made plain in the three sketches. The accompanying equations show the value of overflow solutions, of ore and of barren solutions in the various cases specified. These flow-sheets and equations have been worked out at the Tom Reed mill, and are those applied in practice to the work.

THICKENER EQUATIONS

V = Value of ore;
S = Value of barren solution; in checks, the value of ore is assumed to be $20 per ton;
A = Value of overflow from thickener No. 1;*
B = Value of overflow from thickener No. 2;
C = Value of overflow from thickener No. 3;
D = Value of overflow from thickener No. 4;
F = Value of overflow from thickener No. 5.



Flow Sheet of Gold Road Mill

CASE 1

$$E = \frac{D}{2}$$

$$D = \frac{75\,D + 525\,S + 150\,C}{825} = \frac{525\,S + 150\,C}{750} = 0.7\,S + 0.2\,C$$

$$C = \frac{675\,D + 150\,B}{825} = \frac{472.5\,S + 135\,C + 150\,B}{825} = \frac{472.5\,S + 150\,B}{690}$$

$$= 0.6848\,S + 0.2174\,B$$

$$B = \frac{675\,C + 150\,A + 0.5\,V}{825} = \frac{462.24\,S + 146.745\,B + 150\,A + 0.5\,V}{825}$$

$$= \frac{462.24\,S + 150\,A + 0.5\,V}{678.25} = 0.6815\,S + 0.2211\,A + 0.0007372\,V$$

$$A = \frac{675\,B + 225\,A + 0.5\,V}{900} = \frac{460.0125\,S + 374.2425\,A + 0.99761\,V}{900}$$

$$= \frac{460.0125\,S + 0.99761\,V}{525.7575} = 0.8749\,S + 0.001897\,V$$

$$\begin{aligned} A &= 5.866 = 0.8749\,S + 0.001897\,V \\ B &= 3.645 = 0.8749\,S + 0.0011566V \\ C &= 0.929 = 0.8750\,S + 0.00025\,V \\ D &= 0.326 = 0.8750\,S + 0.00005\,V \\ E &= 0.163 = 0.4375\,S + 0.000025\,V \end{aligned}$$

CASE 2

$$E = \frac{D}{2}$$

$$D = \frac{75\,D + 525\,S + 150\,C}{825} = \frac{525\,S + 150\,C}{750} = 0.7\,S + 0.2\,C$$

$$C = \frac{675\,D + 150\,B}{825} = \frac{472.5\,S + 135\,C + 150\,B}{825} = \frac{472.5\,S + 150\,B}{690}$$

$$= 0.6848\,S + 0.2174\,B$$

$$B = \frac{675\,C + 150\,A + 0.5\,V}{825} = \frac{462.24\,S + 146.745\,B + 150\,A + 0.5\,V}{825}$$

$$= \frac{462.24\,S + 150\,A + 0.5\,V}{678.255} = 0.6815\,S + 0.2211\,A + 0.0007372\,V$$

$$A = \frac{675\,B + 1996\,A + 0.5\,V + 21\,E}{2671},$$

$$21\,E = 9.0992\,S + 0.10094\,A + 0.0003366\,V$$

$$A = \frac{675\,B + 0.5\,V + 9.0992\,S + 0.0003366\,V}{695.89906} = \frac{469.1117\,S + 0.9979466\,V}{525.65656}$$

$$= 0.8924\,S + 0.001898\,V$$

$$\begin{aligned} A &= 5.870 = 0.8924\,S + 0.001898\,V \\ B &= 3.646 = 0.7791\,S + 0.0011568\,V \\ C &= 0.930 = 0.8542\,S + 0.00025149\,V \\ D &= 0.298 = 0.8708\,S + 0.00005029\,V \\ E &= 0.149 = 0.4354\,S + 0.000002514V \end{aligned}$$

CASE 3

$$E = \frac{D}{2}$$

$$D = \frac{525\,S + 150\,C + 75\,D}{825} = \frac{525\,S + 150\,C}{750} = 0.7\,S + 0.2\,C$$

$$C = \frac{675\,D + 150\,B}{825} = \frac{472.5\,S + 135\,C + 150\,B}{825} = 0.6848\,S + 0.2188\,B$$

$$B = \frac{675\,C + 177.5\,A + 0.5\,V}{852.5} = \frac{462.24\,S + 147.69\,B + 177.5\,A + 0.5\,V}{852.5}$$

$$= \frac{462.24\,S + 177.5\,A + 0.5\,V}{704.81} = 0.6558\,S + 0.2518\,A + 0.000709\,V$$

$$A = \frac{702.5\,B + 218.5\,A + 5\,V + 21\,E}{921},$$

$$21\,E = 9.0894\,S + 0.1157\,A + 0.0003258\,V$$

$$A = \frac{469.7889\,S + 0.9983983\,V}{525.4948} = 0.89399\,S + 0.0018999\,V$$

$$\begin{aligned} A &= 5.8785 = 0.89399\,S + 0.0018999\,V \\ B &= 3.7383 = 0.8809\,S + 0.0011874\,V \\ C &= 0.9549 = 0.7754\,S + 0.0002598\,V \\ D &= 0.331 = 0.87551\,S + 0.00005196V \\ E &= 0.165 = 0.43775\,S + 0.00002598V \end{aligned}$$

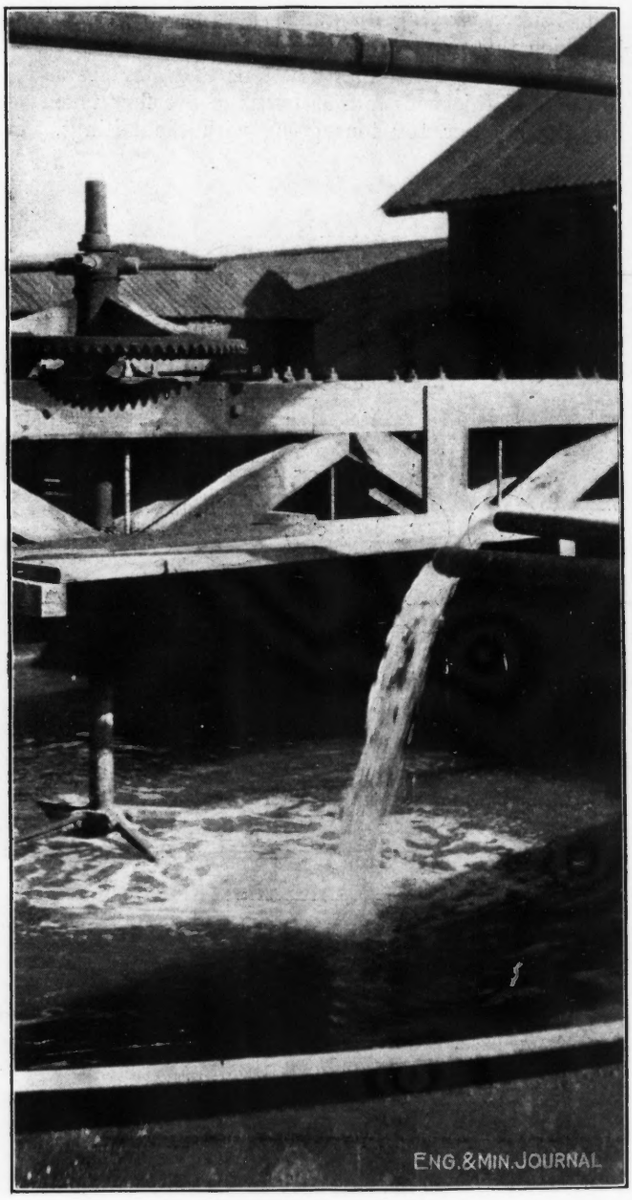
* Value of overflow solution from No. 1 thickener is independent of the amount delivered to it from the stamp mill, since the excess is returned to the battery tank.

The accompanying drawing shows a chart derived from the thickener equations, assuming different amounts of solutions drawn from No. 1 thickener for precipitation. The chart is applicable only for a 5-tank series, of course applying to the Tom Reed work. Assuming that the total value of the ore for any period was $3000, and the solution drawn off during the same time was 500 tons, then the value of such solution would be 0.00199 × 3000 = $5.97 per ton. For the discharged solution, 0.0000285 × 3000 = $0.0855. The total extraction is, therefore, $2994.27, or 99.6%. Assuming the same conditions as to value, but with 750 tons drawn off 0.00133 × 3000 = $3.99. For discharge solution, 0.0000115 × 3000 = $0.0302. Total extraction, $2995.52, or 99.85%. This chart has also been developed by the management of the Tom Reed mines, and is in use by them.

The operators have been much pleased with the results of the change from filtration to counter-current decantation, the process being continuous, requiring less labor and effecting economies as has already been indicated.

The Gold Road Mill

Another plant in the same district, which has made use of counter-current decantation, is the mill of the Gold Road Mines Co., at Kingman, Ariz. Here also a large vacuum leaf filter had been installed, but experiments with counter-current decantation showed that some advantage could be gained by discarding it.

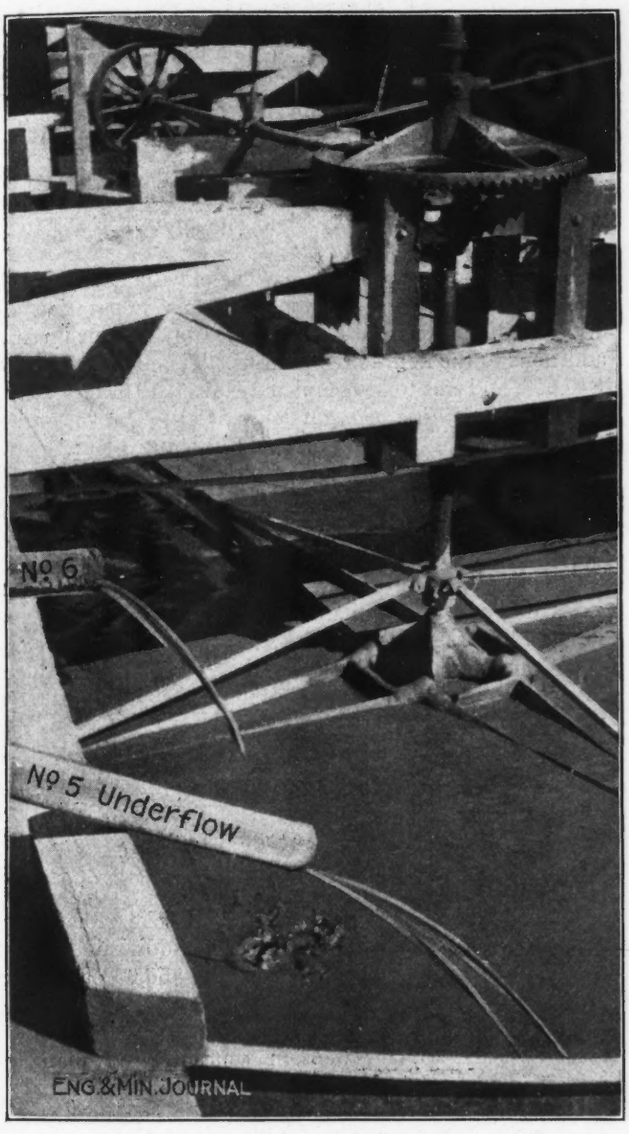


Overflow from No. 1 Thickener

Six hundred tons daily for 150 tons of pulp. Clarified by ten 3x10-ft. filter leaves.

The operators state that the principal disadvantage they found with the vacuum-filtration system upon their ores was that it was almost impossible to wash satisfactorily

the cakes on the leaves. Cakes of uniform resistance could not be formed. They would crack badly and large sections would fall from them, making satisfactory washing impossible. Besides, the expense of labor, repairs and power is considerably more than is necessary in following the counter-current decantation system. They find practically no difference between the two systems in the amount of cyanide and lime consumed, perhaps a slightly greater quantity, amounting to about 0.1 lb. of cyanide, is being consumed in the decantation system.



DISCHARGE FROM THICKENERS 5 AND 6, TOM REED MILL
Note thickness of pulp under No. 6.

An advantage found with counter-current decantation is that the dissolution of gold is so perfect, due to the longer contact between the solutions and the pulp. The difference, considering all things, between leaf filtration and counter-current decantation is at least 60c. per ton of ore treated in favor of the latter.

On account of having to precipitate at least 1400 tons of solution daily (it will be remembered that this plant treats 300 tons of ore per day of 24 hr.) in order to wash thoroughly the pulp in the decantation system, it is necessary to use 280 to 300 lb. of zinc dust per day. Consequently, there is rather a large amount of comparatively low-grade precipitate, which is difficult and expensive to melt and refine. It seems, however, that it would not be impossible to change the system so that a smaller quantity of higher-grade solution might be precipitated, and consequently a higher-grade precipitate made.

ESSENTIALS FOR SUCCESSFUL RESULTS

Among the essentials for successful operation of the counter-current decantation system, many operators have believed that the thorough and comparatively prompt settlement of the slime pulp is one, and another that the greatest dissolution of values be obtained before the pulp leaves the agitators and enters into the decantation tanks. The latter is particularly true in the case of the Gold Road mill, because of the character of the ore, which is such that the gold dissolution seems to be almost directly dependent upon the length of time the ore is in contact with cyanide solution. It is probable that additional time, even after the present process was finished, would develop more gold dissolution. This, however, would probably not be economical, since it might cost more to keep the pulp in agitation than the value of the gold derived through the additional time given. It is also essential that a thorough mixture of the pulp with wash solutions as they are passed from one decantation tank to another, be given. The main points in the decantation process are to get the pulp as thick as possible before discharging it from the decantation tank; to have as little dissolution of value take place in these tanks as possible and get as perfect a mixture of pulp with wash solution as can be obtained. Sufficient wash solution must also be added. At the Gold Road mill, it is found that best results are obtained by precipitating 1400 tons of solution per day, and this solution is used for washing in the decantation tanks.

PULP THICKENING NOT DEPENDENT ON SETTLING AREA

It might be mentioned here that many people have the idea that pulp thickening is dependent solely upon the settling area available per unit of pulp, or of dry slimes. This is true to a large extent, and is a principal factor with ores which do not settle readily. On the other hand, there are instances of slimes which have settling tendencies which do not depend principally upon the area of the settling tanks. There are all kinds of ore, from the purely granular, heavy variety, which settles almost immediately, to the almost purely colloid china-clay slimes, which will not settle at all. The dependence is divided among chemical conditions, such as alkalinity or acidity of solution, the dilution of the pulp and, perhaps, its electrostatic condition. For these reasons, it is well to be careful in outlining a plant to decant an ore whose slimes settle with difficulty. If settling will not take place within a reasonable tank area, it may be true that even a greatly excessive tank area will not accomplish the work. Also, with heavy, quickly settling slimes, extra heavy thickening apparatus is needed in the tank to take care properly of conditions which may arise.

