VOL. X APRIL, 1920 No. 4

COLORADO SCHOOL OF MINES MAGAZINE

THE COLORADO SCHOOL OF MINES ALUMNI ASSOCIATION, PUBLISHERS, GOLDEN, COLO.

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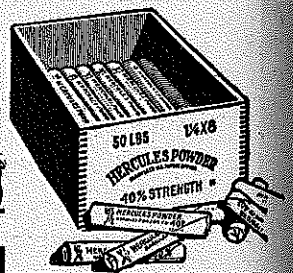
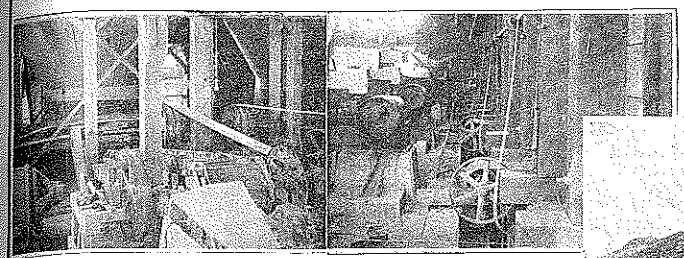
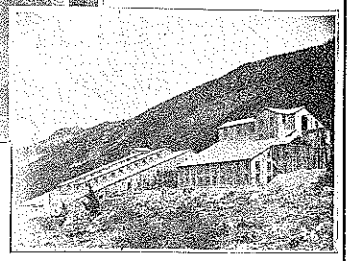




Jeffrey Beaded Flight Conveyer under rock storage bins.

Ore Feeder Belt Conveyers under bins in main mill building.



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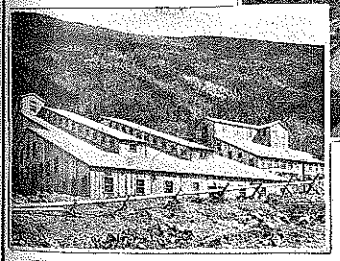
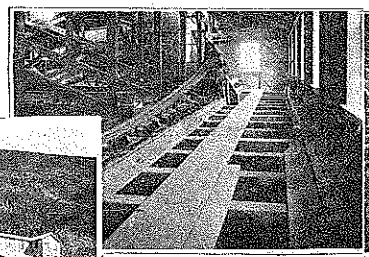
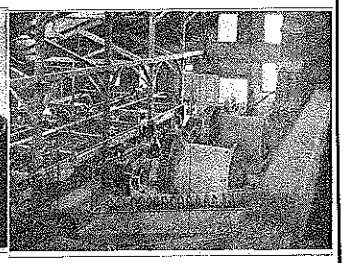


Main Mill Building with crushed ore storage bins.



Belt Conveyer from Rock Crusher House to Main Mill Building.



View of Ball Mills where Jeffrey Manganoid balls are used.

COLORADO SCHOOL OF MINES MAGAZINE

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CONTENTS

Method of Mining Coal Without Powder

By D. Vance Sickman, B.S., E.E.

Part I.

This method consists of a combination of appliances which provides a simple, easily operated and purely mechanical means for breaking down coal after it has been "undercut" in the usual manner. Every detail has been carefully worked out. The method of application and the design of the appliances used, conform with established engineering principles. After the coal has been undermined, the mechanical process of breaking it down, ready for loading out, consists of the use of two mechanical elements (a) The Slotting Machine, and (b) The Hydraulic Expanding Bar. The functions and operating characteristics of each of the machines are as follows:

(a) The Slotting Machine.

This machine represents the final achievement in the successful development of this process of mining. Its purpose is to cut rectangular slots in the coal for the insertion of the Hydraulic bar. The important operating features of the machine are:

(1) Transportation.

In the introduction of any new or additional mining appliance, the extent to which it may interefere with or interrupt the ordinary mining processes in use, is of great importance to the operator. The transportation of coal and the necessary coal mining machines etc., must not be interferred with. In most mines the transportation facilities are already burdened and the introduction of any additional appliances, that would have to be transported from place to place over the same haulage ways, would result in loss of output, and further complicate underground operations in general. To overcome this difficulty the slotting machine is mounted on a self-propelling bed plate of the "chain-track," or "caterpillar," tractor type and driven from place to place in the mine in the same manner as the ordinary tractor is driven on the farm. This construction entirely eliminates any interference with transportation over the trackage system. It is propelled by electric motors, or rotary air engines, using the same power as the other mining machines in use. In practice this machine is driven from room to room through the "cross cuts," thus saving traveling distance, as the "cross-cuts," by law, cannot be more than 60 feet back from the "face", or an average of 30 feet, in order to pass from one room into the next adjacent room. The machine can travel to almost any part of the mine by keeping open the last "cross-cut". The "chain track" of the bed plate is also provided with flanges to fit the gauge of track in use and the machine can be run upon the rails and driven to any part of the mine, should this be desirable.

The total weight of the slotting machine is approximately 6,000 pounds, and as the length of the "caterpillar track", or what would be the "wheel base", is approximately 5½ feet, the machine can be run on twelve pound rails.

The construction of a self-propelled, self-contained slotting machine, transported from room to room on its own bed plate, insures this part of the process being carried out with great rapidity, without interferring with any other equipment, or being itself delayed, and permits of the introduction of this process of mining without causing the slightest interference with any other operation.

(2) Manipulation.

The over-all width of the slotting machine is approximately 3 ft. 10 in., and length over-all 8 feet 4 inches. These dimensions vary somewhat, depending on the height of the vein in which the machine is used and the depth of the undercut. Each side of the "chain-track" can be operated independently, and also reversed independently. By this construction the machine can be manipulated to make a right angle turn, or turned end for end, that is, completely around, in a space not exceeding its own length. The size of the bed plate is such that it can pass between "props" set 4 feet apart. The speed at which one "chain-track" is driven, relative to the other, can be varied at will and the machine will travel a course of any degree of curvature. The ease with which the machine can be manipulated enables it to travel from room to room, avoiding props or other obstructions and also to be quickly adjusted in position for cutting the slot in the face of the coal, where required. Also the machine will travel up a 10 to 15 per cent grade, through mud and water, and over rough, rocky or soft bottom, with the greatest ease. The speed of travel can be varied from barely moving up to two hundred fifty feet per minute.

(3) The Cutter Bar.

Mounted above the traveling bed plate is the cutter bar, used for cutting the slot. This cutter bar, with its driving and feeding mechanism, is practically the old style low vein "breast machine", used for under-cutting coal for many years. Conceive this type of breast machine turned upside down, and that part of the supporting frame removed that will permit of the bar being raised so as to cut a slot close up against the roof (instead of underneath), the motor and driving mechanism remaining the same, except that it will now be on the under side of the machine. This practically, is what is done, the frame simply being changed where required, the entire driving and operating mechanism remaining the same as in the standard machine. Various unnecessary parts and fittings have been omitted or changed, and also the width of the cutter bar reduced, this bar being the latest "short wall" type, and furnished for cutting slots of various dimensions, 18 in., 24 in., and 30 in. long, by 4¾ in. wide and up to 7 ft. in depth. This cutter bar and driving mechanism is supported so as to be raised and lowered **bodily** by means of hydraulic jacks, or rams. This is easily and quickly done, simply by opening and closing the valves controlling the water supply to the lifting ram. A small high pressure, motor driven, turbine type pump is used for furnishing the water to operate the rams, and as the bar is lowered, the water is pumped back into a small, five gallon tank and used over and over again. In the collapsed position, the cutter bar, with its driving mechanism, drops into sockets, formed in the bed plate frame, and is held perfectly rigid for transportation about the mine. Also, the bed plate itself is provided with three lifting rams, two mounted at the back end and one in the center of the front end. By means of these three rams, the **bed plate itself** can be raised and lowered and the cutter bar given any angle of adjustment. The position of the bar is therefore subject to the combined adjustment of the bed plate rams in conjunction with the rams which raise and lower the cutter bar itself. This combination results in the following:

(A) Very Wide Total Adjustment.

That is, wide range of height of vein in which a slotting machine of a given design can be used. For instance, in a slotting machine designed for a 6 foot vein, at the lowest or collapsed position of the cutter bar, the over-all height is 3 ft. 6 in., giving a normal clearance or head room, of 2 ft. 6 in. By adjusting the rams which raise the bed plate carrying the entire machine, an adjustment in excess of two feet is obtained. After this adjustment is made, the rams that raise the cutter bar from the bed plate can be operated to raise the cutter bar itself an additional 26 inches, making the total adjustment of the cutter bar 4 ft. 2 in. This size machine therefore can be used in coal varying in height from 4 ft. to 7 ft. 8 in, and for cutting slots halfway up in the vein, approximately, if required.

(B) Angular Adjustment.

By manipulation of the three rams for raising the bed plate, this bed plate, carrying the cutter bar, can be adjusted so that the cutter bar will assume any angle relative to the roof. In veins of 7 feet or less in thickness, three slots only are cut as close to the roof as possible, and parallel to the roof. Unless the roof is very uneven, the cutter bar will lie right against the roof. Often the roof changes pitch relative to the bottom, and to adjust the position of the bar under these conditions, the bed plate is given the proper angular adjustment. Also in veins over 7 feet in thickness it is sometimes necessary to put in a "bust shot". This is done by cutting a slot halfway up the vein in the center of the room, and slightly angling downward. This adjustment is readily obtained. The coal broken down by the "bust" shot is first removed by a special appliance (not herein described, but which does this quickly and easily), before the remaining coal is brought down. This provides a large space into which the remaining coal falls so that it can be readily loaded out. In veins less than 7 feet this is not required.

(4) Locking Device.

When the slotting machine is in position and the cutter bar adjusted ready for cutting the slot, the machine is locked in position. This is done by two additional hydraulic rams which press against the roof. The ends of these rams are provided with large, round, spiked, swiveling bearing shoes. The force exerted against the roof is couter-balancer by the force against the bottom, taken up by the two rams mounted on the back end of the bed plate, which are used for raising and adjusting same. The rams bear against the roof with a force of two tons each, the pressure being constant and furnished by the same small turbine pump used for operating all the rams. When these rams are forced against the roof the whole machine is locked in position and rigidly held immovable while the cutter bar is in operation.

(5) Operation, Maintenance and Labor Required.

The slotting machine is operated by one man. The machine is easily and quickly driven from place to place in the mine, in self-contained, quickly adjusted in position and about the hardest work the operator does is to open and close the valves used in the above adjustment. The self-propelling bed plate is a fully developed machine of the tractor type which has been in use for many years. The hydraulic ram adjustment of the cutter bar is standard practice, used in many other machines, and is simple in operation, requiring practically no maintenance or operating cost. The cutter bar and driving mechanism are standard, having been in use for over twenty-four years. This slotting machine is, therefore, simply the combination of two fully developed machines and will require no more than normal maintenance cost, and on account of the ease and rapidity of operation, the labor cost is less than any other machine in common use in coal mining. In operation, the cutter bar is simply inserted the proper depth, from five or six feet, depending on the depth of the undermining, and then withdrawn. The forward cutting speed is from 24 to 30 inches per minute, and the pull back speed, 12 feet per minute. This cuts the slot ready to insert the hydraulic expanding bar. The standard width of the slot is 4¾ inches, and the length is varied for using the small, medium or large size hydraulic bars by simply using cutter bars on the slotting machine of the proper width, either 18 inches, 24 inches, or 30 inches, as required.