At the Gold Road mill, there are 4.7 sq.ft. of settling area per ton of ore milled per day, and the pulp is discharged from one decantation tank to another at a little better than one of solids to one of solution, and by using an auxiliary tank, the final pulp is discharged to the

tailings dump at one ton of solids to two-thirds of a ton of solution. In all, the pulp is washed five times by decantation after it leaves the Pachuca agitation tanks, three times with low-grade cyanide solution, containing 2 to 4c. gold per ton, and twice with barren mine water.

Mechanical Equipment

There are three 17x44-ft. Pachuca tanks operated continuously in series, and by keeping these tanks in good order and not allowing them to build up from the bottom and sides with pulp, a satisfactory agitation is obtained. The pulp enters and leaves the tank, at a dilution of one to one.

Mixing launders are used to get the pulp and wash solution mixed. The upper end of the launder contains a well or pocket extending 8 to 10 in. below the bottom of it. Into this pocket, the pulp of the preceding tank is discharged by means of an air lift. The clear solution from the following tank flows across the pocket and floats the pulp out of it. The mixture is further assisted by baffles nailed to the bottom of the launders. The launders are from 10 to 15 ft. long, and discharge into a settling well in the center of the tank. These wells are 5 ft. in diameter, 3½ to 4 ft. long and extend 2 ft. below the surface of the solution in the tank. It is believed, after trying different ways of mixing, that this arrangement gives a fairly satisfactory result. The accompanying flow sheet shows the arrangement of the Gold Road mill and will clear up any questions which may occur in regard to the treatment there.

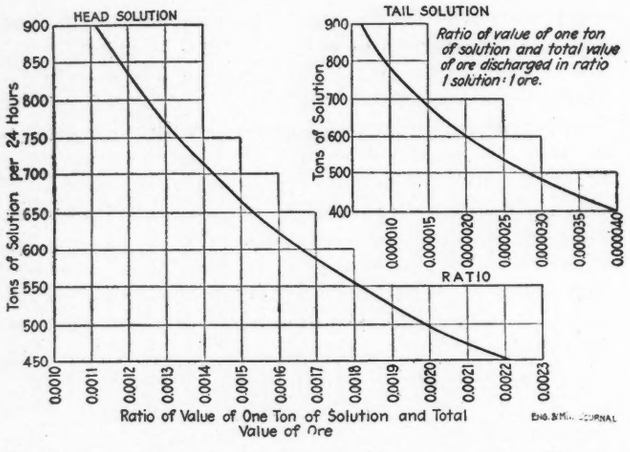


Chart for Five-Tank Series Derived from Thickener Equations

When considering the last two installations, it is well to remember that both of them made use of vacuum-filtration systems which had already been installed at considerable cost. Undoubtedly, to displace them, a new process had to prove clearly and distinctly that it would effect a material saving over the use of these plants, and this demonstration had to be so clear and positive that there should be no chance for error. That the plants have been in operation as long as they have is quite sufficient to show that they have justified all expectations and that they are working in an entirely satisfactory manner.

Continuous Decantation in Copper Treatment

That the silver-gold treatment field is not the only one in which counter-current decantation can be used to advantage is indicated by the experiments which have been and are being carried out on copper ores. The modern methods of pulp handling have added impetus to copper hydrometallurgy, and highly successful methods are being evolved. Many of the principal copper companies are experimenting with the system, and it seems probable that in the near future there will be opportunity to study such a plant in practical operation.

New Mine and Metallurgical Construction

Delarof Development Co., Unga Island, Alaska, broke ground June 15 for 200-ton cyanide plant, to cost $25,000, and to be completed Nov. 1. The plant is being built to treat 400,000 tons of tailings of the Apollo company, now on the tide flats of Unga Bay.

Argonaut Mining Co., Jackson, Calif., expects to remove 40-stamp mill to a new site and increase to 50 stamps.

Engels Copper Mining Co., Taylorsville, Calif., broke ground June 1 for 250-ton Minerals Separation flotation mill, capable of being extended to 400 tons by small additions to the flotation apparatus. The plant was to cost $40,000, and was to be completed Nov. 1, 1914.

Melones Mining Co., Melones, Calif., broke ground Aug. 1, for 250-ton cyanide sand-leaching plant, to cost $10,000 to $12,000, and to be completed Oct. 1.

Royal Consolidated Gold Mines, Copperopolis, Calif., contemplates overhauling old 120-stamp mill and installing new machinery.

Sierra-Alaska Mining Co., Pike, Calif., is building experimental cyanide plant of 10-ton capacity, to be enlarged if process is successful.

Tulare Mining Co., Porterville, Calif., contemplates installing machinery to manufacture epsom salts from magnesite waste.

Cariman Mining & Milling Co., Caribou, Colo., broke ground in July for 150-ton concentrating and cyanide plant, to cost $6000 and to be completed Nov. 1, 1914.

Hector Mines Development Co., Westcliffe, Colo., broke ground Aug. 10 for 50-ton cyanide plant, to cost $40,000 and to be completed Nov. 10.

Wanakah Mining Co., Ouray, Colo., broke ground May 1 for 200-ton copper-matting furnace, additional to 100-ton plant already in operation, to cost $50,000 and to be completed Oct. 20.

Cumberland Mining & Milling Co., Joplin, Mo., broke ground, July 15, for 350-ton concentrating plant, to cost $25,000, and to be completed Oct. 5.

Porphyry Dike Gold Mining Co., Rimini, Mont., broke ground June 25 for 100-ton stamp mill with amalgamating plates, to cost $40,000 and to be completed Sept. 15.

Eastern Star Mining Co., Midas, Nev., expects to break ground Nov. 1 for 50-ton all-slime cyaniding plant.

Nevada Douglas Copper Co., Ludwig, Nev., broke ground Aug. 1, 1914, for 250-ton copper leaching plant, to cost $125,000 and to be completed in January, 1915.

Pittsburgh-Dolores Mining Co., Rockland, Nev., broke ground May 1 for 60- to 100-ton continuous-decantation cyanide plant, to cost $30,000.

Rochester Consolidated Mining & Milling Co., Rochester, Nev., broke ground Aug. 1 for 100-ton all-slime cyanide plant, using the Dorr system, to cost about $100,000 and to be completed Feb. 1, 1915.

Union Mines Co., Union, via Palisades, Nev., broke ground June 24 for 50- to 100-ton concentrating plant, to cost $125,000, and to be completed June 1, 1915.

Tough-Oakes Gold Mines, Ltd., Kirkland Lake, Ont., is building 100- to 125-ton cyanide plant.

Bolivia Wants Its Tin Smelted Here

On account of the European war, Bolivia is unable to market its principal metal product, tin, of which the United States is the world's largest consumer. Roughly speaking, Bolivia produces about 25% and the United States consumes about 45% of the world's tin output, or about double the Bolivian production. The annual production in Bolivia is nearly 40,000 tons of *barilla*—containing about 60% Sn. Most of this product is shipped to Liverpool and normally about one-half of the *barilla* finds its way to Germany for smelting.

With the disruption of international credit, Bolivia finds itself hampered in its ability to purchase the articles of manufacture it needs, notwithstanding that it has an ample supply of tin to counterbalance those requirements. Recently, the Bolivian government began informal inquiries as to whether Bolivian tin concentrates could not be smelted in the United States, thus establishing a basis of credit with which the Bolivian people could purchase from the United States such manufactures as they needed. President Montes suggested to Adolfo Ballivian, consul-general at New York, that he take up this question with Richard M. Atwater, an American mining engineer who had been in Bolivia, but now consulting engineer for the firm of Ladenburg, Thalmann & Co., of New York.

The principal reason why the United States has not a tin-smelting industry is that it has no supply of tin ore, and Mr. Atwater judged that the only way in which an adequate ore supply could be assured was to have the Bolivian government undertake the smelting of the ore in this country, presumably near New York or some other convenient port where conditions of fuel, labor and market are more favorable than in Bolivia. He proceeded to sound the United States Government, as to its attitude toward the construction and operation of such a smelting works in this country by the Bolivian Government, for which his firm, Ladenburg, Thalmann & Co., consented to act as agents. The suggestion was favorably considered by the Department of Commerce, which has asked U. S. Minister O'Rear at La Paz to express an opinion as to the attitude of the Bolivian Government and to discover whether the latter would be likely to consider favorably an invitation from the United States to erect a tin-smelting works in this country.

For the moment there is no further progress, as the matter of adequate ore supply has not been solved. Most of the Bolivian ore is under contract with European smelters and much British and German capital is invested in the Bolivian mines. At present, it may be presumed that ore from other properties owned by South Americans such as the Llallagua and the important mines of Sr. Patiño is free to be shipped to the United States; eventually this ore would again be sought by European smelters, and the ore of the European-controlled mines would almost surely find its way to the former smelters, unless special inducements could be made by smelting works established in the United States. Competition would eventually decide the place of smelting but with a ready market in this country for the metal, which must now be sent to Europe and then freighted back to New York, it seems likely that a smelting plant in this country could easily survive if it could once get started with a fair ore supply as a nucleus.

New California Mining Association

By Lewis J. Eddy*

A California metal-producer's association is being organized by the mine operators of the state with the purpose of subserving, promoting and protecting the interests of men and companies engaged in the production of metals, and of securing betterments in all branches of the industry. The association contemplates the promotion of health, safety and welfare of miners and other employees, and of harmonious relations between employer and employee. There is no intention of taking up labor disputes, and the association is not formed in opposition to unions or other workmen's organizations.

This is the first time, in the history of metal mining in California, that there has been a direct and positive effort of producers to get together, except by the semi-popular method of organization and convention. The California State Miners' Association has been prominent and its accomplishments have been worth while, but popularity, if not politics, has had a great deal to do with the control of the association. Its conventions are a forum for free speech. Whatever its objects may have been, it has never put forth a positive effort for the direct betterment of working conditions in the mines. In fact, there was usually little done outside of convention times. This was not the fault of the members individually, but the result of the system of organization.

The present proposed organization has on its tentative list of members, invited to meet Oct. 28, the names of managers and owners of more than a hundred of the most important metal mines in the state. All persons, copartnerships and corporations of approved standing, engaged in the production of metal, may be admitted to membership. There will be a membership fee of $25 for those employing 25 men or more, and $10 for those employing less than 25 men. Monthly dues will be paid on the basis of the number of men employed. There is no apparent reason why the membership roll should not contain the name of every producing metal mine and metallurgical works in the state.

The need for getting together was never greater. There are numerous ways of protecting and promoting the interests of producers and of securing betterments in various branches, when the undertaking carries the strength of concerted effort. With such an organization as this proposed, the needs of the individual producer will be the common interest of all the members, and by keeping the association free of politics and labor troubles, the advancement of individual and collective interests will be assured. The initiative has been taken by a number of the largest and strongest producers in the state, and the subject of organization has been under consideration by many others, who have expressed approval of the general plan outlined.

*Associate editor, "Eng. and Min. Journ.," San Francisco, Calif.

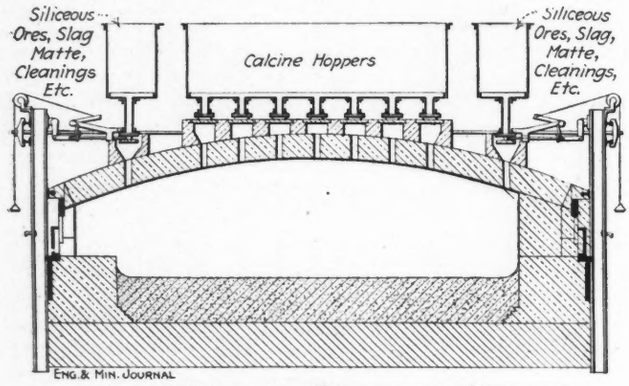
Correspondence and Discussion

Fettling Reverberatories

I notice in the JOURNAL of Mar. 14 an editorial on the subject of fettling reverberatory furnaces, the last sentence of which says: "With the improved methods of fettling through the roof, more cold material can be placed on the furnace sides with much less cooling of the interior than was possible when fettling was thrown through the open doors with shovels."

Believing that I was the first one to conceive and work out the present method of fettling reverberatory furnaces, I wish to call attention to the fact that this method is patented and I hope that any company using it will be honorable enough, after trying it out, to communicate with me and arrange for the privilege of using it.

While some have benefited by the use of the method of fettling suggested in my patent, I feel sure that no one has gained the full benefit to be had in running a large



CHARLES' METHOD OF FEEDING AND FETTLING

reverberatory furnace in the way I have suggested in U. S. Pat. 871,477, granted to me Nov. 29, 1907. In describing my continuous method of feeding reverberatory furnaces, I said:

> My invention consists in a practically continuous feeding of ores to the furnace, through dropping very small charges at frequent intervals, or continuously, at various places over the hearth without interrupting the smelting or reducing the temperature.
>
> I propose to feed siliceous material or ores through a series of small holes in the roof located near the edge of the hearth, so that such material will pile against the furnace walls and protect them from corrosive action. The raw or calcined ores I propose to feed through a series of small holes located over the remaining portion of the hearth.

I discovered that by feeding the raw siliceous ores close to the side walls of the furnace and by reducing the size of the charges and feeding them in oftener and in various places over the hearth with the furnace kept at full heat all the time, the tonnage was compounded several times and a saving of labor in feeding, leveling charges and fettling was accomplished. A saving of heat was also effected as large charges bring the furnace below the smelting temperature whereas under my system a practically continuous operation results.

The feature of continuous charging as well as the fettling of the reverberatory through the roof were covered both singly and in combination in my invention. The editorial in the JOURNAL of Mar. 14 refers to the change in material used for fettling, but it will be noticed from the drawings submitted with my application for patent that I had anticipated the use of slag, matte, cleanings, etc., as I recognized that it was only necessary to feed sufficient cold material on the side to prevent corrosion of the furnace wall. Three of the subjoined claims of my patent will suffice to indicate how fully the present practice was covered by my invention:

> (1) The within described method of feeding ores into reverberatory furnaces consisting in dropping the same over the hearth in small charges at frequent intervals.
>
> (4) The within described method of feeding ores into reverberatory furnaces consisting in feeding raw siliceous ores between the calcined ores and the edges of the hearth.
>
> (7) The within described method of feeding reverberatory furnaces consisting in feeding silica or siliceous material for fettling continuously from a hopper or trough extending around the edge of the hearth and in feeding the ore in small charges over the hearth of the furnace by any convenient means.