(B) THE HYDRAULIC BAR.

The hydraulic bar used in this process represents the result of over fourteen years of experimenting and designing. The smallest size bar, No. 1, has a total expanding capacity, at normal water pressure of one million pounds (500 tons); No. 2 bar, one million five hundred thousand pounds (750 tons); No. 3 bar, two million pounds (1,000 tons), and No. 4 bar (the largest size), two million five hundred thousand pounds (1,250 tons). The smallest size bar, No. 1, is made in one piece and is "L" shaped. For this size bar the slot is cut 18 inches long. The short side of the bar is 17 inches long and contains three very powerful pistons, while the long side is 27 inches long and contains five pistons. At normal water pressure, this bar develops a total expanding force of nine hundred and seventy-five thousand pounds. This size bar is suitable for coal 4 feet to 5½ feet in thickness. In all other sizes, the bar is made up of two members, or sections, in effect two separate bars. The shorter section is inserted so that the pistons lie parallel to the back wall of support, and the longer section is inserted parallel to the "rib" wall. When both bars are properly placed in the slot, the forces are applied in planes at right angles to each other, one to shear the coal off along the "rib" wall, and the other along the back wall of support. Making the larger size bars in two sections, facilitates placing the bar in the slot, as each section is comparatively light in weight and much easier to handle. In the largest size bar, No. 4, the shorter member, which is placed in the slot first, and parallel to the back wall, contains six very powerful pistons and weighs 159 pounds. The longer section, placed parallel to the "rib" wall, contains seven pistons and weighs 192 lbs. It has been demonstrated that bars up to 200 pounds in weight can be easily handled by two men and often by one man alone, so that the above weights are well within practical limits. The slot for the No. 4 size bar is cut thirty inches long. This bar at normal water pressure has the enormous exertive expanding force of two million four hundred thousand six hundred (2,400,000) pounds. From a large number of experiments, it has been demonstrated that a force of one million (1,000,000) pounds, in a bar thirty inches long, will shear lignite or bituminous coal 7 to 8 feet in thickness, when the bar is placed 12 inches distant from the termination of the undermining at the "rib," and parallel to the "rib" wall, the coal being undercut six feet. Lignite coal is much tougher, tenacious and harder to shear than the higher grades of bituminous coal. In the No. 4 size bar, the section that parallels the "rib" wall develops one million three hundred and nine thousand six hundred pounds (1,309,600) pounds at normal water pressure, which is fully one-third greater than the force required to shear lignite or bituminous coal of any character nine feet or more in thickness, and undercut 6 to 7½ feet. The bars can be varied in design and capacity to fit any particular condition, or character of coal in which they are to be used. The size of the pistons and the number of pistons used can be varied at will so that the exertive capacity can be increased to meet almost any requirement. Normally, however, the pistons in the section of the bar that is placed parallel to the back wall of support, although fewer in num-

ber, are larger in size and exertive force than those in the bar placed parallel to the "rib" wall, the total expanding forces being about equally divided between the two sections. All types of bars are rectangular in cross section, and 4½ inches in depth, which permits of their being readily slipped into the slot which is 4¾ inches wide. The width of the bar varies in accordance with the size of pistons used, water pressure, etc. The smallest bar is 4¼ inches wide and the largest size is 5½ inches wide. The one and a half million pound bar, No. 2 size, is five inches wide. This size bar is suitable for coal 6 to 8 feet in thickness. The shorter section weighs 112 pounds and the longer section 168 pounds. All parts of the bars are made of chrome vanadium heat treated steel, drop forged into proper shape and machined to dimensions. This steel has a minimum ultimate tensile strength of 200,000 pounds, and a minimum elastic limit of 180,000 pounds per square inch.

(2) Piston Construction.

The enormous forces developed by the hydraulic bar, ranging from 1,000,000 to 2,500,000 pounds exertive force, necessitates special construction of the pistons and piston chambers. Many peculiar internal reactions, bending moments, and stresses, are developed, and to relieve the bar of these and prevent distortion, they must be eliminated. To do this the pistons are of the "reaction type," one piston being ejected downward, or against the coal to be broken down, and the other upward, or against the solid roof rock. In construction the pistons are telescopic, and the forces exerted are counter-balanced within 18 percent, thus relieving the piston chambers, as well as the bar containing same, or such internal bending moments, stresses and reactions, as would otherwise cause distortion and make the bar imperative. In effect, the bar acts simply as the container, holding the pistons and piston chambers in position, the internal stresses tending to bend the bar itself being **reduced to 18 percent** of the **maximum expanding** force exerted by any one piston. The bar is sufficiently rigid to withstand easily this force. Engineers who have examined this type of telescoping piston pronounce it a most ingenious design, yet it is simple in construction, easy to manufacture and extremely powerful. It represents the result of years of constant experimenting and designing. One of the most important and necessary operating features is that, with this construction, the total expansion of the pistons is more than twice as great as can be obtained by any other design. In breaking the coal down an expansion in excess of 3 inches is often required. In the standard bar, 4½ inches in depth, the combined expansion of both pistons is nearly 4⅞ inches. This insures ample expansion to make the coal fall after it has been broken and shattered. An expanding bar of this type is practically indestructible, requiring no maintenance cost, except possibly the renewing of the leather gaskets after a long period of use. The end of each telescopic piston (one bearing against the coal and the other against the roof rock), is enlarged into a flat bearing surface 5 inches square. This large bearing surface prevents indentation. Even in the softest coal indentation of any piston does not exceed ⅛ inch, when exerting full expanding force.

(3) Piston Valves.

The enormous force exerted by each piston precludes the use of holding bolts, of any description, to prevent the further ejection of any one piston, after it has made its normal outward travel. At the same time, some means must be devised to maintain constant water pressure on each piston, that may be only partially ejected, in the event that one piston completes its outward travel. In other words, each piston must continue to exert its full pressure, independent of what any other piston may be exerting, or the distance it has traveled. This operating characteristic must be made "fool proof." This is done by providing each piston chamber with an automatic cut-off valve, actuated by the movement of the piston. This valve is very simple and effective in construction, and operates to shut off the water supply to the piston chamber at **the instant** the piston has made its **proper, normal, outward** expansion. The cutting off of the water supply to any particular piston chamber does not effect in any way the pressure exerted by any other piston—the other pistons continuing to be ejected at full pressure until they are fully expanded, should this be necessary.

(4) External Control Valves.

In the application of the bar it is very **necessary for the operator** to be **able to control** the ejection of the pistons. At certain times during the breaking down process, more satisfactory results are obtained by retarding the ejection of certain sets of pistons, or in some cases stopping their ejection entirely, for a few seconds, while other sets of pistons are

being ejected at normal speed. To obtain these operating features, separate water passages are provided, leading to certain sets of piston chambers, the water supply being controlled by separate **external** valves. In the small size, No. 1, type of bar, the three end pistons, or those located in the short side of the "L" shaped bar, are controlled by one valve, while each set of two pistons in the long side of the bar is controlled by separate valves. These controlling valves are placed in a "valve head," attached to the bar externally, at a safe distance from the "face" of the coal, so that the operator is in no danger of being injured when the coal falls and topples over.

In the large size bars, made in two sections, the pistons in the short section which parallel the back wall of support, are controlled by one external valve, as the separate control of each piston or set of pistons in this part of the bar, is not necessary. In the section which parallels the "rib" wall, however, it is necessary to control at least each set of two pistons, and in some cases each of the first two pistons, separately; that is, the two nearest the face of the coal. This is necessary for the reason that the front pistons have **very much less work** to do than those further back in the coal, and the speed of their ejection must be retarded, and at times stopped entirely, thus throwing full pressure on the back pistons for such period as is necessary to shear the coal at the back first. Better results are obtained by keeping the body of coal together in one mass until it is ready to fall, rather than "shelving" it off in sections, as would result if the ejection speed of the forward pistons were not controlled. After the two sections of the bar are placed in the slot, the feed pipes, or water passages, leading to the piston chambers, are connected together externally by a special "T" so that both sections of the bar are operated simultaneously from the same water supply and in the same manner, as if both sections were one bar. By reason of being able to control the ejection of the pistons in this manner, the operator is enabled to produce, and control the application of the forces, at such times, and in such a manner, as to produce **certain** and **definite** results. The coal characteristics determine, in a large measure, the manipulation necessary to produce the best results, and also the operator, by observing the progress and conditions, as the forces are applied, can determine, from experience, when, and to what extent, the various sets of pistons should be brought into action, or otherwise controlled. After a very brief experience the operator can apply the forces of the bar in a manner that will insure uniform results and cause the coal to be broken up to almost any extent desired, by the time it is ready to fall, thus making it easy to load out. If necessary each piston, or set of pistons can be so manipulated as to cause a definite fracture of the coal immediately in line with the force applied, and in this manner produce a large number of separate lumps. This is only necessary, however, in coal that contains a comparatively small number of cleavage planes, or "slips." In fully 90 percent of the ordinary bituminous or lignite coals there is always found a large number of these natural "slips" and as the forces **always** shatter the coal along these planes or "slips," it is very seldom necessary to manipulate the ejection of the pistons to break the coal into smaller lumps. In practice, after the bar is inserted, water is admitted to all the piston chambers, and these are ejected until sufficient pressure is developed to cause the coal to commence to "work"; that is, begin to crack and boom. The whole mass is then under the enormous internal stresses. This stage is reached, usually, when the water pressure is between 3,000 and 4,000 pounds and the bar developing a total force of about ⅓ to ½ million pounds. The valves controlling the ejection of the front pistons (that is, those nearest the face of the coal, which, of course, have **very much less** work to do and require less pressure), are then partlaliy closed, or if the coal shows any tendency to shelve off the front, closed entirely. The back pistons; that is, those paralleling the back wall of support, and the rear two or more paralleling the "rib" wall, continue to be ejected until a definite fracture occurs along the back and side walls. When this occurs the operator need not be told what has happened, as this is accompanied by a loud "boom" that indicates a definite fracture. The booming noise is simply due to the slipping of the fracture, as would occur in breaking a huge beam of wood, under similar conditions. The front pistons are then again brought into action and the coal cracked and broken until it falls. In producing the enormous forces necessary to make clean-cut fractures along the walls of support, the water pressure is often 10,000 pounds per square inch, or even greater, and at this pressure the force developed by **each piston** is from 150,000 to 192,500 pounds. The hydraulic bar is designed for 15,000 pounds per

square inch water pressure, but will stand 20,000 pounds without injury. When the bar is inserted in the center slot, the manipulation is practically the same, the only requirement being that the front pistons be not ejected too fast, until the back pistons produce a definite shear along the back wall, and after this is done the coal will usually fall without any further manipulation. If the coal has a tendency to stick to the roof, the front pistons are ejected until it is torn off and toppled over. From the above the great advantages to be obtained by the use of this form of bar are apparent. The ability to control the ejection of the pistons is of the **greatest importance** in the successful application of this process of mining. It permits of the forces being applied scientifically, where and when required, producing results that are uniform, and which can be obtained in no other manner.