I desire to set at rest for all time who was the originator of this method of fettling reverberatory furnaces through the roof. One of the illustrations from my letters patent, inclosed herewith, will show plainly that there is no essential difference between the present fettling practice and the method I developed.

H. L. CHARLES.

La Fundicion, Peru, Aug. 18, 1914.

Cutting Up a Boiler with Dynamite

In connection with A. O. Christensen's article in the JOURNAL of Oct. 10, I thought the following taken from § 127, Part V, *Professional Paper* 29, Corps of Engineers, U. S. Army, would be of interest:

"All charges will be external. The standard formula is $C = 2.5\ Bt^2$, in which C = the charge in pounds, B the width of the section in feet, and t its thickness in inches. The charge must extend entirely across the plate or sheet. The accompanying table gives the charges necessary to cut through a plate 1 ft. wide of the thickness given. It is computed from the above formula for 50% dynamite:

CHARGES FOR CUTTING STEEL PLATES

Thickness of Plate, In.	Charge of 50% Dynamite, Lb.	Thickness of Plate, In.	Charge of 50% Dynamite, Lb.
¼	0.16	1¼	3.90
½	0.62	1½	5.62
¾	1.40	2	10.00
1	2.50	3	23.50

"A single 'chain' (1 lb. per running foot) will cut a plate up to ⅝ in. thick. Two, three and four 'chains' will cut plates ⅞, 1⅛ and 1¼ in. thick, respectively. The charge must be held snugly against the plate . . . . and whenever possible must be tamped. For structural shapes figure the width as the sum of web and flange widths, and the thickness as the area of cross-section in square inches."

F. HAROLD BROWN.

Elizabeth, N. J., Oct. 17, 1914.

Editorials

Some War Reflections

In the gradual recovery from the hysterics immediately following the great calamity, we are beginning to see some things with a truer perspective, although there is no one keen enough and wise enough to see all things clearly.

The greatest problem has been, and still is, the restoration of international exchange. The world could not suddenly settle all of its debts with gold without becoming bankrupt. The blockade of financial transactions has been relieved, but is still far from being solved.

The ocean carrying capacity appears to be ample. Indeed some big ships have been laid up because there is no use for them. Let it be remarked that there has been relatively little destruction of ships. The German flag has been swept from the seas, but the captured ships will remain available for use as soon as their ownership be adjusted.

The great cost and waste of the war are things to be recognized, but they are probably exaggerated. The destruction of material is largely what was intended for just this purpose, which has been paid for, and which may not have to be replaced. Moreover, the main parts of the armies in the field had to be supported in the previous time of peace and were withdrawn from industry anyway. If the result of the war should be disarmament and the saving to the world of a large part of the $2,000,000,000 which Europe has spent annually on her military establishments and the release of millions of men from unproductive occupations, there will be some gain. It was these enormous military expenditures previous to the war that were crushing Europe's financial and industrial structure and were consequentially affecting the American.

Immediately after the war started there was a building of great hopes upon what an expansion of export trade would do for the United States. When no material expansion occurred a pall of pessimism spread over everybody. It was forgotten that the machinery of a new trade could not be developed over night. But now after three months we are witnessing the beginning of a real expansion, which is shown both by the statistics and by the easing of sterling exchange.

An increased export trade, however, is not alone going to restore prosperity in the United States. People and corporations have merely been living, buying only from hand to mouth and refraining from building for the future. Supplies of foreign capital have been cut off, present domestic capital is insufficient for all of our needs, and what there is of it is being husbanded for emergencies. This is why business in this country has been dull.

There is a curative process in operation, however, which has not been sufficiently estimated. This is the new spirit of economy that has developed in this country. Our national and personal extravagance has been for years the subject of unavailing exhortation. It needed the shock of Aug. 1 and the pinch of curtailed incomes to change our way of thinking. There is now a new and nation-wide idea of saving and thrift, where previously there was no thought of it. The saving of about 15c. per day is $50 per year; and $50 per year saved by 20,000,000 families is $1,000,000,000, a result by no means impossible, not even if incomes are lower than they were. With such an addition to our resources we should be able to do our own building without drawing money from anywhere else. Something of this kind is going to happen, and to America it may be the most important result of the economic earthquake.

Nero Fiddles while Rome Burns

For many months before the war, American business experienced the agony of waiting for the Interstate Commerce Commission to render a decision in the railway-rate case. Finally the mountain labored and produced a mouse. The Eastern railways were granted a partial increase of freight rates and were advised to take the rest of what they wanted out of the public by an increase of passenger rates. Mr. Average Man has no Brandeis to look out for him, and consequently he has lately been paying 2¼c. for his mileage instead of two cents.

However, the war conditions have produced new problems for the railways, and they have gone again to the Interstate Commerce Commission, asking permission to make a further increase in freight rates. The executive department of the Government and Congress itself have lately been acting promptly and sensibly in emergency measures, and there was hope that the members of the Interstate Commerce Commission had also read the signs of the times. The characteristic postponement of this hearing caused some qualms; but when the hearing itself finally came off, the attitude of the commission produced a very distinct chill. Must we then run the gamut of another period of uncertainty, indecision, and final refusal, with Mr. Brandeis, like the Pied Piper of Hamelin, leading the way to destruction.

In these extra-legislative bodies—the Interstate Commerce Commission, and the new Trade Commission, and the Federal Reserve Board—the country is obtaining experience in the new system of government by commission. Congress, unwieldy in numbers, and overloaded with work, delegates certain of its powers to a commission, which is supposed to be composed of experts. The Interstate Commerce Commission, however, has come to regard itself as a judicial body, which must split hairs in determining the merits of every case. Questions of policy do not enter into its calculations at all.

The railway case is probably not so abstruse as the commission thinks, if it would only forget Mr. Brandeis, and consult business administrators. The president of a Western railroad, not concerned in these cases, himself a distinguished philosopher, expresses the opinion that

passenger rates ought not to be raised; that class rates on freight ought not to be raised; but that commodity rates ought to be raised very materially, being far too low.

However, decision in the present case is demanded promptly by the dictates of policy. If the Interstate Commerce Commission cannot act upon such grounds, let Congress recall its delegation of authority, and act itself.

Australia under Labor-Union Rule

The labor unions of Australia have got about everything they want. Having captured the governments of the several states some years ago, they are in official control of things and can dictate much as to what employers may and may not do. The hours of labor are fixed and the rates of wages. Also, the quantity of work that any man may do. The hours for quitting at noon-time and at the end of day and the recess for tea in the afternoon are named and there may be no deviation from them. It matters not if the stevedores loading a ship have only one more bar of copper to put aboard when the gong strikes at the end of the day; the ship waits for the next day. And so on.

Yet there seem to be some discordant notes in the situation, some things that are not wholly to the satisfaction of the unions. A paragraph in a recent letter from a correspondent in Sydney, reveals something of this. He writes:

> Broken Hill is operating on part time, I believe, and the unions seem to be having everything their own way. They have a nice (?) class of men there. As the troops were leaving the town they were hooted and jeered by the miners who failed to respond to the call for volunteers.
>
> Some of the causes and effects of strikes here are so ridiculous that I wish I dared to write an article about them. Some day I will, but at present I dare not even refute the statement made in our leading morning paper of yesterday, that there were men in Chicago earning but 10@15c. per day, and that farm laborers were being offered $1.20 per week.

We opine that the leading morning paper of Sydney, N. S. W., has not heard about the $9-per-day plumbers of Butte, Mont.

Our Sydney correspondent remarks further, "There is one thing, however, that I can say for Australia. Certainly it is a great country." It is, no doubt, that very thing and the long period of prosperity that has lately been enjoyed has permitted some things to come about.

If Australia has been afflicted in recent years by a series of its old-time droughts, things might have been different. Not even labor unions can butt successfully against the laws of nature. The shadow of the great war has been teaching some lessons in Australia, as elsewhere. In an official report of the Wallaroo & Moonta Mining & Smelting Co., dated Adelaide, Sept. 15, 1914, it is said that "Notice having been given by the purchasers of our copper of suspension of the contract, it became imperative to conserve the funds available to the company, in order to provide for pumping operations and other work necessary to keep the mines in such a condition as to be able to resume work with as little delay as possible when the situation warranted such a course." Consequently, the mines and smelting works were closed about the middle of August. However, this did not suit the State government which wanted to keep the men employed. After some communication between the government and the company, an arrangement was made whereby the government undertook to advance to the company 80% of the then value of copper on all metals shipped or produced. At the same time, the employees of the company agreed to a 10% retention of their salaries and wages as a fund to assist in meeting any loss that might be sustained under these resumed operations. Operations were resumed on Aug. 28.

The company soon found, however, that the state-aid arrangement was not going to be a panacea, and that the only way out of the difficulty was a reduction of wages by 20%, which reduction was made Oct. 1.

Copper Near Its Nadir

When the war burst upon us, copper stood at about 12½c. For two months, producers made no efforts to sell, but let consumers have what they wanted, and the price held fairly firm. During the last month, however, the market has been gradually losing its one-sided character, and some producers have more openly exhibited their desire to sell copper. The result has been a crumbling of prices, until at last the market was down to about 11c. Even at that there was no noteworthy increase of interest among the wire-drawers, brass-makers, etc., who continued to buy only from hand to mouth, refusing to enter into forward contracts.

When copper was available at about 11½c., there were intimations that the manufacturers would show some courage at about 11c., but when copper was actually available at 11c., the manufacturers revised their ideas and thought about 10½c. The question was asked, What did they want? They wanted to buy at the very lowest price. The man who buys at 11½c. and two weeks later sees that if he had waited he could have got his copper at 11c., feels chagrined. During the last week, producers offered more resistance and consumers tended to revise their ideas.

In fact, copper is already far below the cost of production. The average cost for labor, material, power and transportation in the production of the copper of America is about 10c. per lb. The capital invested in plant is about 15c. per lb. of annual production. Add, therefore, 2c. per lb. for the interest on capital invested in plant and the depreciation of that plant, which is constantly wearing out. The cost on account of the capital invested in the mines themselves is additional. The average mining company selling copper for less than 12c. per lb. is not only depleting its principal, but also is throwing away money in doing so. This is figured on the basis of production at full capacity. Operating at half capacity the cost is materially increased.

On the present scale of operations, we do not believe that even the Utah Copper Co. can really make any money in selling copper at 11c. We do not believe that our copper-mining companies as a whole can come out even unless they get at least 13c. This is without any regard to the capital represented by the orebodies themselves.

Why, then, is production not more rapidly extinguished by force of circumstances? Simply because the closing of a mine means destruction of organization, and consequently loss in starting up again; the deterioration of equipment, and consequently loss; the continuation of overhead charges and some maintenance charges, such as pumping, and consequently loss. It is, therefore, better

up to a certain point to suffer loss in operation than the loss by idleness. But the time comes when the pendulum of losses swings past the neutral point and then closures begin. Reports of them are becoming more frequent. Truly the copper industry is now near its nadir.

⁂

The loss of over 800 tons of Straits tin on two vessels sunk in the Indian Ocean by a German cruiser calls attention to the risks to which our supply of tin is at all times subject. All of it, or nearly all of it, comes from the Far East and reaches us by a long water transit, which is more or less hazardous even in times of peace. Production and consumption of the metal are so nearly balanced that the loss of 1000 tons may make a serious deficit and will affect the price, possibly to a considerable amount. Efforts to find a nearer supply of any quantity have failed, and the tin consumers are still dependent on the East.

BY THE WAY

A recent phrase in the Raritan Copper Works *Ingot* strikes us as happy: "Any fool can take a chance—it takes brains to be careful."

⁂

The cashing of a number of worthless checks, purchasing supplies and not paying for them, and successfully perpetrating other frauds by a young man posing as an engineer of the U. S. Geological Survey engaged in special work on the Green, Grand and Colorado Rivers, would not have been possible had the victims asked to see the identification card with which every field man of the Survey is provided. Such cards carry the engraved signature of the Secretary of the Interior and the personal signature of the Director of the Survey, George Otis Smith, as well as the signature and photograph of the employee himself, with the seal of the Survey stamped through all three. This may be worth remembering.

⁂

Heilbron, which is reported captured by the new outbreak of rebellious Boers under the leadship of Generals De Wet and Beyers, is about 75 miles south of Johannesburg, in the northern part of the Orange Free State; Premier Botha has issued a proclamation calling upon all residents of the Union of South Africa to assist in the suppression of this new rebellion. The first outbreak, led by Colonel Maritz, was quickly suppressed and some of the rebels captured, but Maritz, though wounded, succeeded in escaping into German Southwest Africa. Dispatches from Lisbon state that German troops have invaded the Portuguese colony of Angola, West Africa; preparations are being made to send troops and warships to Angola and also to Mozambique, Portuguese East Africa.

⁂

In view of the statements to the effect that the destruction wrought by German shells upon fortresses in Belgium points to their possessing a secret explosive much more powerful than any known to the other European armies, the *Engineer* gives the warning that such rumors should be taken with a great deal of reserve. It became known some 12 months ago that Germany had adopted trinitrotoluene in the navy for high-explosive shells, torpedoes and sea mines, and in all probability it is this substance that has caused consternation in some quarters. As an explosive, trinitrotoluene is eminently safe to handle, and needs to be detonated by mercuric fulminate. A shell or mine loaded with it bursts into larger fragments than when picric acid is the explosive, and although wet guncotton is more powerful if exploded in close proximity to the target, the effect produced by trinitrotoluene is much greater when the explosion takes place at some distance. Whereas picric acid readily forms metallic picrates which are dangerous to handle, trinitrotoluene does not react with metals, and can be manipulated safely even when hot, as it burns slowly without exploding.

⁂

The Government attorneys who are trying the case against the U. S. Steel Corporation have an ingenious theory of how prices are made in the steel industry. In the trial at Philadelphia they read alleged minutes of a secret meeting of the board of directors of the Steel Corporation, held a few months after its organization. Judge Gary was in the chair. Rails were taken up for discussion. They were selling at $28 a ton. Judge Gary said they should be made $30 a ton at once. There was a general disagreement. Someone feared that the press would say nasty things about the advance—so soon after the formation of the corporation. Someone remembered the smaller companies which, while not members of the combination, were accustomed to send representatives to the Gary dinners as if they had been bidden. "Let them raise the prices first," some one said. "Tip them off. There'll be no talk then." Six weeks later the small companies quoted rails at $30 a ton and a week after that the U. S. Steel Corporation's price went up to a like figure. This, the Government charges, is the price-making system which still prevails over 90% of the steel industry in this country. The Government attorneys also intimated that the panic of 1907 was a pool arrangement to boost prices. These are new ideas, and queer ones.

⁂

Some memories of fake mining promotions of 10 to 15 years ago are revived by the arrest in Toronto of Dr. Richard C. Flower, for whom the police have been looking for several years. Flower—otherwise known in Boston, Richmond and elsewhere, as Oxford, Montgomery, Courtland, etc., etc.—was a gentleman of various activities. After operating in different cities, he came to New York and was first known there as the proprietor of a "medical institute," which attracted some attention from the police. Not content with the profits—mostly nefarious—derived from his patients, he started the brokerage firm of R. C. Flower & Co., which did a profitable business. The firm actively dealt in some reputable stocks, but sandwiched in some mining projects of doubtful worth—perhaps we should say of undoubted worthlessness—the most notorious of which was the Arizona & Eastern Mining Co. The police finally came down on the concern, and Dr. Flower left New York for parts unknown. One of his specialties was jumping bail, and bonds have been standing against him in various states. For some years nothing was heard from him, but recently he was found in Canada. He is now about 70 years old, and the detectives report that he is in feeble health and addicted to the use of drugs. It was believed at one time that he had accumulated quite a fortune, but most of it seems to have been hidden or scattered.

PERSONALS

Ludwig Schlegler has taken charge of the Esmeralda mines, Chontales, Nicaragua.

P. W. Davis, of the Eastern Metal & Refining Co., has been visiting in New York.

J. Parke Channing, fully recovered from his recent operation, is again attending to business.

W. D. Pearce, who has been in New York for several weeks, has returned to Chihuahua, Mexico.

Arthur J. Hoskin has examined the George Law property in the Argentine district, Georgetown, Colorado.

Leo K. Kennedy has resigned as superintendent of the Jualin mines in Alaska, and has gone to Mexico.

Forbes Rickard has made an examination of the Auburn group near Middleton, in Ouray district, Colorado.

James H. Payne, of Baltimore, is on his way to Chile to start the nodulizing kilns for the Braden Copper Co. there.

Henry Gardner, senior director of Henry R. Merton & Co., Ltd., of London, is expected in New York early next week.

James Wilding, Jr., has completed the flotation work in which he was engaged at Silverton, B. C., and has returned to San Francisco.

Morton Webber, who recently examined the McIntyre mine, Porcupine, Ont., on behalf of the Nipissing Mining Co., has left for the Western States.

O. B. Perry, general manager of the Yukon Gold Co., has returned to the States from Alaska and is expected in New York at the end of this week.

Gen. Walter Scribner Schuyler, U. S. A., retired, manager of the Alaska mine at Pike, Sierra County, Calif., made a business visit to San Francisco recently.

M. A. Wolff, of Hauxhurst & Wolff, has joined the 72d Regiment, Seaforth Highlanders, of Canada, and has proceeded to the seat of war in Europe.

K. P. Campbell, chemist for the A. S. & R. Co., who was obliged to leave his duties because of troubles in Mexico, has returned to Monterey to resume work.

Walter E. Koch, mining and metallurgical engineer, of El Paso, Texas, has been severely ill at Pittsburgh, Penn., since last August, but is now getting along nicely.

R. L. Herrick has returned to the practice of his profession as a mining engineer and is making temporary headquarters with A. J. Hoskin, 308 Commonwealth Building, Denver, Colo.

Summer S. Smith, federal mine inspector of Alaska and mining engineer of the U. S. Bureau of Mines, is visiting his family at Oakland, Calif. He will return to Alaska in November.

H. A. J. Wilkens, president, and W. B. Devereux, Jr., general manager of the Mines Management Co., are now in California, looking over some properties in that state with a view to commencing operations.

Lawrence Addicks, of Douglas, Ariz., is visiting New York. The experimental leaching operations which he is directing for Phelps, Dodge & Co., are progressing well and a 75-ton pilot mill will soon be put in operation.

Charles L. Thomas, formerly superintendent of the Hay Foundry & Iron Works, Newark, N. J., now is engaged in the Russian Government service at Petrograd, where he is directing the use of a special steel in the manufacture of large guns.

Arthur Thacher, J. H. Troutman, J. A. Van Mater, L. G. Rowand, P. B. Paul, C. A. Schmidt and C. T. Brown, officers and directors of the Mineral Point Zinc Co. and its associated companies, have been visiting the properties of the Empire Zinc Co. in New Mexico.

W. J. Rogers, who has been exploring in northern Alberta for coal and oil lands in the interests of D. A. Thomas, the Welsh coal operator, has returned to Vancouver. He reports having encountered banks of pure asphalt along the Athabasca River, and oil indications farther north.

Robert B. Kelly has been appointed engineer and head of the Safety-First Department at the Washoe Reduction Works, Anaconda, Mont. His thorough knowledge of machinery and of all processes of smelting work give him a peculiar fitness for his new position. In addition to his work at the smelters, he will have supervision over all the operations of the Anaconda company throughout Deer Lodge County, with special attention to safety-first.

OBITUARY

Peter Lebeau died at Bozeman, Mont., Oct. 14, aged 85 years. He was born at Trois Rivieres, Quebec, and after traveling extensively through the western country, he went to Montana with the pioneers in 1865, working placers at Virginia City, French Gulch and Butte. He retired a number of years ago.

W. E. Proctor, superintendent of the Trinity River Mining Co., Trinity County, Calif., died of apoplexy on Oct. 12, at the mine. He was 45 years old and always appeared to be in good health. His home was in Oakland. He was formerly superintendent of the Amador Canal Co., at Sutter Creek, Amador County.

Henry Mayers, 84 years old, died at Oakland, Calif., on Oct. 1. Mr. Mayers was a native of England. He went by way of New York to San Francisco in 1853, and engaged in the jewelry business. He was one of the early manufacturers of gold quartz-set jewelry. He made a fortune in the Comstock mines. Since the fire in San Francisco, in 1896, he had made his home in Alameda.

Alfred Sang, for some years a resident of Pittsburgh, died Oct. 13, from wounds received in the siege of Antwerp. He was a lieutenant in the English bicycle corps and had been in active service since the British declaration of war. He was born in Paris, in 1874, of English parentage, and was graduated from a leading French technical school. In 1900 he located in Pittsburgh and resided there until 1909, when he went to England. While in Pittsburgh, he was known as an expert analytical chemist and a writer on metallurgical subjects. He was a member of the Engineers' Society of Western Pennsylvania, the American Society for Testing Materials and of the Electrochemical Society.

James E. York died in Brooklyn, N. Y., Oct. 10, aged 68 years. He was born in England and came to this country when a young man. He was known as an expert in rolling-mill work and an inventor of several improvements. In 1906, he, with some associates, took a lease on some ore property in Venezuela, interested capital and commenced to mine and ship ore, when President Castro canceled the concession. The Venezuelan Government subsequently made an award of $385,000 to reimburse American companies having Venezuelan concessions, and Mr. York's company may eventually recover its expenses. Suffering from ill health in recent years, he was unable to give active attention to business matters.

Capt. Harry Roberts died on Oct. 20, at Augustana Hospital, Chicago, at the age of 59 years. He was a pioneer of the Minnesota and Gogebic ranges, and one of the best known of the mining men of Lake Superior. A native of Cornwall, Eng., where he worked in the tin mines when a boy, he came to this country when in his youth, locating first near Sharon, Penn. In the early '80s he journeyed west to Ishpeming, on the Marquette range, where he was employed by the late Joseph Sellwood in the open pits, where Mr. Sellwood had contracts from the Cleveland Iron Mining Co. In the latter '80s he went with Mr. Sellwood to open the Colby mine at Bessemer and other Gogebic range mines. He and Mr. Sellwood went to the Vermilion range when the first ore was discovered there and opened the Chandler mine at Ely, the largest on that range today. Later, Capt. Roberts opened the McKinley at Biwabik, on the Mesabi. He was associated with Mr. Sellwood in various enterprises until the latter's death a few months ago. In 1896 he commenced explorations for himself and obtained interests in several Minnesota mines. At one time he held a lease on the great Leonard mine at Chisholm. Of late years he paid considerable attention to the Roberts-Kingston Construction Co., of which he was the head. The company had contracts to strip many of the large pit mines of Minnesota. He had a wide acquaintanceship in the district and was highly respected. The body was taken to Houghton, Mich., for burial. He was a prominent Mason and a member of the Lake Superior Mining Institute.

SOCIETIES

University of Wisconsin—Prof. A. N. Winchell is trying the experiment of teaching the microscopic study of minerals and rocks by correspondence. The work is done under the auspices of the extension division of the university, and is proving satisfactory. Each student must be equipped with his own petrographic microscope and thin sections.

American Institute of Chemical Engineers—The seventh annual meeting will be held in Philadelphia, Dec. 2-5. A program of excursions to a number of the large chemical manufacturing plants in and around Philadelphia is being arranged for. A number of addresses and papers on "The Present Opportunities for American Chemical Industries" will be delivered by prominent chemical engineers and business men.

Canadian Mining Institute—This society has made a proposition of union to the Mining Society of Nova Scotia. That society is to retain its name and local self government; the members to become members of the Canadian Institute and receive its publications on payment of $5 yearly. The approved papers read before the Mining Society will be published in the transactions of the Canadian Mining Institute and the name of the Mining Society of Nova Scotia will appear on the cover and title page of the volume.

Engineers' Society of Pennsylvania—A special meeting of this society has been called for Oct. 28, as a get-together meeting to discuss matters pertaining to the exhibit of the Pennsylvania Industrial Welfare and Efficiency Conference, and the winter activities of the society. On the same day, a public hearing will be given at the society headquarters in Harrisburg, by the Engineers' Commission of the Commonwealth of Pennsylvania, to obtain expressions of opinion and to take testimony on the desirability of fixing, regulating and controlling engineering responsibility for the design, construction and operation of engineering works, public or private, where there is unusual hazard to life, health and property. A draft of a proposed legislative bill has been circulated among the members of the society as a basis for discussion.

The Pennsylvania Industrial Welfare and Efficiency Conference will be held under the joint auspices of the Department of Labor and Industry of the State of Pennsylvania, and the society. Matters pertaining to sanitary measures and to the safety, welfare and efficiency of employees will be discussed by engineers and leaders of industry and labor at a conference to be held in the House of Representatives, in Harrisburg, Nov. 17 and 19. A manufacturers' exhibit of appliances and equipment will be held in the same connection on Nov. 16 to 20, inclusive.

INDUSTRIAL NEWS

The S. Flory Manufacturing Co., Bangor, Penn., announces the death on Oct. 20 of its manager of sales, Andrew A. Bruch, who had been with the company since its inception.

The Justrite Mfg. Co. has recently purchased a tract of land, 226 ft., on Southport Ave., and 125 ft. on Hawthorne Ave., Chicago. Plans have been drawn for a 5- or 6-story building, to be used as a manufacturing plant, and which will be constructed probably next year.

TRADE CATALOGS

Link-Belt Co., Chicago, Ill., Link-Belt Locomotive Cranes. 38 pp., illus., 10¾x8½ inches.

General Filtration Co., Inc., 326 Cutler Bldg., Rochester, N. Y. Catalog. Filtros. 28 pp., illus., 7x5 inches.

E. M. Freese & Co., Galion, Ohio. Catalog. Brick, tile and fireproofing machinery. Illus., 8½x11 inches.

Lehigh Car, Wheel & Axle Works, Catasauqua, Penn. Catalog No. 50. "Fuller Quality" face hardened sprocket and traction wheels, chilled charcoal iron castings. 64 pp., illus., 6x9 inches.

Marion Malleable Iron Works, Marion, Ind., Handbook, shoes for wood stave pipe. 135 pp., illus., 7x4½ in. This little book describes the malleable-iron fittings this company makes for continuous-stave pipe, much of which is used in bringing water to mining operations. It also contains much tabular data useful in installations of this character.

Armstrong Cork & Insulation Co., Pittsburgh, Penn. Catalog. Nonpareil insulating brick for boiler settings. 16 pp., illus., 6¼x3½ in. The Nonpareil insulating bricks described in this pamphlet are made chiefly of diatomaceous earth and are intended for insulation of boilers and other furnaces. Examples are shown of the Nonpareil brick set between firebrick and common brick, and also with the Nonpareil on the outside.

NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

AGGLOMERATING—Process of Agglomerating Fine Ores. James H. Payne, Baltimore, Md. (U. S. Nos. 1,114,029 and 1,114,030; Oct. 20, 1914.)

ALLOYS—Process of Producing Alloys Stable against Strong Acids. W. and R. Borchers, Aachen, Germany. (Brit. No. 18,212 of 1913.)

AMALGAMATOR. Fred Stringham, Denver, Colo. (U. S. No. 1,113,065; Oct. 6, 1914.)

CHLORIDIZING—Process of Chloridizing Ores and Residues. A. D. Ledoux, New York. (Brit. No. 17,411 of 1913.)

CONCENTRATION—Improvements in or Relating to the Concentration of Ores. A. H. P. Lowry, Prahran, Victoria, Aust., and H. Lavers, Broken Hill, N. S. W. (Brit. No. 16,302 of 1913.)

CONCENTRATION—Improvements in or Relating to the Concentration of Ores. T. M. Owen, Broken Hill, N. S. W. (Brit. No. 16,141 of 1913.)

CYANIDING—Leaf of Vacuum Filters for Cyanide Process. Yeikichi Ohtsuka, Tokyo, Japan. (U. S. No. 1,111,609; Sept. 22, 1914.)

DRILL. Charles C. Hansen, Easton, Penn., assignor to Ingersoll-Rand Co., New York, N. Y. (U. S. No. 1,113,620; Oct. 13, 1914.)

DRILLS—Improvements in and Relating to Rock Drills and Detachable Bits or Cutters Therefor. R. Jones, Johannesburg, Transvaal. (Brit. No. 16,125 of 1913.)

ELECTRIC FURNACES—Improvements in or Relating to Cooling Lower Electrodes for Electrical Smelting Furnaces. (Brit. No. 6731 of 1914.)

ELECTROLYTIC CELL. Court C. Titus, Helena, Mont., assignor to Montana Metallurgical Co., Helena, Mont. (U. S. No. 1,111,977; Sept. 29, 1914.)

FILTER. George Spence, Mexico, Mexico. (U. S. No. 1,111,275; Sept. 22, 1914.)

FUME-CONCENTRATOR for Smelters. Stephen W. Smith, San Jose, Calif. (U. S. No. 1,112,860; Oct. 6, 1914.)

FURNACE CRUSTS—Improvements in or Relating to Devices for Use in Removing Sediments or Crusts from Rotary Furnaces or the Like. N. Ahlmann, Copenhagen, Denmark. (Brit. No. 16,893 of 1913.)

IRON—Process of Producing Iron and Steel Directly from the Ore. K. A. F. Hiorth, Christiania, Norway. (U. S. No. 1,112,007; Sept. 29, 1914.)