These special and particular operating and constructional characteristics **produce** and **insure** results that are **mechanically** and **scientifically impossible** in any other form, or type, of expanding bar. They solve the problem of applying mechanical forces for the mining of coal.

(5) Spring Return of Pistons to the Piston Chambers.

At the moment the coal falls, the pistons are ejected at least one-half their normal travel and in some cases as much as 3½ inches or even 4 inches. In this condition it is very difficult to extract the bar from the fallen coal, as these projecting pistons occupy, in a large measure, the space the coal has fallen. Also the fallen coal is broken up and there are large cracks and crevices which interfere in the withdrawal of the bar, as long as the pistons remain expanded. It is, therefore, very important to provide some means for rapidly collapsing the pistons, thus reducing the bar to normal thickness, and allowing ample space for its being withdrawn freely. Also, with the pistons collapsed, the surface of the bar is perfectly smooth, and there are no projections to get caught in the cracks and crevices of the broken coal. To provide for the return of the pistons to their collapsed position **quickly**, powerful springs are provided which, as soon as the water pressure is removed, force the pistons back into the piston chambers. This action is assisted somewhat by the suction of the pump which, at that time, is removing the water from the piston chambers and pumping it back into the supply tank. This suction effect is, however, comparatively feeble, as the pistons of the high pressure pump are very small and not suitable for creating a vacuum. Also, unless special gaskets are provided on the bar pistons, air can pass freely into the piston chambers and destroy any suction effect. The introduction of special gaskets to prevent this, complicates the piston construction, so that the action of heavy springs is depended upon for forcing the pistons back into their chambers. In the collapsed position, each piston is held firmly in its chamber with a force equal to from 12 to 14 times its weight. As the piston is ejected, this force increases slightly, but the force of the spring action is practically constant. This is accomplished by using a compression spring in combination with a lever action, the fulcrum of which is shortened, in proportion to the travel of the piston, as it is ejected. This spring action has been very carefully worked out, as it is of considerable importance in saving time and annoyance in handling the bar and in permitting of the bar being extracted from the slot, readily and quickly, after the coal has fallen.

(6) Special Designs.

In some cases and under certain conditions it is advantageous to produce a combination of stresses, part of which are in a vertical plane and others in an angular plane. The result of this combination is to produce shearing stresses in the coal that insure its being shattered in many different directions. Also, when the rooms are turned down the "pitch", or other conditions make it necessary, the coal can be given an outward thrust, as well as downward, thus causing the coal, as it falls, to roll outwardly. To produce these various results, the pistons are set in the bar at an angle of from 10 to 22 degrees, the direction of ejection being **downward** and **outward**, producing what may be termed, "angular displacement" of the applied forces. To appreciate the effect of the application of the forces applied in this manner, consider the body of coal as a beam rigidly supported at both ends and along the back wall. As the pistons are ejected, they cause a rotating, or twisting, of this beam, and develop **enormous torsions** that twist and rend the mass, producing fractures along all the seams of less density and thickness, as well as along the natural "slips". In some cases part of the pistons may be placed in the bar at a given angle, while the others remain vertical. By shifting the angle of application of the forces, or by the combination of vertical and angular forces, such stresses may be set up in the body of coal as to produce almost any desired result. The bearing surfaces of the pistons, which are placed at an angle in the bar, are also of special design.

This construction is made possible only by reason of the use of reaction type pistons. In any other form of piston, the bar would be distorted, due to the angular displacement of the piston reactions, to such an extent as to make it impossible to apply the forces exerted, in this manner. This type of bar is used only in coal that is very solid, homogeneous in character, and where it is necessary, or desirable, to have the coal broken up to a much greater extent than would be produced by the use of straight, vertical type pistons. If this type of bar is used in coal having the usual number of natural cleavage planes, or "slips", it will cause the coal to be broken into small lumps, or "sheets", producing a greater percentage of slack coal than would be produced by the standard bar, which is normally less than 10 per cent, in a 6 foot vein. The placing of pistons in an expanding bar at an angle is an entirely **new form** of application and produces results that **have never been possible in any other** type of expanding bar. Also the ability to give the coal an outward rolling action is, in some cases, of great importance. The conditions which require this type of bar area, however, very unusual, as normally the standard type of bar fulfills every requirement. The development of this type of bar further extends the field for the introduction of this process of mining, enabling it to be successfully used under the most adverse conditions, and further permitting of variations in design, adapted to the character of coal in which the expanding bar is to be used.

The Hydraulic Pump.

The water pressure for ejecting the pistons of the hydraulic bar is obtained from a small triplex or quadruplex pump, driven by a 2½, 3, or 5 horse power, variable speed motor, depending on the size of the bar used. These pumps are manufactured by a number of different companies in this country and have no special features. The normal working pressures are ten thousand and fifteen thousand pounds per square inch, and the capacity is such that the bar can be fully expanded in from 4½ to 5 minutes. Usually the coal will fall when the pistons have been ejected about two-thirds of their maximum travel, so that the average time required for one "shot" is from 2 to 3 minutes.

Folding Steel Tubing.

The water is conveyed from the pump to the expanding bar through specially designed, folding steel tubing. This tubing is ¾ inch outside diameter and is cut into lengths of from 20 to 24 inches, and these lengths joined together by means of a special universal joint. The joint is so constructed that it permits of the tubing being folded up like a clothes rack. The joint is very simple in construction and absolutely leak proof. It represents the result of over two years designing and experimenting in perfecting this means of conveying water, at very high pressure, from a stationary pump, to the expanding bar. The joints are of chrome vanadium, heat treated steel, which permits of their being very light in weight. The standard length, unfolded, is 21 feet. Connections between the bar and pump can be made at any distance, from a few inches up to the total length, by simply unfolding the amount of tubing required. A length of 21 feet of this jointed steel tubing with the flexible joints, weights about 30 pounds. The tubing and joints are indestructible and require practically no maintenance cost. Each length of tubing is designed for a working pressure of 30,000 lbs., water pressure, per sq. inch. The tubing is very high grade tool steel and is very stiff and substantial. One end is provided with a special coupling for attaching to the "valve head" of the hydraulic bar, while the other end is permanently attached to the discharge of the high pressure pump. This means of conveying water from the pump to the bar has proven very satisfactory and has never failed, or caused a moment's delay, in three years of service. The joints are easily taken apart and the leather gaskets renewed should this ever become necessary. The water, or "water emulsion" as it is called, containing just sufficient oil to provide lubrication and prevent rusting, is carried in a ten gallon tank. After the hydraulic bar has been expanded and the coal brought down, the emulsion is pumped back into the tank. The only loss of the emulsion is that due to making connections and the drippings. A ten gallon tank will mine from 1,000 to 5,000 tons.

The "emulsion" in the tank is put under a pressure of 150 pounds by air pressure, and as practically the same amount of fluid is pumped back into the tank after each expansion of the bar, this air pressure remains fairly constant after once being pumped up. A small power driven air pump can be used to furnish this air pressure or it can be pumped up by hand. As soon as the bar is inserted and the jointed tubing connected, the valve connecting the supply tank to the

suction end of the high pressure pump, is opened, and the fluid passes through the pump valves and jointed steel tubing, into the piston chambers, thus completely filling the entire expanding mechanism, **before** the high pressure pump is started. This saves time and also "sets" the pistons. In the No. 2 bar, at 100 pounds pressure, each piston is exerting a force of 1,300 pounds, or the total expanding force of the bar is 13,000 pounds. With the pistons exerting this force, upon the application of the **tank pressure** only they are "seated" ready to receive the pump pressure at the first stroke of the pump pistons. In the No. 2 size bar, each

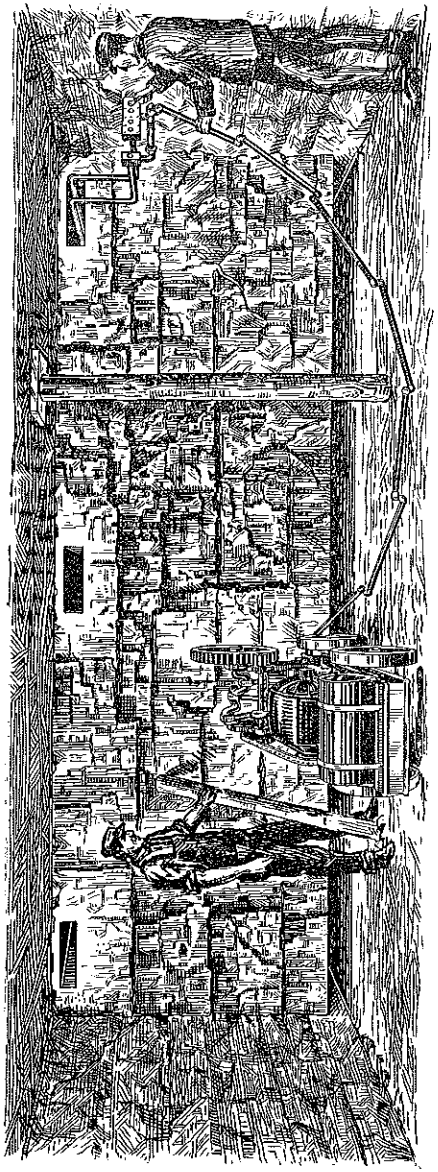


FIGURE 1—Complete breaking-down equipment ready for operation. Folding steel tubing conveys water at high pressure to Hydraulic Expanding Bars.

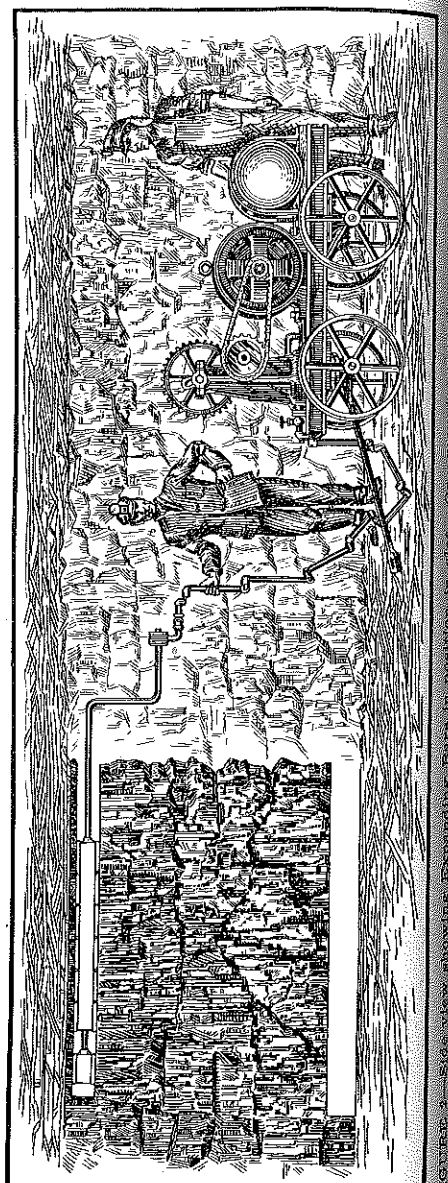
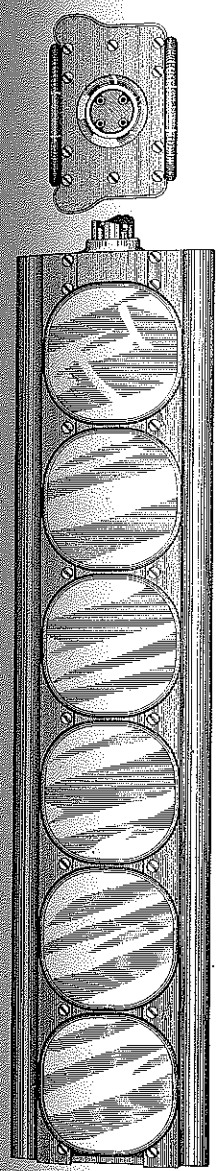


FIGURE 2—Showing hydraulic Expanding Bar in place. One man can operate the pump and do the work of a dozen men.

stroke of the high pressure pump causes the pistons in the bar to be ejected, seventeen ten-thousandths of an inch. At normal speed the pump makes five hundred strokes per minute. Each stroke drives the pistons of the bar against the coal with a combined force equal to one million, five hundred thousand pounds! Conceive of this force being delivered to the mass of coal at the rate of five hundred impulses per minute and you will have some idea of the enormous shattering effect produced. The rapid application of these enormous impulses, causes the complete disintegration of the coal, not only at the point of application, but



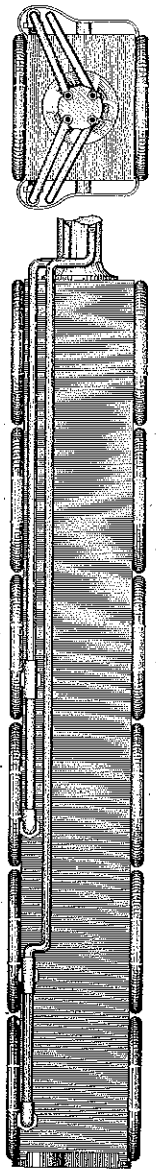


FIGURE 3 (above)—Top view of long section, No. 2 size bar showing shape of bearing surfaces of pistons. Total exertive expanding force of No. 2 bar is 1,500,000 pounds at normal water pressure.
FIGURE 4 (above)—End view showing side plates or covers enclosing steel tubes that convey water to piston chambers.
FIGURE 5 (lower)—Side view of No. 2 bar—sideplates removed—showing steel tubes that convey water to last four pistons. Depth or thickness is 4½ inches, allowing insertion into slot cut 4¾ inches by 20 inches, and 5 to 6 feet deep, depending on undercut.
FIGURE 6 (lower)—End view, with end enclosing plates removed.

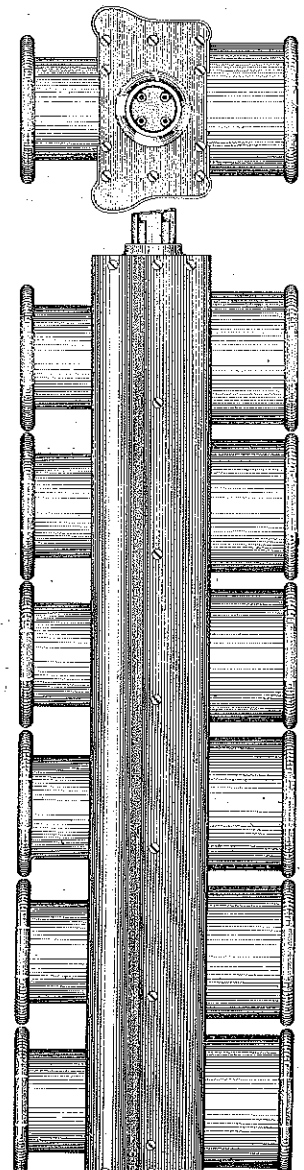


FIGURE 7 (left)—No. 2 size bar with both major and reaction pistons fully ejected. Side enclosing plates in place.
FIGURE 8 (right)—End view of bar. Pistons fully expanded.

throughout the mass to a surprising distance, often ten to fifteen feet distant, from the point of application. A peculiar fact in this connection, is that the harder the coal and the greater the force required to shatter it, the larger the volume of coal that will be broken at one application, and the more completely it will be broken up when it finally falls. The same effect has been noted in breaking wood beams, as the harder and more rigid the wood, the greater the load required, and when the beam is finally broken, it will be more completely shattered than a beam of less rigidity.

General Operation.

The tank, pump and motor are mounted on a small portable truck which is attached to the self-propelling slotting machine as a "trailer" and conveyed from place to place in the mine. The hydraulic bar is also carried on this truck. The slotting machine, with its trailer, carrying the pump, the hydraulic bar, the folded steel tubing, and other fittings and tools, is one unit. The process of slotting the coal and breaking it down is carried on as **one operation.** It requires three men, one of whom acts as "nipper" when the equipment is moved from room to room, and as general helper to the other two, while working in a "place". The usual procedure, on arriving at the face of the "room", is to detach the "trailer" from the slotting machine and push it to one side. The slotting machine then proceeds to cut a slot, on, for instance, the right hand "rib" side of the room, and as soon as this is done, requiring from five to seven minutes, it then moves to the center. As soon as the first slot is cut, the other two men proceed to insert the bar and bring down this section of the "room". In the meantime, the center slot is cut and ready for the bar, and the slotting machine proceeds to cut the last, or third slot, on the left "rib", while the center section is brought down. In this way the entire breaking down process is completed at one time, requiring not to exceed thirty minutes. In veins of 7 feet or less, in rooms, three slots only are cut, as close to the roof as possible, one in the center and one close to each "rib". When necessary, additional slots can also be cut, approximately halfway up the vein. This is only necessary in high veins, 7 feet or more in thickness, or where, on account of unusual local conditions, it is desirable to break down half of the vein only, at each application. In cutting these additional slots, the machine is not moved, as the only adjustment necessary is to raise, or lower, the cutter bar, both slots being cut with one "set up". After the slotting machine is once locked in position, the cutting of the additional slot requires only 3 to 5 minutes, as the cutter bar is quickly raised, or lowered, the required distance by the hydraulic rams, and the bar inserted and withdrawn. In rooms 20 feet or more in width, where the coal is well stratified, or has the usual "slips" and cleavage planes, it is very seldom necessary to cut more than the three slots up against the roof, even in veins 8 to 10 feet in thickness. In driving entries, and narrow places, three slots are cut, two near one "rib" wall, one of them near the roof and the other halfway up the vein, while the third is cut near the roof and the opposite "rib". The hydraulic bar is first inserted in the lower slot and the coal broken down, then inserted in the slot near the roof on the opposite "rib", and lastly in the top slot on the same " rib" as the first application. This breaks the coal down in three sections, at the same time shearing it off squarely along both "ribs" and the back wall of support. If necessary, in narrow entries and high coal, four slots can be cut, that is, one above the other on each "rib", and the coal broken down in four sections instead of three. It is not necessary to put in a center slot in "places" twelve feet or less in width.

In long wall mines, the first slot is cut near the "rib" and the coal sheared off and broken down to whatever distance it may break. The next slot is cut from 15 to 25 feet beyond where the coal has fallen with the first application, and so on, each successive slot being cut only after each application. The number of slots required depends on local conditions and character of coal, usually spaced from 30 to 50 feet apart. Also, in long wall mining, as soon as one-half of the coal is loaded out, this section of the "long wall" can be again cut and broken down while the other half is being loaded out, and thus the three operations of extraction—undercutting, breaking down and loading out—can be carried on without interruptions, or interference with each other, resulting in continuous, uniform output. In "room and pillar" mining the same routine of operations is carried out. Where the men are skillful and become familiar with the procedure, it is estimated that, including moving, etc., three men will break down ready to load out, from eight to twelve "places" per day, producing from two to three hundred tons, or an average of over seventy-five tons per day, per man employed.

(To be continued in May issue.)

Some Notes on the Operation of a Portland Continuous Filter in Costa Rica, Central America

By H. H. Juchem, '10.

In considering the following notes on a Portland Filter Unit, it must be borne in mind that the men employed in the operation of the filters are absolutely inexperienced and ignorant so far as machinery of any kind is concerned. They are peons from the fields for most part. Rarely has one of them enough mechanical sense or application to learn the work. From hundreds of men, a few efficient cyanide plant men have been developed.

It must be remembered, also, that the filters have to work under tropical conditions, four months of extreme drought, and eight months of dampness. These tropical changes of climate have a direct bearing on the cost of operation and maintenance.

It should be noted that the material treated averages only 6.5 percent coarser than 100 mesh. However small the hole which develops in the filter medium, a certain amount of grit goes through the valves and vacuum pumps. On the other hand, classification to slime without grit, cuts down the capacity of the filter and runs up to dissolved values in the tailing.

Equipment.

A unit includes one 7½ x 12 ft. Portland Filter; 6-in. x 6-in. American air compressor; 4-in. x 4-in. Connersville Rotary Vacuum Pump; air receiver, motor, etc.

Operating Data.

(1) The conditions held: 10 lbs. air is maintained in the receiver; 15 to 20 inches vacuum is carried on the pump, depending upon state of wear of the pump and valves. The vacuum pump for 4½ years lifted the solution to a height of 9 feet above the level of the center of the pump. The pressure has since been taken off the pump, because it would not give the required vacuum nor perform the lift on account of wear; 2 to 5 lbs. air pressure is carried in the discharge pipes of the filter.

(2) The tonnage treated averages 991 tons dry material per month.

(3) The slime of 1.456 specific gravity sp. gr. of dry ore is 2.63) is treated by filter. Screen analysis of the material treated averages:

On 80 mesh.....	2.5 percent
On 100 mesh.....	4. percent
On 150 mesh.....	6.5 percent
On 200 mesh.....	5. percent
Thru 200 mesh.....	82.0 percent

(4) 8 to 13 gallons of solution is discharged by vacuum pump. This depends upon the state of the filtering medium.

Only one solution product is made.

(5) The dissolved value in the tailing runs $0.03 to $0.05 per ton of dry slime.

(6) The tailing is sluiced to the river.

(7) The average total cost of filtering, including operation, repair, maintenance, but not power nor superintendence, is $0.028 per ton filtered.

Life of Various Parts.

Thirty-five hours are required to recover the filter. This includes taking off the old wire, cloth and burlap, removal of all screens and cleaning by hand, sluicing out of solution pipes, re-assembling, recovering and rewinding. Valves, gears and the pump are always gone over carefully and the necessary repairs made.