LAMP—Miner's Acetylene Lamp. Yeikichi Ohtsuka, Tokyo, Japan. (U. S. No. 1,113,042; Oct. 6, 1914.)

LOCOMOTIVES—Reel for Mine Locomotives. George C. Abbe, Lansdowne, Penn., assignor, by mesne assignments, to The Baldwin Locomotive Works, Philadelphia, Penn. (U. S. No. 1,110,995; Sept. 15, 1914.)

MAGNETIC SEPARATOR. George Ullrich, Magdeburg, Germany, assignor to Fried. Krupp, Aktiengesellschaft, Grusonwerk, Magdeburg-Buckau, Germany. (U. S. No. 1,114,071; Oct. 20, 1914.)

MINE-CAR-DUMPING APPARATUS. Charles A. Griffith, Pruden, Tenn. (U. S. No. 1,111,830; Sept. 29, 1914.)

ORE DRESSING—An Improved Process and Apparatus for Hydraulic Jigging, Ore Separating and the Like. K. Kleinberg, Libuschin nr. Kladno, Bohemia. (Brit. No. 13,191 of 1913.)

ORE TREATMENT—Treatment of Zinc or Copper Ores, Ashes, Waste and Chippings. F. Bourgeot, Lastours, France. (Brit. No. 15,943 of 1913.)

PIG IRON—Improved Manufacture of Pig Iron, C. A. Keller, Paris, France. (Brit. No. 22,692 of 1913.)

PULVERIZING APPARATUS. Alexander Granger, Bulawayo, Rhodesia, South Africa. (U. S. No. 1,111,454; Sept. 22, 1914.)

PUMP—Mine Pump. Lewis McIsaac, Inverness, N. S., Canada. (U. S. No. 1,112,820; Oct. 6, 1914.)

RADIUM—An Improved Process of Concentrating Ores and the Intermediate Products of Radium and Mesothorium. E. Ebler, Heidelberg, Germany. (Brit. No. 1173 of 1914.)

RARE METALS—Improved Means for the Extraction of Rare Metals such as Thallium and Radioactive Metals from Lead Ores and Production of a White Pigment. Deutsche Felsen Oel Ges. Franzen & Co., Berlin, Germany. (Brit. No. 16,891 of 1913.)

ROASTING—Ore Roaster. George H. Dern, Salt Lake City, and Theodore P. Holt, Park City, Utah. (U. S. Nos. 1,113,961 and 1,113,962; Oct. 20, 1914.)

ROASTING FURNACE. Frederick Laist, Anaconda, Mont. (U. S. No. 1,114,371; Oct. 20, 1914.)

SCREEN. David Cole, Tucson, Ariz. (U. S. No. 1,111,217; Sept. 22, 1914.)

STEEL—Alloyed Steel. Samuel S. Wales, Munhall, Penn., assignor to Carnegie Steel Co., Pittsburgh, Penn. (U. S. No. 1,111,711; Sept. 22, 1914.)

STEEL ALLOY. Samuel S. Wales, Munhall, Penn., assignor to Carnegie Steel Co., Pittsburgh, Penn. (U. S. No. 1,111,710; Sept. 22, 1914.)

TRANSPORTATION—Ore, Bulk or Dense Cargo Carrier. Hugo P. Frear, San Francisco, Calif., assignor to Bethlehem Steel Corporation, South Bethlehem, Penn. (U. S. No. 1,111,740; Sept. 29, 1914.)

ZINC—Metallurgy of Zinc. A. L. J. Queneau, Torresdale, Penn., assignor to Queneau Electric Zinc Furnace Co., Philadelphia, Penn. (U. S. No. 1,114,036; Oct. 20, 1914.

Editorial Correspondence

SAN FRANCISCO—Oct. 21

The Contest for the State Senatorship in the 36th district is between two lawyers and one mining engineer. There are 22 lawyers in the senate, but no engineers. So the voters of the district, which embraces a part of Los Angeles and all of Pasadena and the mining camp of Tropico and others in that vicinity, will have opportunity to reduce the number of lawyers and add one engineer by electing J. Nelson Nevius, of Pasadena. It does not matter much what Mr. Nevius' politics may be. So far as the interests of the mining industry are concerned the less politics the better. California has had so much politics mixed in with the conduct of mining affairs and the making of mining laws that the industry has suffered rather than benefited by legislation. Mr. Nevius has announced one plank in his platform to be the favoring of further coöperation between state and Federal authority for the protection of forests from destructive fires. It was he who secured the insertion of such a plank in the Democratic state platform. Preservation of forests from fire is of essential interest to mining. But Mr. Nevius need not stop at that should he be elected to the state senate in November. There are other matters of vital and direct interest to the mining industry of California that can be advanced by coöperation with the Federal Government. Just now California is having a demonstration of such coöperation in laying the foundation for a system of mine inspection. Mr. Nevius will find plenty of work if elected. His standing as a mining engineer and his practical knowledge of constructive legislation in the interests of mining are beyond question. He is entitled to the support of every man and woman interested in the preservation and advancement of California's mines.

DENVER—Oct. 22

At the Colorado Fuel & Iron Annual Meeting, held in Denver, Oct. 19, president J. F. Welborn rendered an informal report, at the same time explaining that he would in a few days furnish each stockholder a full printed report. The value of manufactured steel products during the fiscal year was about $12,000,000, of which fully $10,000,000 was distributed in Colorado as wages and regular expenses. The company now employs approximately 12,000 men in its coal mining, coking, steel manufacturing and allied operations. There was a 40% decrease in the company's coal production during the last year, due only in part to strike conditions, there having been a notable decrease in orders for rails. All officers were reëlected for another year. The numerous subsidiary companies, such as the Colorado Supply Co., held annual meetings the same day.

BUTTE—Oct. 22

The Seventh Week of Military Rule finds Butte more or less settled down to normal conditions. Hold-ups and robberies, however, after the withdrawal of an additional 250 soldiers, Oct. 16, have again become almost daily occurrences. The announcement that eight prisoners had made their escape from the county jail during the week and that this was not discovered until Oct. 19, came somewhat as a shock to the community. That the prisoners found it possible to break out of jail and pass unnoticed through the lines of military guards surrounding the court house and jail on all sides, indicated to say the least, lax surveillance. The laxness is the less excusable because of the fact that the prisoners had recently become unruly and obstinate in their refusal to obey orders. Muckie McDonald and Joe Bradley were leaders in stirring up tumult in the jail and inciting the prisoners to resist authority. Inspection of the jail following the escape, showed that they too had made plans for a getaway.

About 160 officers and men are left. When the reduction was made, Major Donohue announced that there would be no abolishment of martial law, and that the military force would continue in supreme control of public affairs as before, provost marshall Conley having general supervision over the sheriff and the chief of police and their men, and the court continuing to transact civil proceeding, but not any criminal business. This order stands for the present, and there will be no resumption of criminal jurisdiction by the courts until another order is made. The guard lines have been withdrawn from the courthouse and the soldiers are no longer required to do police duty.

The attorneys of the several prisoners illegally tried and sentenced by the military courts, are busy making arrangements for retrial in the civil courts. The motion of the county attorney to have the trials of the leaders of the new miners' union removed to some other county, is being bitterly resisted by their attorneys who claim that there are 12 men in Silver Bow County not afraid to give a fair judgment. Damage suits filed against the Governor and the military authorities aggregate up to date at least $60,000 and it is reported that more are to come. Evidently, somebody made a colossal blunder. It is to be hoped that those responsible will be made to bear the consequences and not the innocent taxpayer. He already has to foot the large bills for the military occupation which in full swing cost over $2000 per day, and for the illegal court proceedings as well as for the legal ones to follow.

On Oct. 20, attorneys for Driscoll made application to the state supreme court for a writ of supervisory control. This was denied Oct. 21. Counsel has announced a second appeal to be made in another form. The case of Duncan will, no doubt, take the same course.

On Oct. 17, a report was made to the military officers that the I. W. W. movement had not stopped. The national convention of the organization approved the request of Joe Bradley that direct actionists come to Butte. On Oct. 16, 40 men got off Northern Pacific trains from the east. They said they were I. W. W. coming "to help their brothers" and that before Nov. 1 there would be "a big crowd of I. W. W. in Butte and there would be some action." Spokane advises that more are coming from that direction. Military officers are confident that they can handle any situation that may arise.

SALT LAKE CITY—Oct. 22

The Suit in Partition between the Silver King Coalition and the Silver King Consolidated companies of Park City over ground owned jointly was ended Oct. 21, by a division of the ground in question, agreed to by both companies. This will prevent the sale of the claims, advertised to take place Oct. 24; this sale has several times been postponed. By the division agreed to, the Consolidated deeds all of its rights in four claims, the Vesuvius, Delaware, Lady's Drum, and Mayflower No. 1 to the Coalition, receiving in return from that company all of its rights and interests in two claims, the Andes and Custer. The partition suit ends all litigation between the two companies. It was thought that ore had been mined from the jointly owned ground by one of the companies, but surveys failed to show trespass.

Utah Copper is treating 12,000 tons of ore daily at the Magna mill. The mine works one shift, except Wednesdays and Sundays—two or two and a half days off a week—which is all that is necessary to keep up the mill supply. A small amount of stripping is being done. All told, eight to 10 shovels are worked. Mining is being done with great economy, and a new system of cost keeping is in use, by which all supplies and expenses are checked up daily, instead of monthly as heretofore. Construction work, repairs, and overhead expenses have been reduced. Between 1000 and 1200 men are being worked at the mine, and 65 men per shift at the mill, exclusive of the machine shop, etc. Flotation experiments are still being carried on, and a large number of tests have been made with a slide machine, in the laboratory. Twenty-eight flotation cells designed by the Utah Copper are in use. Of these, 14 are installed on the lower vanner floor, and are cleaning the low-grade concentrates. This removes silica satisfactorily, and produces good concentrates, but there have been some mechanical difficulties. Each cell consists of a circular iron casing about 24 in. deep by 36 in. diameter, and is driven by a 10-hp. motor. The second unit of 14 cells is also on the lower vanner floor. These treat the vanner feed from the fourth and fifth spigots of the secondary classifiers, but material from the primary classifiers has also been treated. This unit is still in the experimental stage. The low-grade concentrates from the vanners and tables of the mill are elevated to a Richards-Janney classifier; the first two spigots make high-grade concentrates, and the next two low-grade concentrates containing silica, which is the feed for the flotation. About 200 tons of low-grade concentrates per day are being treated. Three shifts are being worked in the mill, and all men are working half time—two weeks on and two off; the Magna shift changing with the Arthur.

SEATTLE—Oct. 21.

Between $7,000,000 and $8,000,000 will probably be interior Alaska's output for the season of 1914 according to the estimates of several of the largest operators. It is figured that Fairbanks will produce $3,500,000; Iditarod, $3,000,000 and the Ruby district about $800,000. New strikes were scarce last summer, only one new district being opened up, that at the head of the Tolavana River, where it was reported pay was found. Some quartz mining was done in the Fairbanks region, but the cost of fuel, $18 per cord for brush, made it unprofitable to mine anything but the highest-grade ores. A tunnel is being driven at the 150-ft. level of the Newsboy mine, the Rhoads mine was in operation and a lease was let on the Rainbow property. These hardrock properties will be worked all winter. The Nome district should yield about $3,000,000 in gold this year. Conditions in the north were a little better during the summer. There was plenty of rain, which means increased production. The dredges at Nome all did fairly well, particularly those on Ophir Creek, in the Council district, and the dredge operating for tin at Cape York. The latter machine made between 120 and 150 tons of concentrates, which brought a good price. There was little quartz mining at Nome this year.

The Alaska Gold Mines Co. is putting the finishing touches to the mine, mill and power plant, in order to have these in operation by the first of the year. At the Salmon Creek dam the reservoir with 110 ft. of water in it is more than two-fifths full. It is probable that the company will go into the winter with the reservoir at least 80% full; anyhow, there is an abundance of water to furnish all the power requirements until spring. At the mine, work is now being done with a view to have everything in smooth running order to supply the mill. One of the most important details is to have the transportation way in good shape and therefore the Sheep Creek tunnel is being leveled up and the final track is being laid between the tunnel and the mill; the grade is all finished up to height and surface and the track will be in good shape before it commences to snow. In the mine the 6, 7, 8 and 9 levels have been driven west to the surface in Icy Gulch, giving entrances to the mine on six levels, from the 5 to the 10, inclusive, the entrance to the 10, of course, being through the Alexander tunnel. While there has been no work done with the sole idea of developing ore, the actual preparation of the mine, cutting out stopes, driving crosscuts, etc., has been productive of indications of further extensions. At the reduction plant everything is finished in the coarse-crushing department, with some slight exceptions; the tunnel from the coarse-crushing plant to the main mill is all completed and the underground ore bin is nearly finished. All of the foundation work at the mill has been completed and by this time practically all of the steel work is erected. Some of the permanent riveting will be postponed, but by about the middle of November the buildings will have been entirely roofed. The forms for flooring and machinery foundations are pretty well finished in the upper portions of the two sections. Everything at the three divisions is well up to schedule and provided deliveries of equipment are promptly made, there is no reason why the company should not start by the specified time of Jan. 1. A crew of trained men from other mills controlled by the same interests will start this mill.

DULUTH—Oct. 24

The Tonnage Extracted from the Great Northern Leases by the Steel Corporation during the time of the leases is given as follows, the tonnage for the remaining few weeks of the present season having been approximated and included in the figures:

Fay	610,000	Dale	3,157,500
Leonard	8,365,000	Hill	3,810,000
Harold	1,065,000	North Star	1,165,000
Mace	580,000	Walker	987,500
Mississippi	1,270 000		
North Uno	1,840,000	Total	26,600,000
South Uno	3,750,000		

HOUGHTON—Oct. 24

The Copper Depression Has Awakened the Public to a realization of the fact that there are many other industrial opportunities in this district and already plans are on foot for the organization of at least three different corporations to manufacture refined copper into articles of value. Aside from the commercial expansion along lines more or less closely allied with copper, the agricultural development of this district has been astonishing. There is a ready market for all farm products at the highest prices in the country. And the expansion in agriculture has only commenced.

Practically the Last Western Federation Agitator has left this district, answering the summons from Butte. At the conclusion of the strike in this district some of the worst of the Federation men were kept here as paid agents of the United Mine Workers and they were employed in seeking memberships among the miners for that organization. They used the argument that none of the crimes chargeable to the Western Federation could be blamed on the United Mine Workers, and they succeeded in getting a few members. However, the developments in Butte in the past few months have worked against them. And now their source of income has been cut off through the defections there. Furthermore there was a pronounced feeling among the majority of the men here that they had heard enough talk from agitators. They realized that the same chaps were working for the Mine Workers that formerly shouted for the Western Federation. They blamed them for all of the troubles that grew out of the strike, and for everything in the way of misfortune that has come afterward. And they were not at all backward in making known their personal feelings of antipathy toward the agitators.