(1) The life of the valve plate and seat averages 4½ years without regrinding or scraping. The life thereafter depends on the skill of the mechanic.

(2) The life of the hose from the valve plate—no replacements.

(3) The life of the vacuum pump on this duty is about five years. Impellers and case become worn by sand, and pinions wear out.

(4) The valves of the air compressor last about four years.

(5) A new soft iron scraper, to remove the tailing, is replaced about every four months.

(6) A filter cover lasts eleven months. One set of burlap undercovers lasts twenty-two months.

(7) The wire winding is generally changed with the cover, though on two occasions it was used over with no trouble except in rewinding.

(8) The main driving gear lasts three years.

(9) The main driving worm lasts thirteen to fifteen months.

(10) The main driving gear and pinion—no replacements.

(11) After five years the wooden parts showed no deterioration except a few worm holes which were stopped with tar and rosin. Those holes were made during a two months' shut-down.

Manipulation.

(1) The scraper plate tails are filed flat every shift (12 hours).

(2) The slime is agitated every two hours.

(3) The slime is pumped from the bottom of tank by air lifts twice each shift (12 hours).

(4) The vacuum is cut off and ten lbs. of air blown through the ports after every two shifts for one revolution of the filter.

(5) The filter is cleaned every two weeks. When the discharge drops to 8 gals. per min. the filter is cleaned. The cover is brushed with fiber brushes and then steel brushes until it is clean. It is then given a wash of 50 gallons of 2½ percent. hydrochloric acid with the vacuum and air pressure on. Acid is left on for 15 minutes, and then washed off with water. The tank is sluiced out. The operation takes two to four hours from the time of taking off the vacuum to the time of removing the cake off the clean filter.

(6) When first erected, the solution distributor did not work well. It was removed and a solution applied in a fine spray. The spray was very satisfactory so far as replacement of pregnant solution was concerned, but it could not be regulated to such a point that it washed well and at the same time did not dilute the pulp in the tank and channel the cake. The distribution pipe was replaced after having been bent so that it would distribute evenly. A constant pressure was kept on the valve; for with variable pressure the distributor gave an uneven wash and the pressure was different than that for which it had been regulated. The distributor was placed very close to the cake so that the solution ran down in a continuous stream and did not drop on the surface.

A burlap drag was placed in front of the solution distributor at a distance of two feet. This drag is merely a pipe with a 6-inch width of burlap fastened to one edge, the other edge of the burlap touching the cake the whole width of the filter. Sufficient solution is used to cover the whole space between the drag and distributor. Below the drag the solution thus regulated covered the cake in streaks for 2 feet or more and then disappeared.

The object is this: From the surface of the charge to within a foot of the drag, the pregnant solution most loosely held is removed. The barren solution wash then spraying upon the pregnant solution remaining replaces it. After passing the distributor the cake comes under the water spray and the barren solution is replaced by water. This seems exaggerated, but the results show that this is very nearly what takes place. Without the drag, covering the entire surface of the cake with solution wash from the surface of the filter charge to the distributor, the dissolved value in the tailing runs up because of channeling by the large amount of solution running down the filter face. The capacity of the filter is cut down by the dilution of the charge by the excess barren solution.

(7) Water wash is applied in four four sprays. The water strikes the cake 6 inches from the solution wash distributor.

(8) The holes in the filtering medium are covered by a square cloth (same as filter cover) ½-inch square or longer, depending upon the size of the hole. These cloth squares are simply slipped under the wires without stopping the filter. When the cover is cleaned all the holes not previously caught are repaired. Holes which do not show while the cake is on the filter are found by putting on the water spray and blowing through the air port. Patches two feet square have been made by this method. No slime leaks through, and the cake is as thick over the patches as over the unpatched surface.

(9) When the wire breaks, during winding or when an end is reached, six inches of wire are worked back under that already placed, selecting a cleat on which to make the joint. Six inches of wire, about to be placed in position, is warped in beside the end of the wire already wound on the filter and the two tacked down to the cleat by staples. One turn of the filter is then made with the new slack wire even. Then pressure is applied and the winding continued. A piece of tin sheet 1 inch by 6 inches is placed over the tacked point beneath the wires. When a worn turn of wire breaks it is cut off at the soldered cleats, a new wire placed and the joints made as outlined.

(10) If the proportion of gritty material in the discharge is too small to allow good washing of the cake, a little sand is added in the tank.

(11) If the charge becomes too thin because of an excess of solution wash, 10 or 15 gallons of lime water are added to the charge and the filter run without solution wash, the valve on the vacuum line corresponding to the position of the solution wash on the filter is closed and the charge is not agitated until the thin pulp on top of the charge has been removed. This is, of course, a matter of settling the slime and pulling out the supernatant liquid. The overflow pipes and pump are not used. Whatever goes into the tank remains and is subsequently separated into tailing and solution.

The Occurrence of Gold and Silver in the Ferberite Deposits of Boulder County, Colorado*

With each depression in the tungsten market statements have been made that if the gold and silver in the ferberite ore of Boulder County, Colorado, could be saved, the tungsten industry would be helped considerably. Considerable doubt existed whether gold and silver occurred in quantity in the ferberite veins of Colorado. Accordingly, samples from several parts of the ferberite district were analyzed. No gold was found and a small amount of silver in only two samples. The work stopped at this point, there apparently being no problem of recovery, so that the results given here are negative.

The occurrence of silver and a trace of gold is reported by W. E. Greenawalt[1] in three samples of concentrate:

	Bear Creek	Nederland	Gorden Gulch
WO_3	66.41%	63.20%	60.84%
Gold	Trace	Trace	
Silver	1.2 oz. per on	2.4 oz. per ton	3.1 oz. per ton

W. Lindgren[2] states that the telluride veins of Boulder County have an intimate relationship to those of Cripple Creek, but that the tungsten veins of Boulder County do not contain any notable amounts of gold and silver and are entirely distinct from the gold and silver veins.

R. D. George[3] reports the occurrence of ferberite with telluride ore in the Graphic Mine, at Magnolia, and also in a mine near Sunshine. The Wellman Tunnel shows both ferberite and sylvanite.

V. G. Hill[4] found an average of 0.01 ounces of gold per ton in eight samples of concentrate.

Gold is said to be sometimes found with ferberite in the Logan Mine, at Crisman.[5]

F. L. Hess and W. T. Schaller[6] state that gold and silver are reported to occur in some of the ferberite veins other than those in which sylvanite is present. In an ore of this character which was examined small quantities of sulphide were found, and the gold is probably associated with the pyrite. They report the occurrence of small quantities of gold and silver in tungsten veins to be fairly common, but in many if not in most veins the precious metals, though of the same general period of vein formation, are probably of later deposition than wolframite. Silver seems to occur in larger quantities than gold.

Mr. George W. Teal,[7] president of the Slide Gold Mining Company, states that he knows of only two veins in the county where gold and tungsten occur in appreciable quantity in the same vein. He probably refers to the Red Sign Mine, located in Boulder Canon about six miles from Boulder. From this ore concentrates were obtained containing 30 percent WO_3, and 15 to 20 ounces of gold per ton, but the quantity was not great enough to warrant erection of a plant for separation of gold and tungsten. He is of the opinion that there is not a deposit of ferberite carrying gold so far discovered in Boulder County, which is of sufficient grade or quantity to warrant any experimental work for the purpose of working out a process for separation.

In the operation of the concentrator of the Tungsten Products Company, Mr. Warren F. Bleecker[7] was found that if gold occurs in the concentrate from wet concentration, it is in sulphides. The ores concentrated were from various parts of the county, but particularly from the district near Boulder. The products of wet concentration have been subsequently passed over a magnetic separator, which results in a separation of tungsten from the gold and the iron sulphide from any free gold. He has found that the concentrate of gold obtained by magnetic treatment run in all cases less than 1 ounce of gold per ton, but usually more than 0.75 ounce of gold per ton. The concentration is several hundred into one. Chinese wolframite and Arizona hubne-

*A contribution from the Department of Metallurgical Research, Colorado School of Mines, Golden, Colorado.

[1] The Tungsten Deposits of Boulder County, Colorado. E. & M. Journal, May 18, 1903, page 951.

[2] Gold and Tungsten Deposits of Colorado. Economic Geology, August, 1907, page 453.

[3] Main Tungsten Area of Boulder County, Colorado. Colorado Geological Survey, Report 1908, page 76.

[4] Tungsten Mining and Milling. Proc. Colorado Scientific Society, Vol. IX, 1909, page 150.

[5] Bul. No. 3, 1912, Colorado Metal Mining Association.

[6] Colorado Ferberite and Wolframite Series. U. S. G. S. Bul. No. 583, 1914, page 12.

[7] Personal communications.

Tungsten, Gold and Silver in Boulder County.
Ferberite Ore and Concentrate.

Sample No.	Description	Percent WO_3	Oz. Gold Per Ton	Oz. Silver Per Ton
1	Crude ore, finer, Tungsten Products Co.....	31.2	Trace	Trace
2	Crude ore, coarse, Tungsten Products Co....	7.8	Trace	None
3	Crude ore, Black Metals Reduction Co.....	25.8	3.2	Trace
4	Crude ore, Black Metals Reduction Co..... (From Wolfe Tongue Mining Co.)	42.3	0.06	Trace
5	Saunder jig hutch	62.4	Trace	None
6	Crude ore, Kicker Mine.....	23.1	None	None
7	Richards jig hutch	46.8	None	None
8	Crude ore, Hoosier Mine.....	54.3	Trace	Trace
9	Jig concentrate, Clyde Mine ore.....	58.2	Trace	Trace

rite do not carry as much gold as even the small quantity found in Boulder County ore.

Gold and silver has never been found to occur in appreciable quantity in the ferberite ores mined on the properties of the Wolf Tongue[8] Mining Company, near Nederland.

[8] Personal communications, R. E. Ewalt.

Samples analyzed confirm the general trend of opinion of operators and others in that silver occurs with ferberite only in rare instances, and then not in large quantity, and that gold rarely occurs in greater quantity than a trace in crude ore. This indicates that sylvanite is rarely found with ferberite in Boulder County and that any gold and silver present is probably associated with sulphides.

A MAMMOTH GRAIN ELEVATOR.

The immense grain elevator of the Pennsylvania Railroad at Canton, near Baltimore, one of the largest on the Atlantic seaboard, began operations with a successful testing out of the machinery and a trial with a large amount of grain, which has been received there.

Baltimore grain merchants are anticipating the full operation of the elevator in a short time, and it is expected that the facilities for speed in loading and unloading grain will add impetus to the export of grain from Baltimore. The elevator has a capacity of 4,257,900 bushels, whereas the other seven elevators now in use here have only a total capacity of 10,000,000 bushels. The grain storage capacity at the railroad terminals, therefore, will be increased nearly 43 per cent.

This monster grain elevator is equipped throughout with elevator and conveyor belting made by the B. F. Goodrich Rubber Company. This represents the largest single order of belting ever shipped, and it required seven box cars to transport it from Akron to Baltimore. The belting totaled 44,254 feet—approximately 8½ miles—and weighed 131 tons. The capacity of one of the 48-inch horizontal carrier belts is 350,000 bushels in a ten-hour day.

Accommodations are provided for the loading of five ocean liners at once and, with the new apparatus for loading that has been installed, the ships can be loaded within 10 hours.

In conjunction with the facilities that have been made for handling ship cargo, the latest device for the unloading of grain railroad cars has been put into operation and found to have proved a large factor in the expeditious handling of incoming grain from the Maryland, Virginia, West Virginia and Middle Western districts.

GEOLOGICAL FOLIO SALE.

The Geological Survey is offering for sale at the nominal price of 5 cents a copy, a considerable stock of slightly damaged geologic folios covering various parts of the United States. The damage to the folios, only slight, resulted from a fire some years ago. The list price of these folios is 25 cents and 50 cents a copy. A list showing the folios available at this 5-cent rate will be furnished on application to the Director, United States Geological Survey, Department of Interior, Washington, D. C.

LARGE MAP OF ARIZONA.

A new and accurate map of the State of Arizona has just been compiled and printed by the United States Geological Survey, Department of the Interior. The map measures 4 feet by 4½ feet; it is printed in black, and shows the county and township boundaries, the names of all towns and most of the names of even the small settlements, the railroads, all rivers, and many of the smaller streams and water features. The map is sold by the Geological Survey, at Washington, for 35 cents.

TECHNICAL REVIEW

GENERAL.

Transactions American Institute of Chemical Engineers, 1919.

We are just in receipt of the eleventh volume of the Transactions of the American Institute of Chemical Engineers, 1918, published by D. Van Nostrand Company, which is well worth giving some thoughtful attention. The conditions in which we find ourselves now that the war is over require careful handling, and the "Human Element" between employers and employes is one of the uppermost in which case Bolshevism would be forgotten.

The results of Alfred H. White's research in Nitrogen Fixation appears in print by the permission of the Chief of Ordnance.

Walter M. Russell takes up the subject of coal and water gas plants, illustrates the article, and mentions improvements. The United States Patent No. 688,872 on the manufacture of sulphuric acid by the multiple tangent system is described in detail by L. A. Thiele.

The reconstruction aspects to be found in this volume are well worth considering, especially with reference to the preservation of our chemical industries and research together with our relations scientifically to foreign countries. P. G.

"Selling Your Services."

Published by Jordan-Goodwin Corporation, Jefferson Bank Building, New York. Price, $2.00.

For the man who has no job, the man who has not the kind of job he desires, and the man who feels he has reached his limit in his present job, Mr. George Conover Pearson's new book, "Selling Your Services," will be of real benefit.

Knowing that the same fundamental laws that are effective in selling any product apply equally well to selling a man's services, Mr. Pearson has given in simple, practical, usable form, plans that any man can follow to conduct a resultful campaign to sell his own services.

Such a book is of widespread interest today because many returned service men are still out of employment, and many of those who have secured work have had to accept jobs that do not give them a real chance to develop according to their ability.

The book is filled with practical examples of advertisements, circular letters, application letters, follow-up letters, and telegrams, most of which has been actually used in obtaining better opportunities for bookkeepers, salesmen, sales managers, foremen, accountants, advertising managers, clerks, stenographers, editors, etc. It is presented in very readable form and is completely indexed.

C. E. W.

Herbert Hoover: A Sketch. By T. A. Rickard. (M. & S. P., April 3, 1920.)

This timely article on the new president of the A. I. M. E. quite properly begins with his parentage. His college career, and first job at Grass Valley, California, are next mentioned. Later he became an engineer for Louis Janin, and was sent to Western Australia. At the age of 24 he was chief engineer for the Chinese Imperial Bureau of Mines. His public prominence was emphasized by his assistance of Americans stranded in Europe, 1914. Since then he has been head of the Commission for Relief in Belgium, U. S. Food Administrator, and head of the American Relief Commission.

J. H.

Political and Commercial Control of the Nitrogen Resources of the World—I. By Gilbert G. Chester. (C. & M. E., March 10, 1920.)

This is a general review of the sources of nitrogen with the aspects of the control of nitrogen resources in normal and war times. Free nitrogen forms four-fifths of our atmosphere, but this cannot be used until it is combined with other elements, a reaction which it does very unreadily. Mineral nitrates have an uncertain origin, which may be best investigated in Chile, where the greatest nitrate deposits are. Organic nitrogen forms the greatest part of commercial fertilizers. Carboniferous deposits always contain a variable quantity of nitrogen. The universal availability of the nitrogen resources makes it impossible for any one nation or company to gain control over them. Although the mineral nitrates of Chile are controlled by that state, and lie, in time of war, at the service of the nation which controls the sea, the other sources of nitrogen are so great that no country need fear a shortage. J. H.

Review of the Copper Industry for 1919. (Arizona Mining Journal, March, 1920.)

In this article, a statistical review is given, by the Boston News Bureau, of the

world's chief non-ferrous metal. These articles include the copper production of the greatest copper companies, the statistics on refined and blister copper, copper exports and smelter production in the United States. The production of gold and silver, obtained from copper ores, is also given. F. A. L.

The First Miners and the First Civilization. By Grant H. Smith. (M. & S. P., March 27, 1920.)

This article affords a pleasant view into classical antiquity after too close proximity to the cold science demanded by modern mining and metallurgy. Among the first miners are placed the ancient miners of England who mined for flint ten thousand years ago. The Egyptians opened the first metal mines six thousand years ago. Five thousand years ago the same ingenious people were using a tubular rock drill. At the same time they led the world by centuries in the civilization of science and mechanics, but they produced no men of literature. J. H.

MINING.

Possibilities of Diamond Drilling. By Robert Davis Longyear. (Salt Lake Mining Review, March 30, 1920.)

The diamond drill, though not a new machine, is only recently finding the wide application it deserves. It is true that after ore has been found with a diamond drill it becomes necessary to drive a drift to mine it. But this is so seldom, in exploration work, compared to the instances where negative results are obtained that much fruitless development work can be spared by the intelligent use of the diamond drill. Some of the purposes for which the drill is especially adapted are:

1. Prospecting below water level.
2. Obtaining general geologic information.
3. To ascertain the limits of an orebody before deciding on an economical method of mining it.
4. To search for faulted segments.

The author gives cost, technical and general data relative to diamond drilling operations. He suggests contracting on a "cost plan" basis as being the most advantageous to all concerned. C. E. W.

Neutralizing Mine Waters on the Rand. By F. Wartenweiler and E. H. Croghan. (M. & S. P., March 13, 1920.)

The four objects to be held in view in the treatment of mine water, according to the authors, are as follows: (1) The prevention of pipe corrosion; (2) the settlement of suspended solids to prevent pipe choking; (3) the utilization in the reduction works of water free from precipitated salts; (4) the utilization of the water for spraying and underground washing. The current neutralizing agents are soda, calcium carbonate and lime. Soda effects precipitation the most rapidly, but it does not clear the water as well as the other re-agents. J. H.

The Bunker Hill Enterprise—VII. By J. A. Rickard. (M. & S. P., April 3, 1920.)

The development of crushing and concentrating practice is outlined. The first mill was built in 1866. This was followed in 1890 by the Old South Plant, in which the first flow sheet was elaborated. The next mill, the West No. 1, began operations in 1909. Its scheme of treatment is given in detail. Very complete descriptions with tables and diagrams are given of the grading system for re-dressing jig concentrates, the influence of sizing on jig operations, and the Bunker Hill and Callow screens, as well as the other equipment. No. 2 West Mill started in 1912. J. H.

Thawing Frozen Gravel with Gold Water, By Walter S. Weeks. (M. & S. P., March 13, 1920.)

This is a report on experiments in thawing made by John H. Miles at Nome. It was found that superheated steam thawed 109 cubic yards in 156 hours; saturated steam thawed 83 cubic yards in 98 hours; hot water thawed 81 cubic yards in 67 hours; and cold water thawed 511 cubic yards in 192 hours. The steam penetrated clay only to a slight extent. Most of it was expended in keeping a comparatively quiet body of water hot. The hot water application showed uniform thawing, but a low efficiency. Cold accomplishes all that is desired, at a slight expense.
a slight expense. J. H.

The Dolly Varden Mine. By Robert Dunn. (E. & M. J., March 13, 1920.)

This mine, in British Columbia, is Canada's newest silver producer of importance. Within five months after production began the mine shipped four hundred thousand ounces of silver. The metal is in the form of proustite, pyrargyrite, cerargyrite and native silver. The Dolly Varden Mines Co. received from the Canadian government many rights and privileges, contingent upon the completion and operation of a company railway by the end of 1918. This time limit was later extended by special legislation. Difficulties arose and the Traylor Engineering Co. acquired control of the mine. J. H.

An Oil Engine Installation in New Mexico. By Theodore M. Robre. (E. & M. J., March 27, 1920.)

Description of the Snow semi-deseil engine power plants of the Empire Zinc at Hanover and Cleveland, New Mexico. Engines run 98 percent of the time with a fuel consumption of 0.45 lbs. oil per b.h.p. Engines are 250 h.p., four cycle. C. E. W.

Mine-Sampling. By W. H. Wagner. (M. & S. P., March 27, 1920.)

Author describes method of sampling used by the North Butte Mining Co. of Butte, Mont. Samples of each heading are taken daily, assayed, the results transferred to the shift-bosses note-book, maps and stope cross-sections. Maps greatly facilitate work of getting out reports and estimating reserves, in addition to making mining more economical. Illustrated with several photographs of maps and record blanks. C. E. W.

METALLURGY AND ORE-DRESSING.

Magnetic Separation of Bismuth, Tin and Tungsten Concentrates in Tasmania. By Wm. E. Hitchcock and J. R. Pound. (M. & S. P., March 13, 1920.)

The use of Wetherill Magnetic Separators is here described as well as the conditions necessary for its satisfactory operation. At Launceton complex material containing bismuthite, cassiterite and wolframite are separated magnetically into firsts and seconds. The concentrates are cleaned after roasting to convert pyrite. Details of the roasting process and sundry applications of the process to custom ores are given. It is possible to remove with a magnet from one-half to two-thirds of the original concentrate. J. H.

The Requirements of Refined Copper. By Lawrence Addicks. (C. & M. E., March 10, 1920.)

The requirements of refined copper are explained as to electrical conductivity, pitch, ductility, casting and dimension. Impurities in copper, which affect conductivity, may be soluble, partly soluble or insoluble. "Pitch" refers to the appearance of the copper with regard to cavities and variations in texture caused by faulty control of the gases incidental to molten copper. Troubles from brittleness are generally traceable to a low pitch. Tensile strength and torsion depend entirely on the thin coating over the mine; with this removed the torsion is increased several times. J. H.

Pulverized Lignite Fuel in California. By Roy N. Buel. (Met. & Chem., March 31, 1920.)

This article discusses the lignite fields in a commercial way, and shows how relatively poor coal can be used to a decided advantage by pulverizing it. The burning of pulverized lignite coal under boilers and in metallurgical plants is coming into use very rapidly. Coal is high as 20 percent ash have been reported to have been used to a great advantage. The article is very interesting in that it gives the operation of the combustion equipment, advantages of burning pulverized lignite and results obtained in a power plant. F. A. L.