There is Comparatively Little Pessimism Among the people of the Copper Country. It has been the custom of the Calumet & Hecla group voluntarily to raise wages 10% whenever the selling price of copper got to 15c. and staid there for any length of time. With each raise of this nature there would be an announcement that the old scale would be resumed if the price went below the 15c. mark again. But as a matter of fact the higher wage scale was in effect recently for a long period during which the price received for the metal was materially under 15c. Therefore when the cut in wages was announced it caused no particular complaint among the men. It was, in fact, generally anticipated and generally understood. The men were well pleased that operations were not suspended altogether. One feature of strength in the situation is the large treasury balance ordinarily carried by practically every copper-producing company in the district. This system has in the past sometimes occasioned complaint among shareholders who believed that mining companies ought to divide all profits as soon as possible. But the directorates never agreed with that theory and the majority of the shareholders backed up the policy of heavy treasury balances and equalization of dividend disbursement. The Quincy mine first established this plan; President Agassiz of the Calumet & Hecla always insisted upon it; and other officials of companies operating here have maintained the same system in all cases of profitable producing mines. The Quincy, for instance, ran for over 50 years without missing a dividend disbursement. The Wolverine's record was not so long but was more important in the amounts paid. The Calumet & Hecla's dividend disbursements were so steady that people here generally look upon Calumet & Hecla stock as in the same classification as government bonds. These treasury balances came in handy recently. Without large cash surpluses none of the companies could have maintained its head above water during the protracted contest with the Western Federation. That contest was followed almost immediately by a decline in the metal market and by the war. And now, following two years of serious depression and disastrous and unforseen commercial difficulties, not a single copper mine in this district has been forced into the hands of a receiver. Unusual and extraordinary methods of financial conservation have been necessary, to be sure, but the producing mines are keeping their organizations intact to date and maintaining their working forces. It has been necessary to suspend dividends in most instances; the managements took the stand that the shareholders were better able to put up with this loss in income than the workmen.

ST. LOUIS—Oct. 23

The Disseminated Lead Belt of Southeastern Missouri was visited by a cloud-burst, Oct. 16, when over 4 in. of rain fell, doing much local damage, carrying out or injuring several bridges and trestles and drowning out one of the Desloge mines. There is a great excess of labor in the district, as all the companies are curtailing output and reducing expenses. Thus far there has been no cutting in wages, but with the steady sinking of the price of lead, a cut is inevitable. The present conditions are more trying for the companies than when lead went to $2.65 in the Bryan campaign of 1896, for then surface labor was paid only $1 and underground labor $1.25, while the shifts were then 10 to 12 hours.

TORONTO—Oct. 24

A Rich Strike of gold and silver in the Broad Pass district of Alaska has been reported to the Canadian Mines Department by G. H. Collins, of Prince Rupert, B. C. It is stated that great lodes have been discovered, causing a rush of miners and prospectors to the district. The Department will send two geological experts to Broad Pass to make an inspection and report on the formation with a view to determining the probability of an outcrop to the East in Yukon Territory.

The Mining News

ALASKA

CYANIDE SCARCITY felt in Alaska as elsewhere. Hoped and believed by operators result will be manufacture of cyanide in Alaska.

ALASKA'S SECOND LARGEST NUGGET reported found early in September at Ruby on Long Creek property operated by Xavier Ditz and associates. Has value of $1900. Two smaller nuggets also found recently on same claim, one valued at $400 and other at $300.

ARIZONA

Maricopa County

ALVARADO (Congress Junction)—Property one time controlled and financed by James A. Houston, of Boston, sold by sheriff to E. W. Durfee, former manager. Property is extensively developed, equipped with cyanide plant. Negotiations for sale and operation under way.

Yavapai County

DEPOSIT OF TUNGSTEN ORE reported discovered in Crown King district southeast of Prescott. Ore is hübnerite, occurs in pegmatite. H. R. Wood and associates of Prescott working property in small way, propose to install mill later.

CALIFORNIA

Amador County

CENTRAL EUREKA (Sutter Creek)—Impounding dam and flume being constructed for disposing of tailings. Flume will be carried on high trestle across county road west of mine.

KENNEDY EXTENSION VS. ARGONAUT — Plaintiff has filed notice of motion for new trial in superior court of suit contesting apex of Argonaut vein. Motion will be heard Oct. 26.

ARGONAUT (Jackson)—New hoist will be installed on 3900-ft. level. Capacity of surface hoist about 4000 ft. Decided to make two lifts instead of installing surface hoist of increased capacity.

Eldorado County

PACIFIC (Placerville)—Since Placerville Gold Mining Co. suspended development on account of stringency of European money market, orebody on 500-ft. level is being worked under lease by J. H. Santo and P. D. Burtt. Are installing five-stamp mill. Mine owned by Alexander Baring interests in London. Extensive development was undertaken, deepening the shaft to 2000 ft. War necessitated curtailment in expenditures for development and leasers are finding opportunity to make some money by mining on limited scale.

Nevada County

NORTH STAR (Grass Valley)—Deepening of shaft continuing below 5700-ft. level. Station cut at that level and another will be cut at 6000-ft. point. Drifting on both levels contemplated.

San Bernardino County

PHŒNIX (Johannesburg)—New electric installation used for operating five-stamp mill and hoist. Ore largely extracted from 350-ft. level. Mine operated under bond and lease by Barney Osdick.

Shasta County

MIDAS (Harrison Gulch)—Water reduced to point below 500-ft. level. Electric pumps at 600-ft. still under water. As soon as released unwatering will proceed more rapidly. Cyanide plant remodeled; 12-stamp mill crushing good ore from Gold Hill dump. First month's cleanup under new ownership was $10,000. Sixty men employed.

AMERICAN (French Gulch)—Compressor plant installed; 1100-ft. tunnel being cleaned out and retimbered; 10-stamp mill will be overhauled and remodeled. When mine shut down under former management ore was said to average $20 per ton. Reopening, begun recently by James Sallee, owner of Reid mine at Old Diggings. Mr. Sallee conducted early development of Iron Mountain and Bully Hill copper mines of which he was then owner.

Siskiyou County

DREDGING GROUND being prospected along Klamath River by J. R. Wade, who formerly operated dredge at Callahan. Klamath River dredged in neighborhood of Hamburg for several years. Good dredging prospects all along river. Problem to be solved is one of economic construction of small dredge that can be operated in stream. Has led to use of orangepeel and clamshell dredges. Pay gravel not largely confined to bars, as in some rivers, but found in bed of river, which has not so far been worked with bucket-elevator dredge.

JOLEY (Humbug)—New two-stamp mill installed. Property at head of Jake's Gulch.

CONZETTI (Cecilville) — Small stamp mill will be increased, since development warrants more extensive work and some expectation of making producer.

Tuolumne County

ELEANOR MINING CO.—New corporation to operate in Tuolumne County with capital stock of $500,000. Directors: Cappel Cohen, M. L. Crafts, Willis D. Parker, of San Francisco; C. J. Doelering and J. A. McGowan, of Oakland and H. C. Anderson and W. H. McKean, of Alameda.

MILL VILLA (Sonora)—This gravel mine sold by Henry Cavill to San Francisco men. Price reported, $9000. Property in early days occupied by flour mill and residence, and in [illegible] times flour mill was considered about as valuable as [illegible] mine.

COLORADO

Clear Creek County

GOLD HILL MILL (Idaho Springs) — New concentrating table known as Egan being tried out on Vindicator ore.

Dolores County

LILLIE D. (Rico)—Robert L. Greene, of Providence, R. I., and Hal. J. Sisty, of Rico, have taken bond and lease and will begin development.

Gilpin County

PENNSYLVANIA (Central City) — New mill containing crusher, feeders, ten 1050-lb. stamps, two Gilpin bumpers and two Wilfley concentrators erected.

Lake County

MILLER (Leadville)—While excavating for mill foundations, fine gold-bearing vein struck, is being developed. In mine proper adit encountered shoot yielding 3-oz. gold ore.

PENROSE (Leadville)—In preparation for plant to unwater Downtown district, according to plans of Downtown Pumping Co., electric transmission line being built and transformer house erected. Many other improvements under way.

San Juan County

OPHIR (Cripple Creek)—This Raven Hill mine secured by Conners & Harris under long-term lease. Underground workings being overhauled and repaired and property being equipped preparatory to campaign of systematic development.

SILVER LEDGE (Chattanooga)—Mine unwatered by Bonavide & Matties, underground workings being placed in repair. Systematic development contemplated on main vein. Mill placed in operating condition and force of men now at work repairing tramway damaged two years ago by snowslides. New equipment will be installed.

Summit County

TONOPAH PLACERS (Breckenridge)—Reported No. 3 boat, in Galena Gulch, made recovery during September, of approximately $80,000. No. 1 boat, in Blue River at mouth of Swan River, has crossed right-of-way of Colorado & Southern which was tied up 12 days in operation.

Teller County

ABOUT 200 TONS OF WASH from west slope of Bull Hill shipped to sampler. Material assaying about $[illegible] per ton, was washed down gulch by cloudburst last summer and banked against old railroad grade. Prospectors trying to determine its source.

MOUNTAIN BEAUTY (Bull Hill)—Goldsworthy - Shephard Leasing Co. has secured property under favorable terms and will commence exploration at once. Supplies shipped to property and work of repairing and cleaning out old workings begun. Development work will be carried on through Joint shaft.

IDAHO

Cœur d' Alenes

CŒUR D' ALENE PRODUCERS AT LAST CURTAILING on account of low lead prices, according to report.

TUSCUMBIA (Wallace)—Fine shoot of ore reported encountered in raise from lower tunnel of the Idora Hill, tunnel leased to Tuscumbia. Raise will be continued, completion likely to be followed by deal to make Tuscumbia shipping property.

MICHIGAN

Copper

WINONA (Winona)—Operations on limited scale resumed, 30 miners entering into contract arrangement. Mining in No. 3 shaft on tribute; of course taking copper from richest portions.

VICTORIA (Victoria)—Operating to full capacity; copper well sold up; money enough in treasury to carry mining operations through remainder of season. Costs above 11c. but management feels it can afford to carry copper rather than to shut down mine and lose efficient working force. Moreover general underground conditions are better than ever before.

MINNESOTA

STEEL CORPORATION ORE FLEET will practically all be laid up for winter by Nov. 7.

Cuyuna Range

CROFT (Crosby)—Dale & Baumgartner, railroad contractors, have started work on Northern Pacific extension to mine.

KENNEDY (Cuyuna)—Season's shipments completed including entire stockpile. Daily product now being stocked again.

ROWE (Riverton)—Shipments discontinued; no reason assigned. Stripping operations continue wth one shovel and two hydraulic units.

CUYUNA RANGE TAXATION of iron ore will hereafter be on a per ton basis, similar to plan followed on Mesabi.

Hearings now in progress at St. Paul to determine equitable basis for such taxation.

HILL CREST (Ironton)—Clearing in progress preparatory to stripping operations on this fourth Cuyuna openpit. Dumping ground also being drilled. Northern Pacific will haul tonnage. No organization details announced.

CUYUNA-SULTANA (Ironton)—No. 2 shaft now down 32 ft. Orebody should be reached Nov. 1. Company intends to strip northern part of its 40-acre tract this winter and operate by milling system. Product is manganiferous iron ore, similar in composition to Cuyuna-Mille Lacs ore.

CUYUNA IRON & MANGANESE ORE CO. (Crosby)—Clement K. Quinn and associates, of Virginia, Minn., have taken over lease at advance from 40c. per ton to 60c., making cash payment of $25,000 to apply on advance royalties. Property will be stripped next spring and shaft also sunk for milling operations. Property adjoins Pennington pit on north and northwest, but is not extension of that ore deposit; contains some ore running over 30% in manganese, but main deposit is low-manganese iron. Land was recently check drilled by Jones & Laughlin, but not taken over. Incidentally, $25,000 furnished dividend No. 1 to Cuyuna Iron & Manganese stockholders, first dividend paid by any of typical stock companies on range.

Mesabi Range

SPRUCE (Eveleth)—Stockpile all shipped and 25 cars going forward daily from shipping pocket. Operations will continue through winter.

THORN (Buhl)—Shaft just started on this new property of Great Northern interests; north of Sharon mine, near Sect. 17 shaft; orebody said to cover large area, but of shallow depth.

MISSOURI-KANSAS-OKLAHOMA

Joplin District

NEW CENTURY MINING CO LAND again coming to front after being idle some time. New company took lease on mill and 40 acres of land, drained ground and is subleasing it to miners. Several shafts already in operation and some good prospects struck. Company in most cases cleans ore for miners in company mill.

SCARLET KID (Galena, Kan.)—Mine shut down several weeks installing new boiler for pumping. Expected to start mill soon.

DIPLOMAT (Galena, Kan.)—Mine one of largest producers in Galena district, running mill steadily from new shaft, mill shaft being shut down. Only one crew working cutting prospect drift.

NEW ENGLAND—Operations resumed after shutdown for three weeks on account of water which filled mines during recent heavy rains. New development work will soon be started in east shaft with hope of striking new run of ore believed to exist there.

MONTANA

Deer Lodge County

SILVER KING—Butte miners who have this mine on upper Lost Creek under lease and bond, opened deposit of high-grade silver ore; appears of considerable extent.

Missoula County

AMADOR MINING CO. (Iron Mountain)—Nine miles of railroad and townsite of Amador, both owned by company organized to promote Amador mine sold under hammer, Oct. 18, to satisfy judgment secured some weeks ago by former stockholders. Creditors represented by J. A. Kelley of Chicago. He stated nothing would be done with property until spring, when extensive improvements to make summer resort of the town of Amador are contemplated.

Silver Bow County

TUOLUMNE (Butte)—Crosscut from station on 2600 level struck lode Oct. 19, 275 ft. from station. Ore shows indications of being best yet taken from mine. Reports that Tuolumne had pulled pumps and would shut down indefinitely are declared by company officers absolutely without foundation.

BUTTE & SUPERIOR (Butte)—Shut-down of Black Rock mine night of Oct. 18, threw out of work 900 men, 150 to 200 being retained to assist in repairs to shaft and improvements at concentrator. Manager Bruce says repair work can be finished in about 60 days which will enable entire plant to start up again before Christmas. Known for some time extensive repairs to the shaft would be necessary during latter part of year. Portion caved in Oct. 17, without injury to anyone. Skip suspended under cage was caught in the squeeze at cave, torn loose and dropped 1250 ft. to point between 1500 and 1600 levels, where it rebounded into chippy compartment, breaking out several wall plates and center pieces. As temporary repairs would put shaft in no better condition than before accident, and would make recurrence of such accident probable, was decided to retimber from 300 to 700 level and make necessary repairs elsewhere, including improvements in mill.

NEVADA

Clark County

GOLD STRIKE EAST OF LAS VEGAS 22 miles, on old Quo Vadis property, rich producer in past but abandoned; 4-in. shoot of quartz, rich in free gold, opened. Rush made from Las Vegas, every available automobile and other conveyance pressed into service.

Esmeralda County

REOPENING OF SAMPLER AT GOLDFIELD strongly advocated following recent discoveries in district, especially in Jumbo Extension. Local or Columbia sampler of Western Ore Purchasing Co. closed year ago. Stated if plant is not reopened, local company will be organized to build new sampling plant.

Humboldt County

GOLDBANKS QUICKSILVER CO. (Goldbanks)—Shipment of 43 flasks of mercury made recently.

GREAT WESTERN GEM CO. (Winnemucca)—Articles of incorporation filed with county clerk. Capitalization, $25,000; Winnemucca principal place of business. Company will mine for precious stones in Nevada, operating in Virgin Valley opal district.

Lincoln County

RAND MINING CO. (Pioche)—Company will incorporate and work mining property recently located in Jack Rabbit district. Stated contract will be let for considerable development work. Several cars ore shipped recently.

AMALGAMATED PIOCHE (Pioche) — Development work on 1200-ft. level proved oreshoot to be much larger than expected; work on 1400-ft. level making satisfactory progress. Water in winze lowered 145 ft. below 1200-ft. level. Change room at No. 1 shaft enlarged recently. Lessee south of No. 1 shaft operating three jigs and making good-grade zinc product. Results of tests on mine water, to determine suitability for use in boiler plant at No. 1 shaft satisfactory. Changes necessary for use of this water may be made this winter.

Lyon County

WESTERN NEVADA (Mason)—Stated lease granted to Constantine Bros. who are also operating property east of Yerington.

MASON VALLEY (Thompson)—Since closing, former employees at Thompson allowed to live in company houses free. Experimental leaching plant, Weidleis process, will continue operations. Results from test runs, up to 20 tons daily, entirely satisfactory.

Nye County

NORTH STAR (Tonopah)—Contract made to deliver to West End mill 150 tons per week. Mine force will be increased.

PIONEER CONSOLIDATED (Pioneer) — Ten-stamp mill now treating 40 tons daily. Ore stoped on 150- and 250-ft. levels, where shoot is 8 ft. wide and assays $10 per ton. Treatment is stamping, amalgamating, regrinding in Huntingtons, amalgamating, and leaching of sands. Stated 60% recovery made by amalgamation. Development work progressing with satisfactory results and large tonnage ore blocked out. Heating plant being installed in mill. Other properties operating in district are Yellow Jacket, Buguni, Rickard Lease and Indiana. Good showings also made on Bullfrog Pioneer Extension, Mullen & Murphy, Savage, Pioneer Syndicate, Mayflower, Marx, K. K., and Starlight claims.

Ormsby County

COMSTOCK DEVELOPMENT CO. (Empire)—Old mill tailings in Carson River being successfully retreated in plant below Empire. New channel being cut to divert river. Operations will be continued until ground freezes.

Storey County

MILLING PLANTS OPERATING IN VIRGINIA CITY DISTRICT are Butters, Fischer and Pfeifer in Six-Mile Cañon, that of Techow & Waterhouse lease on Cedar Hill and Yellow Jacket on Gold Hill; latter treating half Yellow Jacket dump and half Belcher mine ore.

OPHIR (Virginia City)—Central tunnel being reopened. Objective point original workings, where large tonnage of low-grade ore can be mined; this will be treated at company's milling plant.

MEXICAN (Virginia City)—Fire broke out Oct. 19. Following dispatch sent to presidents of United Comstock Pumping Association, Ophir and Con. Virginia by superintendent T. F. McCormick: "Fire proved to be in main Mexican stope. Probably started on 2500 level, but now high up in timbers. Smoke passes through both Ophir winzes but does not go south of them. Think damage will be confined to Mexican stope timbers and that fire will soon burn itself out sufficiently so that it can be more and more closely confined. Mexican already has bulkhead on 2000 crosscut to Mexican winze, and has battened Mexican door near Union line on 2500 level. Will seal Union shaft below old drain tunnel near surface. This will make strong draft from C. & C. side, holding back gases. Helmet men from Ophir side will then try to strip floors on 2500 coming south from Mexican stope to prevent spread of fire. Also putting two bulkheads on 2000 and one on 2100 of Ophir to guard against back drift of gases from up-casts. My opinion, Con. Virginia, Ophir and pumping plant absolutely safe from all danger and think workings of Union and Sierra Nevada can suffer no damage from fire. On 2400 level, there is long distance from Mexican stope to Ophir with no timbers, so should be no danger of spread of fire through there. On 2300, no connection to Ophir. Above 2300, Mexican stope untimbered, so will be little fire above 2300 and its connection to 2200 is bulkheaded. It seems certain is little danger from spread of fire, danger only that due to gases, requiring cautious handling of men. Am warning all men under me to preserve strict discipline, and take no risks whatever on their own initiative, and if my orders are obeyed, none will be risked." Whitman Symmes, superintendent of Mexican, in San Francisco at time started immediately for Virginia City. Reported fire under control, stope bulkheaded. Stated ground would be allowed to cool before removing bulkhead and returning to work. Fire supposed to have resulted from old fire that had slumbered for long time in ore sulphides having sufficient air to keep it alive.

White Pine County

HAMILTON POWER, MINING & TRANSPORTATION CO. (Hamilton)—Work resumed on Grand Prize group and considerable production being made.

NEVADA CON. (Ely)—Rumors that Veteran mine is to be closed denied by company. Force of 175 men working and no further reduction to be made as long as there is any production. Work resumed on Veteran mine, Nov. 1, 1911, after year's shut-down on account of labor trouble. At that time ore reserves estimated sufficient to last one year at regular rate of production. Stated sufficient ore now developed to last several months.

NEW MEXICO

Grant County

COMMUNITY MILL at Pinos Altos under consideration by successful operators. Plans are to combine electrostatic methods and wet separation, etc.

TWIN PEAKS (Steins)—Sale of bonds progressing rapidly. Intention of company to erect 50-ton mill soon.

MOUNTAIN KEY JR. MINING CO. (Pinos Altos)—Company under organization at Silver City by George Jude recently of Mexico. Planned to take over Pinos Altos property of merit.

BURRO MOUNTAIN COPPER CO. (Tyrone)—Newspaper report of extensive mill construction exaggerated. Small force will be employed during winter erecting auxiliary buildings near mill site.

Santa Fé County

AMERICAN GOLD COPPER MINING CO. (Bonanza)—Property sold by receiver to George Heineman, Kansas City and A. P. Towne, Cerrillos, N. M., for $3168. Claims patented, carry low-grade copper-gold ore.

AMERICAN TURQUOISE CO. (Cerrillos)—Famous Tiffany turquoise mines sold to Frederick K. Gilbert for $24,000. Under mortgage to American Turquoise Co. J. H. Crist, commissioner. Claims formerly involved in litigation with M. F. Sena.

Socorro County

EMPIRE ZINC CO. (Kelly)—Tri-Bullion mill being remodeled and made into practically new plant. Company continues periodical shipments from properties in district.

NORTH CAROLINA

Cabarrus County

PIONEER—This mine, 17 miles east of Charlotte, optioned to John H. Furman, of London, England; plans now being made to reopen. Property not worked since Civil War. Yields gold and copper; proposed to concentrate and to cyanide tailings.

SOUTH DAKOTA

Lawrence County

IN TWO BIT DISTRICT near Deadwood, discovery of rich gold ore by Sweet & Hanson, lessees on small block of Monarch territory, attracted attention and stimulated work by owners of nearby property. Sweet & Hanson were driving tunnel from site on Monarch property to develop some of their adjoining holdings when ore was found. Mining of rich material steadily going forward for some time; over 80 tons shipped to Omaha. Ore shipped averaged $70. Monarch company is working nearby, and R. I. Zipp is sinking shaft on property, following vertical of $15 ore, which he is piling on dumps, owing to fact that there are no custom mills in district equipped to handle free-gold ore. Nearly two-thirds of Zipp's values in free state; balance could be cyanided. Is endeavoring to develop sufficient to warrant erection of mill.

JUNGLE (Roubaix)—Construction work on copper-leaching plant suspended on account poor market.

HEIDELBERG (Two Bit)—Shaft now 35 ft. deep; being sunk with windlass; plans call for installation of steam plant. At this depth ore shows sustained width and value.

NEW RELIANCE (Trojan)—Forest fire destroyed Bunker Hill hoist house in which was installed electric hoist operating skipway over which large portion of mill supply was sent. Repairs being made; meanwhile ore being drawn from other sources.

MOGUL (Terry)—Company has secured lease on Clinton group, Nevada Gulch, is installing air compressor, drills, etc., and will mine large body of quartzite. Mining will be done by sublessees. Freight on ore will be 65c. per ton, it being necessary to transfer from narrow-gage to standard-gage cars between mine and mill.

UTAH

Beaver County

MINING COMMITTEE OF SALT LAKE COMMERCIAL CLUB, which visited new gold camp of Fortuna reports favorable outlook, such as would warrant investment of capital to determine merit of properties. Strong quartz veins outcrop over considerable area, carrying free gold. Country rock is monzonite. Development work being done. Camp can be reached from Milford on Salt Lake Line by automobile.

MOSCOW (Milford)—During September 750 tons of ore produced. This came from neighborhood of 800 level, and according to management, had gross value of $15,000. In Back vein in old workings good lead-silver ore opened in four places. This vein carries more lead and less silver than Silver vein. Winze sunk in ore, 100 ft. below 800. Drifting being done on 800 level of new shaft to make connections with old workings, which will give about 250 ft. of stoping ground on dip of ore. About 150 ft. remains to be driven. Both Silver vein and Back vein have been cut and drifted on from new shaft workings.

Juab County

TINTIC STANDARD (Eureka)—Fifty-ton shipment of ore carrying lead and silver being made. New hoist installed on 1000 level; ore being broken on 1200.

Salt Lake County

MICHIGAN-UTAH (Alta)—Company being reorganized, more than 75% of bondholders having signed agreement to that effect. Reorganization being promoted by Judge Haire.

OHIO COPPER (Bingham)—Effort of Heinze to have bankruptcy proceedings set aside ruled against by Judge Mayer in New York. Heinze claims conspiracy of interests hostile to him, and that Ohio copper should not have entered bankruptcy court. Judge Mayer said he was satisfied that company, acting through directors had power to be adjudicated bankrupt. Apparent company could not for various reasons pay debts, and situation was accentuated by condition of copper market; situation is precarious and can only be worked out through court action as preliminary step.

Tooele County

WILSON CONSOLIDATED MINING (Wendover)—Company in Deep Creek district will ship 25-ton lot of bismuth ore, carrying gold and a little silver. Vein runs up to 7 ft. in width. Ore carrying about 8% bismuth hand jigged so as to bring shipments up to about 20%. Gold is largely free.

Utah County

MOUNTAIN DELL (American Fork)—Property recently sold by sheriff to R. N. Baskin.

VIRGINIA

LITTLE ELLIOTT (Calverton)—This gold mine sold by Clayton E. Emig, of Washington, to Colorado company, which will develop and operate. Vein opened to 200 ft. depth; ore shipped to Norfolk several years ago. Recently, small extemporized mill erected and operation claimed to be successful.

WASHINGTON

Ferry County

KELLER & INDIANA CONSOLIDATED MINING CO. (Republic)—Property sold under judgment recently, bid in by Lester P. Edge, prominent Spokane attorney, for $1160. Included in purchase is Boyle smelting plant, dam, flumes, generating machinery and other equipment at Keller, erected at cost of $300,000 by Indiana investors. Mining property developed by 2000-ft. tunnel not included in transaction.

WISCONSIN

Zinc and Lead

B. M. & B. (Mifflin)—Company has taken over Biddick lease and removed Slack mill to Biddick shaft.

WISCONSIN ZINC (New Diggings)—Champion mill of 500 tons capacity made initial run; is largest mill in district. Mine is new producer.

ALDERSON—Mill of Charles Kistler and H. E. Stephens assembled and being wired and equipped with dynamo and motors to operate with electric power furnished by Interstate Light & Power Co.

MINERAL POINT—Coker No. 2 mill completed and placed in operation at Livingston; Penna-Benton mill, at Benton, completed and will be started milling within next two weeks upon completion of shaft.

CANADA

Ontario

COBALT TOWNSITE—Hoisting begun from new shaft, 400 ft. deep, with capacity of 300 tons per shift.

BEAVER (Cobalt)—New vein carrying 3 in. of high-grade encountered on 530-ft. level, 125 ft. west of main shaft.

JUPITER (Schumacher)—On 400-ft. level, 200 ft. good ore developed. Vein on 475-ft. level widened to 4 ft., with gold averaging high.

LAKE SHORE (Kirkland Lake)—Three-drill compressor and 50-hp. boiler in operation and 40-ft. shaft will be put down 100 ft.

SAVAGE (Cobalt)—New vein recently struck on 110-ft. level stated to be rich. At bottom of winze now down 22 ft., ore is 4 to 5 in. wide, reported to run 10,000 oz.

KIRKLAND LAKE GOLDFIELDS (Kirkland Lake)—Shaft being sunk; property formerly known as McKane claim; extension of No. 3 vein of Teck Hughes, adjoining. Station will be cut at 100 ft.

CASEY-COBALT (Cobalt)—After sinking 100 ft. in clay overburden, company is putting down new shaft to 400-ft. level to pick up vein indicated by diamond drilling. Mill is treating 100 tons daily.

CROWN RESERVE (Cobalt)—Profits following draining of Kerr Lake will probably be postponed until next year, as lake bottom will have to be cleared of clay before development can proceed. Present expenses being met out of milling rock; high-grade ore almost all stoped out.

PORCUPINE CROWN (Timmins)—Position of this mine latterly considerably improved. Vein picked up beyond fault on both 300- and 400-ft. levels. On 300-ft. there is 160 ft. of $18 ore over width of 4 ft. On 400-ft., vein has been traced 30 to 40 ft. beyond fault, carrying 5½ ft. of $20 ore.