The Ganelin Chloride Process. (Mining Magazine, March, 1920.)

This is a description of the Ganelin chloride process for silver-lead-zinc middlings, etc. The patentees are Solomon Ganelin & Co., of Brooklyn. It is a British Patent, No. 20,781, of 1918 (135,968), and contains the best of information relative to the chloride process which is being tested by the Amalgamated Zinc Co., Ltd.

Briefly, the process is to chloridize lead-silver-zinc ores. Other ores are also reduced to chlorides, and the metals recovered by leaching. F. A. L.

The Electrolytic Zinc Plant of the Judge Mining and Smelting Co. at Park City, Utah. By L. S. Austin. (M. & S. P., March 20, 1920.)

The zinc concentrates treated are considered by the writer as coming from the jigs or from the tables. They contain 35 percent zinc, 8 percent iron, 5 percent silica, 31 percent sulphur, 3.5 percent lead, and 15 ounces of silver. The effect of high altitudes upon the roasting process is described. The copper and cadmium dissolved in the thickened slime are removed by the addition of zinc dust. The cadmium is later removed from the precipitate by dissolving it in dilute sulphuric acid and electroiyzing it. J. H.

A Modification of Horwood's Process for the Flotation of Copper-Zinc Ores. By H. L. Hazen. (M. & S. P., March 27, 1920.)

Mr. Hazen's article deals with the difficulty of separating sphalerite from sul-

phides of copper. Horwood's method was: First, the extract of the sulphides in a mixed concentrate; second, quick roasting of the concentrate at about 400 degrees C.; third, re-treatment by flotation. Mr. Hazen advocates as a modification the oxidation of the copper ores by roasting, and then their leaching. Flotation would then effect the final separation. The details of tests made under this modification are given in two tables. The great advantage of this system is that it does not require the delicacy of control as Horwood's method. J. H.

Commercial Development of Fused Silica. By John Scharl and Wallace Savage. (C. & M. E., March 31, 1920.)

This is an account of the development of the electro-thermal processes of fusing glass sand. Fused rock crystal ware is very transparent and may be used for thermometer stems and ultra-violet ray tubes. The reactions between carbon and silica, and the application of gas phases are discussed, as well as the peculiar phenomena of fused silica. The commercial production was negligible before 1904, when the Thermal Syndicate, Ltd., of England, began producing fused sand ware. The article ends with an explanation of the important properties of fused silica. J. H.

Aluminum Rolling Mill Practice—I. Commercial Pig and Scrap. By Robert J. Anderson and Marshall B. Anderson. (C. & M. E., March 17, 1920.)

This is the first of a series of articles discussing the details of rolling and mill practice for aluminum, including all phases of work from pig metal to finished sheet. Metal for melting is considered in this installment. Its especially interesting features are a table of the various specifications for pig aluminum as given by the Navy Department and a table showing a typical analysis of pig aluminum. J. H.

Aluminum Rolling Mill Practice—II. Melting Furnaces, Ingot Pouring. By Robert J. Anderson and Marshall B. Anderson. (C. & M. E., March 24, 1920.)

Continuous vs. intermittent melting prior to casting rolling mill ingots is discussed in their second installment. They demonstrate that intermittent melting gives better results, but is practical from a standpoint of efficiency only in small plants. In large plants the advantage of economy and increased production make continuous melting admissible. In the discussion of transferring molten metal by tapping or ladling, it appears that tapping allows less chance for the metal to cool, and is cheaper. J. H.

Aluminum Rolling Mill Practice—III. By Robert J. Anderson and Marshall B. Anderson. (C. & M. E., March 31, 1920.)

Specifications and some of the uses for sheet aluminum are noted, followed by a discussion of furnaces for heating ingots preparatory to slabbing tables and examples of calculations are given, whereby individual orders may be rolled with minimum allowance for scrap. The practice of rolling aluminum ingots without preheating in a furnace is condemned because there is no possibility of temperature control. J. H.

GEOLOGY.

The Ore Deposits of Mexico—I. By S. J. Lewis. (M. & S. P., March 20, 1920.)

In this first article of the series Mr. Lewis declares his purpose to be the exposition of the ore deposits of Mexico, with a discussion of their origin in untechnical language. He classifies the geology of the country upon the basis of Pre-Cambrian, Paleozoic, Mesozoic, and Cenozoic time. The formation of lode channels, their mineralization, the magnetic theory, and the theory of enrichment by circulation are all dealt with. A study of the special conditions which make all ore deposits different is promised in a later article. J. H.

The Ore Deposits of Mexico—II. By S. J. Lewis. (M. & S. P., March 27, 1920.)

Ore deposits in sedimentary rocks are here classified as true contact deposits, non-contact deposits, combination forms, and limestone ore deposits. The Borreno Mine is cited as an excellent example of the true contact deposit. Three stages are distinguishable: The deposition of primary sulphides; the entrance of silicious solutions; and the oxidizing enrichment of the sulphides. The Ajuchitlan Mine is another example of the same type. Mineralization by replacement and the origin of antimony ore in the Santa Maria Mines are explained as being due to emanations from a laccolith. J. H.

OIL.

The Distillation of Shale-Oil. By James A. Bishop. (M. & S. P., March 13, 1920.)

The commercial products into which kerogen may be resolved are the important features of this article. The chief hydrocarbon compounds are methane, ethane, propane, butane, pentane, and hexane. The three grades of distillates are: (1) Those whose boiling points range from zero to 150 degrees C.; (2) those boiling between 150 degrees C. and 300 degrees C.; (3) those boiling above 300 degrees C. Shale distillates are all included in the first thirty-five members of the paraffin series. Paraffins only are found in shale and the presence of olefines and benzenes indicates improper distillation. In Europe this distillation is assisted by a discharge of large volumes of steam into the shale. J. H.

Composition of Petroleum and Its Relation to Industrial Use. By C. F. Moberg, S.D. (Mining Journal, March 13, 1920.)

So far as the elementary composition of petroleum is known it may be briefly stated that petroleum consists principally of a few series of hydrocarbons, with minute admittures of sulphur, nitrogen, and oxygen derivatives, which may be regarded as impurities to be removed in the preparation of commercial products. The author discusses the classification of petroleum in great detail and points out their influence upon commercial products. The article is to be continued. F. A. L.

Wild Boom in the North Texas Oil Fields. By H. A. Wheeler. (E. & M. J., March 27, 1920.)

Author reviews history of developments in the various North Texas fields, laying special emphasis on Burkburnett and Ranger. He describes the various promotion schemes in vogue at the different stages of development. Burkburnett has been ruined by over-drilling. Production after six months is shrinking at the rate of 30 to 60 percent per month. Field 90 percent exhausted. Yield about 8,500 barrels per acre. Average depth, 1,700 feet; cost of well, $30,000.

Ranger field average production about 1,200 barrels per acre; wells, 3,200 feet deep; cost, $50,000. Wells decline very rapidly. Field two-thirds exhausted. Production seems to come from crevices in limestone rather than sands.

Other fields described are Desdemona, Breckenridge, Petrolia, Electra, Brownwood and Moran. A general map of Texas, showing position of wells, is included. Also a financial estimate of the operating results of a typical Ranger lease. Recommend article to anyone interested in oil industry. C. E. W.

Oil Well Pumping Methods and Equipment. By Seth S. Langley. (E. & M. J., March 27, 1920.)

Article contains numerous drawings, estimates of cost and other engineering data relative to the equipment used in pumping oil wells. Splendid reference article for those contemplating operating oil wells. C. E. W.

OHMS, AMPERES AND VOLTS EXPLAINED.

When an electric current is flowing in the trolley wire or electric lighting circuit there are three factors involved. One of these is the pressure expressed in volts which causes the current to flow; another is the resistance or opposition offered by the circuit to the flow which is expressed in ohms; the last is the current strength or volume, expressed in amperes which is maintained with the circuit as a result of the pressure overcoming the resistance. The ohm is named in honor of George Simon Ohm, a distinguished German electrician. The volt is named after the Italian scientist, Volta. The ampere is named after the French scientist, Ampere.

The unit of current is called the ampere. The unit of electrical pressure or electromotive force is called the volt. The unit of resistance is called the ohm. The unit of electric power is the volt-ampere and this is called the watt. Seven hundred and forty-six watts per hour equals one horse power. The unit of energy—the product of electric power and time—is called the joule, but this unit is too small for practical purposes and the kilowatt-hour is used instead. The kilowatt-hour is the work done by a thousand watts working for one hour.

These electrical terms are as familiar to electrical engineers as feet and inches to the average boy; the layman does not understand because he has never been taught, has never had to use the terms, has never read about them.

It is easier to understand these terms if we consider electricity as a fluid and liken it to a current of water flowing through a pipe. The rate of flow of water in the pipe depends upon the gravitation and the height of the reservoir or source above the outlet. The greater the height of the source the greater will be the pressure of water and the greater the flow in gallons per minute. It is just the same with electricity. A current flows from a high potential to a low potential whenever the two are joined by a conducting wire. It is merely a difference of level.

DISCUSSION

On March 10 the secretaries and presidents of the Alumni Association of Colorado University, Denver University, Colorado Agricultural College, Colorado College, Colorado State Teachers' College, and the Colorado School of Mines, met at a luncheon, given by the Alumni Council of Denver University, to discuss the desirability of forming a federated alumni organization. The following is the constitution which was decided upon at a subsequent meeting, held in the Denver Civic and Commercial Association's headquarters in the Chamber of Commerce Building on March 18:

CONSTITUTION of the COLORADO INTERCOLLEGIATE ALUMNI ASSOCIATION.

Article I—Name.

The name of this Association shall be **The Colorado Intercollegiate Alumni Association.**

Article II—Objects.

The objects of this Association shall be:

1. To handle state and national problems affecting the educational interests of Colorado colleges and universities.
2. To aid in raising the standards of educational work in all colleges and universities represented in the Association.
3. So far as practicable, to encourage uniform policies for each Alumni Association.
4. To consider and to aid in any public, political or other matters of interest to the higher educational institutions of this state.

Article III—Officers.

Section 1. The officers of this Association shall be:

President.
Vice-President.
Secretary-Treasurer.

Sec. 2. **Executive Committee.** An Executive Committee shall be created consisting of the presidents and secretaries of all Alumni Associations of Colorado institutions affiliated with this Association.

Sec. 3. **Advisory Board.** An Advisory Board consisting of the President, Vice-President and Secretary of the Colorado Intercollegiate Alumni Association shall have full power to transact all business for the Association. They shall report their action in full at the next meeting of the Executive Committee, and they are instructed to send a written report to each member of the Executive Committee after each meeting of the Board.

Sec. 4. The officers of the Executive Committee shall consist of a **President, Vice-President** and **Secretary-Treasurer.** These officers shall be the officers of the Colorado Intercollegiate Alumni Association. They shall be elected for one year and shall hold office until their successors have been elected and duly qualified.