HOLLINGER RESERVE (Timmins)—Company gone into liquidation, with liabilities estimated at $75,000; principal creditors being Ben Hollinger, $40,000, and General Development Co., $30,000. Ore on dump has estimated value of over $65,000, but prevailing financial stringency rendered it impossible for company to meet obligations.

LA ROSE (Cobalt)—Quarterly report shows surplus, Oct. 1, of $1,396,619. Dividend of 2½% calls for disbursement of $187,500, paid from accumulated surplus and not from profits, as total earnings for first eight months of year amounted only to about $154,000. After ore now known to be in Princess claim is exhausted that property and Fisher-Eplett will be closed down.

MEXICO

Sonora

PILARES (Nacozari)—This Moctezuma Copper Co. mine reported as having reduced production to 60%. Was running full time up to time of war, having paid taxes to military party, getting protection and having been almost immune from interference since first revolution started in 1910.

SOUTH AMERICA

Bolivia

CIA. HUANCHACA DE BOLIVIA (Huanchaca)—Efforts being made to increase efficiency of water-power plant to provide sufficient power for pumping out mine and undertaking deeper work. Only lead and silver being recovered from ore now mined, but preparations being made to recover zinc. Concentrates shipped to United States.

The Market Report

METAL MARKETS

NEW YORK—Oct. 28

In the early part of the week, a rather large business in copper was done, and hopes for this market became stronger, but late events threw everything into confusion again. A large business has been done in lead and the market is stronger. Spelter has been dull. Tin advanced sharply and then declined. Silver declined seriously on account of the operations of the German cruiser "Emden" in the Indian Ocean.

The London Metal Exchange will be opened on Nov. 4.

Some international metal houses have lately been making more money by selling sterling exchange and buying marks than by trading in metals.

Copper, Tin, Lead and Zinc

Copper—The gradual improvement in the conditions of this market proceeded further, and during the last calendar week it could have been said rightly that the market appeared to have regained approximately normal conditions upon the basis of the curtailed production. The shipments abroad had increased, domestic consumers had become more ready buyers and sellers were more free to act. Producers, lately, have not been quite so stiff as they have been represented. Several of those who have been mentioned as holding at 11½c., delivered, regular terms, have, in fact, been accepting 11¼c., but at the latter figure there seemed to be real resistance, and consumers who were waiting to buy copper at 11c. made up their minds they were not going to get it at that. On Oct. 23, a business of some millions of pounds was done at 11¼c., delivered, regular terms, with domestic consumers.

Some substantial business was also done in the early part of the week at 11⅜c., delivered, regular terms. Sellers who subsequently raised their price to that figure, however, reported inability to realize it. Sales have also been reported at below 11¼c. In fact, there was a good deal of uncertainty and confusion after the early interest of the domestic consumers waned. This uncertainty and confusion increased very seriously when, on Oct. 28, came the news of the detention by the British of five ships carrying copper to Italy and Scandinavia. If the foreign outlet for copper is going to be limited to Great Britain, producers do not yet know where they are going to stand. At present, the English market is glutted with copper that has been sent over there on consignment. Late events of this week show the uncertainties which still overshadow the copper market. Just as it was supposed that conditions had regained approximate equilibrium, new events transpired that exhibited the disorganization of commerce in this metal.

The steamships "Regina de Italia," "San Giovanni" and "Kroonland," carrying copper from New York to Italian ports, have been detained at Gibraltar. The "Prosper III" and another ship, whereof we do not know the name, carrying copper to Scandinavia, have been detained at Scottish ports. These ships are said to be carrying 4000 to 5000 tons of copper. The consignors are framing a new protest to the Department of State. The steamship companies have notified shippers that they will not accept shipments for Italy and Scandinavian countries unless it be guaranteed that the shipments are for consumption in those countries. Shippers are naturally unable to give such guarantees.

It is reported that Italy has placed an embargo on shipments of copper out of that country.

Russia, so far as reported, has bought only about 250 tons of copper in this country, but has bought a great deal of lead, antimony and nickel, the shipments of which are now afloat.

Base price of copper sheets was reduced ½c. on Oct. 22 and is now 16½c. per lb. for hot rolled and 17½c. for cold rolled. Full extras are charged and higher prices for small lots. Copper wire is quoted at 12@12½c. per lb. for carload lots at mill.

Exports of copper from New York for the week were 5349 long tons. Our special correspondent gives the exports from Baltimore at 1055 tons.

The Kyshtim Corporation is expected to produce about 7500 tons of copper this year against 7800 tons last year. An increase was expected this year but the war interfered. However, the Russian government is affording special facilities to get the copper to market and the company is realizing £75 per ton.

Copper wire is said to have been offered at 12c. per lb.

Electrolytic copper realizes about 20c. per lb. in Germany.

Tin—This market became very firm at the middle of the last calendar week, when it became known that a steamship carrying about 1000 tons of tin had been sunk. London dealers became excited over the loss of visible supplies and bid up the market violently. Buyers here declined to follow the advance and refrained from purchasing. The absence of American orders had a dampening effect on London, wherefore the market declined and closes weak.

Tin exports from the Straits seven months ended July 31: United States, 10,766; Great Britain, 20,503; other Europe, 7511; China, 150; India, 1117; total, 40,047 long tons, an increase of 3289 tons over last year.

Arrivals of Bolivian tin in England in September were 2280 tons concentrates and 4 tons bars, the whole equivalent to 1372 tons fine tin. Arrivals from Nigeria were 197 tons concentrates, carrying 138 tons tin.

Lead—The drastic curtailment of production in Idaho and Missouri apparently impressed the minds of consumers, who purchased very freely, especially on Oct. 22 and 23, when the transactions amounted to many thousands of tons, the average of the business being 3.50c., New York, and about 3⅜c., St. Louis. Since then a steady business has been done and the market has been very firm. Some relatively small sales for export were made during the week.

Spelter—The advance continued a little further. Some carload lots realized as high as 5c., but the larger business was done at an average of about 4.95c. The total volume of business was of only moderate proportions, and the market having lost all of its snap, the price has gone off quite a little since Saturday. A small tonnage of spelter was sold for export.

We hear that all of the zinc smelteries of Belgium are now idle. Those of Rhenish-Prussia are said to be operating at about 30% of their ordinary capacity.

DAILY PRICES OF METALS

NEW YORK

			Copper	Tin	Lead		Zinc	
Oct.	Sterling Exchange	Silver, Cts. per Oz.	Electrolytic, Cts. per Lb.	Cts. per Lb.	New York, Cts. per Lb.	St. Louis Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.
22	4.9475	50	*	31½	3.50	3.35 @3.40	5.05 @5.15	4.90 @5.00
23	4.9475	49¾	*	31¾	3.50	3.35 @3.40	5.05 @5.15	4.90 @5.00
24	4.9238	49⅛	*	31½	3.50	3.35 @3.40	5.05 @5.15	4.90 @5.00
26	4.9050	48⅞	*	31½	3.50	3.35 @3.40	5.05 @5.10	4.90 @4.95
27	4.9000	48¾	*	30½	3.50	3.35 @3.40	5.05 @5.10	4.90 @4.95
28	4.8950	48½	*	29¾	3.50	3.35 @3.40	5.05 @5.10	4.90 @4.95

*No quotations.

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, 15½c.; St. Louis-Chicago, 6c.; St. Louis-Pittsburgh, 12½c.; Chicago-Baltimore, 10½c.; Chicago-New York, 13½c.

Other Metals

Aluminum—The market is rather quiet, but a little better tone is reported. Quotations are 18@19c. per lb. for No. 1 ingots, New York.

Antimony—This metal is in a peculiar position. Nearly all the antimony here has been bought up by Russia, England and France, and over 300 tons have already been shipped. Exports from England have been stopped, so that no more Cookson's can be received here for sale. The only supplies in sight are a limited quantity of Chinese. The market has been in an excited condition. Quotations for ordinary antimony are unsettled at 14@15c. per lb. Cookson's has sold at 16½c. and is held at 17½@18c. today.

Quicksilver—Demand is fair and the price here has remained around $50 per flask of 75 lb. In London, there has been a sharp advance and the price has gone up to £11 per flask.

Gold, Silver and Platinum

Gold—On Oct. 22 shipments of $4,747,000 gold were made from New York to Canada. Later shipments made a total of $7,400,000 for the week.

Sales of gold bars by the New York Assay Office in September amounted to $2,415,017, being $397,471 less than in August and $967,198 less than in September, 1913. For the nine months ended Sept. 30 sales were $25,177,494 in 1913, and $24,315,433 in 1914; a decrease of $862,061. These sales do not include export transactions.

Gold and Silver Movement in the United States nine months ended Sept. 30, as reported by the Department of Commerce:

	Gold		Silver	
	1913	1914	1913	1914
Exports	$74,079,279	$157,656,778	$49,022,237	$38,480,444
Imports	46,199,608	39,941,946	27,430,312	17,791,486
Excess, exports	$27,879,671	$117,714,832	$21,591,925	$20,688,958

Expors of merchandise for the nine months this year were valued at $1,467,538,446; imports, $1,409,565,530; excess of exports, $57,972,916. Adding excess of gold and silver gives $138,403,790 as the total export balance.

Imports of Gold in Great Britain nine months ended Sept. 30 were £48,421,752; exports, £29,374,025; excess of imports, £19,047,727, against £12,434,843 last year.

Iridium—This metal is scarce and prices are largely nominal. Dealers are reluctant to give definite quotations. Sales have been small.

Platinum—The market is still unsettled and it is hard to get quotations with any exactness, most transactions being the result of special negotiation. Nominal quotations are $48@50 per oz. for refined platinum; hard metal, $53@57 per oz., according to quality.

Silver—The market continues dull; supplies, though limited as compared with normal shipment, are still sufficient to meet all demands.

Official quotations of silver in London for the week were: Oct. 22, 22 1/8d. per oz. standard; Oct. 23, 22⅛d.; Oct. 24, 22½d.; Oct. 26, 22½d.; Oct. 27, 22½d.; Oct. 28, 22⅝ pence.

Zinc and Lead Ore Markets

JOPLIN, MO.—Oct. 24

Blende showed high price, $43; assay base, $40@43; metal base, $39@41, per ton of 60% zinc. Calamine base, $22@23 per ton of 40% zinc. Average, all grades of zinc, $38.30 per ton. Lead had a high price, $42.50; base, $40, per ton of 80% metal content; average, all grades of lead, $40.18 per ton.

One producer claimed tonight to have an offer of $45 for next week's delivery, declining on the ground that it would probably be no lower and might be higher. Best blende advanced only $1 to $3, while second grade and heavy in iron ore advanced $5 to $7 per ton.

SHIPMENTS WEEK ENDED OCT. 24

	Blende	Calamine	Lead	Value
Totals this week	9,320,170	556,840	1,597,690	$221,140
Totals this year	427,686,450	31,590,500	73,993,360	$10,587,870

Blende value, the week, $182,870; 43 weeks, $8,482,190.

Calamine value, the week, $6190; 43 weeks, $368,850.

Lead value, the week, $32,080; 43 weeks, $1,736,830.

PLATTEVILLE, WIS.—Oct. 24

The base price paid this week for 60% zinc ore was $40@41 per ton. No sales of lead ore were reported.

SHIPMENTS WEEK ENDED OCT. 24

	Zinc Ore, lb.	Lead Ore, lb.	Sulphur Ore, lb.
Week	2,662,660	.....	168,700
Year	129,838,120	4,230,700	27,945,210

Shipped during week to separating plants, 2,555,200 lb. zinc ore.

IRON TRADE REVIEW

NEW YORK—Oct. 28

The Navy Department has awarded the contracts for the armor plates for three new battleships. The Bethlehem Steel Co. gets the contract for 16,256 tons, for which it will receive $7,121,808; the Midvale Steel Co., 8128 tons, for which $3,559,404 is the contract price.

The United States Steel Corporation reports for the quarter ended Sept. 30, net earnings after paying working expenses, ordinary maintenance and renewals, as follows:

	1913	1914
July	$12,936,658	$7,475,993
August	12,657,430	7,584,926
September	12,856,312	7,215,083
Quarter	$38,450,400	$22,276,002
Sinking and depreciation funds, etc.		$7,593,980
Interest and sinking fund		5,746,111
Total charges		$13,340,091
Balance, surplus for the quarter		$8,935,911
Dividends		8,846,432
Undivided surplus		$89,479

The usual dividend of 1¾% on preferred stock was declared; but the dividend on common stock was reduced from 1¼ to ½%. The total net earnings for the nine months ended Sept. 30 were $60,727,959, against $114,097,014 last year.

Production of Pig Iron in Germany in July is reported at 1,095,443 metric tons, a decrease of 553,375 tons as compared with July, 1913. For the seven months ended July 31 this makes a total of 11,225,081 tons in 1912, and 10,383,639 in 1914; a decrease of 841,442 tons, or 7.5%, this year .

IRON ORE

Light shipments from Lake Superior are expected in November. It is announced that the Steel Corporation ore fleet will be laid up about Nov. 7. Other companies will follow soon after.

Iron-ore imports in Great Britain nine months ended Sept. 30 were 5,774,351 long tons in 1913, and 4,527,776 in 1914; decrease, 1,246,575 tons.

An embargo has been placed on exports of manganese ore from India to any ports except those in Great Britain.

COKE

The Connellsville coke market continues slow and shipments are chiefly on contract.

Coal and Coke Tonnage of Pennsylvania R.R. Lines east of Pittsburgh and Erie, nine months ended Sept. 30, short tons:

	1913	1914	Changes
Anthracite	7,665,020	8,149,935	I. 484,915
Bituminous	37,774,323	36,112,774	D. 1,661,549
Coke	10,859,413	7,603,937	D. 3,255,476
Total	56,298,756	51,866,646	D. 4,432,110

The total decrease this year was 7.9%; the greater part of the loss being in coke tonnage.

CHEMICALS

NEW YORK—Oct. 28

The general markets are quiet and there has been little change from recent reports.

Arsenic—The demand is moderate and there is no material change. The current quotation is $3.75 per 100 lb. for white arsenic.

Copper Sulphate—The market is not specially active, but is steady. Quotations are unchanged at $4.50 per 100 lb. for carload lots, and $4.75 per 100 lb. for smaller parcels.

Nitrate of Soda—Business remains quiet, with no special change and moderate sales. Quotations are 1.87½c. per lb. for spot and November-December deliveries; 1.90@1.92½c. per lb. for futures from January.

NEW CALEDONIA ORES

Ore shipments from New Caledonia seven months ended July 31 are reported by the "Bulletin du Commerce" of Noumea at 52,498 metric tons nickel ores, 920 tons cobalt ore and 39,789 tons chrome ore. Metal exports were 2275 tons nickel matte.