Sec. 5. These officers shall perform their usual duties, unless otherwise specified by the Executive Committee.

Sec. 6. The Executive Committee shall have general charge and control of the affairs of the Association. They may appoint persons to fill any vacancy in any office until the next regular meeting of the Association.

Article IV—Meetings.

Section 1. The meetings of this Association shall be at such time and place as may be determined by the Advisory Board.

Sec. 2. The first Saturday of each October shall be the annual meeting at which time the election of officers shall take place.

Article V—Membership.

Section 1. Any Colorado Alumni Organization may become a member of the Colorado Intercollegiate Alumni Association upon application and election by a majority vote of the Executive Committee.

Sec. 2. All members in good standing of the organized Colorado Alumni Associations affiliated with this State Association shall automatically become members of the Colorado Intercollegiate Alumni Association.

Sec. 3. Each individual association shall be represented at the meetings of the Colorado Intercollegate Alumni Association by the presidents and secretaries of said Associations. Meetings of this State Association shall be open to all members of Alumni Associations represented.

Article VI—Finances.

There will be no regular dues in this Association, but funds necessary for maintaining the Colorado Intercollegiate Alumni Association shall be raised by an assessment levied by the Executive Committee on the different Alumni Associations which are members.

Article VII—Voting.

Section 1. All questions before the Executive Committee shall be determined by a majority vote of the Alumni Associations which are members of the Colorado Intercollegiate Alumni Association.

Sec. 2. Each institution or Alumni Association so affiliated shall be entitled to one vote.

Article VIII—Amendments.

These articles may be amended or added to at any meeting of the Association by a two-thirds vote of the members of Alumni Associations present, providing a notice shall have been sent to each Alumni Association represented in the State Association at least five days previous to the day of the meeting, outlining the amendment and object thereof.

The present officers of the temporary organization known as the Colorado Intercollegiate Alumni Association are:

Stuart L. Sweet.....President
President Alumni Association,
University of Denver.

J. J. Laton.....Vice-President
President Alumni Association,
University of Colorado.

Roud McCann.....Secretary
Secretary Alumni Association,
Colorado Agricultural College.

These men will hold office until the annual meeting of the Association is held in October, 1920, as provided in the Constitution.

We trust our Alumni members will give this their serious consideration. If you have any suggestions let us hear them.—Editor.

School News

FACULTY REAPPOINTMENTS.

On Thursday, April 8, the board of trustees held their regular meeting. They voted a 10 to 25 percent salary increase to the members of the faculty. This will become effective September 1st.

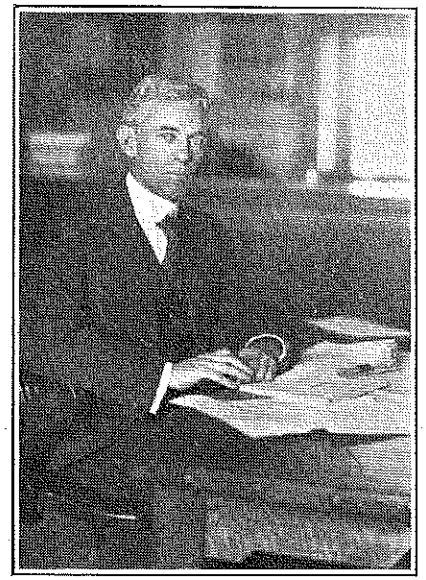
All members of the present faculty were reappointed, with the exception of Professor J. C. Roberts, of the coal mining department, and Mr. H. M. Cronin, chemist at the Experimental Plant, who resigned to enter private business.

1920 GRADUATING CLASS.

Thirty-nine members of the Senior Class will receive the degree of Engineer of Mines on May 10. Dr. John A. Barrett, director of the Pan-American Union, Washington, D. C., will deliver the commencement address.

MINES SERVICE RECORD.

Have we your service record correct to date? We are requested by the Historian of Colorado to supply sufficient information for a book that is being prepared relative to the part the Colleges of Colorado played in the World War. Send us a concise statement of your rank at discharge, branch of service, length of service, major operations in which you participated, and wounds received. See that your friends give us this information. If we do not have you listed correctly after this is published it will be your fault.



T. C. Doolittle

T. C. Doolittle, our well-known Registrar, is still handling the Mines' exchequer. This will probably remind you of the semi-annual conferences you had with him in which you always were the "loser."

Electric lamps are now successfully made in China. An Edison lamp factory in Shanghai turns out 7,000 completed lamps daily.

Alumni News

ALUMNI BANQUET.

The Annual Meeting and Banquet of the Alumni Association will be held at the Metropole Hotel in Denver, Saturday evening May 8th at 6:30 p. m. Cost per plate $2.00.

All members of the present Senior Class are invited to attend as guests of the Alumni Association.

We urge every Alumnus to attend, and request that you immediately advise the Assistant Secretary, Mr. C. Erb Wuensch, that you will be present.

Come and renew the friendships of your college days. You will meet not only your old friends, but many who desire to meet you.

R. B. PAUL,
Pres. C. S. M. Alumni Association.

The Nominating Committee report the selection of the following candidates for the election of officers of the Alumni Association for the year 1920:

For President—W. H. Coghill, '03; J. E. Dick, '12.

For Vice-President—A. V. Corry, '98; C. B. Neiswander, '13.

For Secretary—S. Z. Krumm, '14; W. P. Simpson, '01.

For Treasurer—A. S. Richardson, '12; R. T. Sill, '06.

For Member Executive Committee—A. J. Hiester, '12; E. R. Ramsey, '12.

(Signed) LOUIS COHEN, '97,
CLARENCE MALSTROM, '00,
CHAS. M. GLASGOW, '10.
ROSS R. MAY, '12,
E. S. GEARY, '12.
Nominating Committee.

ELECTRIC OVENS FIND WIDE APPLICATION IN AUTOMOBILE PLANT.

The electric oven installation of the Tarrytown plant of the Chevrolet Motor Company consists at the present time of twenty ovens of various sorts. Of these, eighteen are heated entirely by electricity, and two by a combination of steam and electricity, the whole installation making a total connected load of 2,400 kilowatts.

The General Electric Company has furnished the heating and control systems for many of these ovens throughout the country, which are doing many varieties of work, with a saving over gas, and fuel heated ovens that averages about 20 per cent in actual operating cost, not including the percentage of spoiled material turned out by the fuel furnace.

PERSONALS

'96.

William H. Paul is consulting engineer for the International Railway of Central America; address 17 Battery Place, New York City, N. Y. He is temporarily at the Utah Hotel, Salt Lake City.

'97.

J. Norman McLeod, mining engineer for the Rare Metals Refining Co., 309 South Broadway, Los Angeles, Calif., is examining mining properties in the Western states.

'99.

Gilbert L. Davis, who is with the U. S. Reclamation Service, has moved from Saco, Mont., to Missoula, Mont.

'00.

Daniel Harrington is in the Coeur D'Alenes in behalf of the mine ventilation investigations that he is conducting in the large mining camps of the West for the U. S. Bureau of Mines.

'01.

Karl C. Parrish is at Barranquilla, Colombia, South America.

'05.

L. P. Pressler has resigned his position with the Johns-Manville Asbestos Co. at Asbestos, Quebec, Canada, to join the engineering staff of the St. Joseph Lead Co. at Bonne Terre, Mo.

E. E. Greve is chief engineer with the Oil Well Supply Co., 215 Water St., Pittsburgh, Pa.

'06.

Wm. H. Finigan is president of the MacGowan & Finigan Cordage Co., 432 Pierce Bldg., St. Louis, Mo.

Mr. and Mrs. Max W. Ball announced the arrival of Douglas Schelling Ball at Cheyenne, Wyo., on March 5.

J. Marvin Kleff is on an extensive tour of the United States. He expects to visit the various mining camps of interest in Arizona and New Mexico, the oil fields of Texas and Louisiana, and thence several of the cities on the Eastern coast.

Seely B. Patterson is manager of the Calcite Quarry Co., Myerstown, Pa.

'07.

George P. Moore is chemist for the Wallace-Barnes Co., Bristol, Conn.

J. P. Golden is in the abstracting and realty business at O'Neill, Nebraska.

H. C. Armington is superintendent of the Buckeye Petroleum Co. and the Marigold Oil & Refining Co at Wichita Falls, Texas. Address, 2413 Ninth Street.

'08.

H. D. Whitehouse is with the Continental and Commercial Securities Co. of Chicago, Ill.

'09.

J. T. Boyd has returned to Colorado from New York. He is temporarily at 1115 Race Street, Denver, Colo.

C. E. Lesher, Director of Statistics for the Distribution Division of the U. S. Fuel Administration, is the author of "The Distribution of Coal and Coke"—Part I, which has recently been issued. This is replete with graphs, statistics and economical aspects of the industry.

'10.

A. E. Perkins is back to his old position of Western manager for the Colonial Steel Co., 308 Kearns Building, Salt Lake City, Utah. He was with the naval engineers during the war.

H. H. Juchem, of the Aguacate Mines, San Mateo, Costa Rica, has been examining mines and prospects in the southern part of Costa Rica.

Emil J. Bruderlin's address is care Cia Minerales y Metales, S. A., Monterrey, N. L., Mexico.

'11.

Georgia Smith, wife of Roy F. Smith, died at her home in Denver, on March 19, after an illness of over a year. Mr. Smith is with the Empire Zinc Co. at Gilman, Colo.

Arthur N. Sweet is manager of the American Asbestos Mining & Milling Co., at Idaho Falls, Idaho. He was a visitor in Golden the latter part of March.

Otto Herres, Jr., is superintendent of the United States Fuel Co., Hiawatha, Utah.

'12.

W. G. Ramlow has moved from St. Paul, Minn., and is again with the Empire Zinc Co. at Hanover, New Mexico. He is engaged in construction work.

Leon M. Banks is leasing at Metcalf, Arizona.

Chas. L. Harrington has been transferred from Naturita, Colo., to the Denver office of the Radium Company of Colorado.

'13.

Richard A. Leahy is assistant mill superintendent at the St. Joseph Lead Co., Bonne Terre, Mo.

Harvey Mathews has accepted a position with the Antoro Mines Co., Bonanza, Saguache County, Colo.

'14.

A. Ringgold Brousseau has joined the geological staff of the Rood Oil Corporation at Bartlesville, Okla.

Wm. G. Zulch is with the Vindicator G. M. Co., 603 Symes Bldg., Denver, Colo.

'15.

G. H. Van Dorp is with the Black Hawk Consolidated Mines Co. at Vanadium, New Mexico. Van Dorp was recently married to Mrs. Mabel Hyland Rooney of Golden, Colo.

Mr. and Mrs. John N. Teets announce the arrival of a son, December 21, 1919, at Whitepine, Colo.

Samuel J. Burris, Jr., is engineer for the Metals Exploration Co., Denver, Colo.

'16.

V. D. Howbert has returned to Colorado Springs from California owing to the closing down of the Afterthought Copper Mines.

C. B. Gauthier is manager of the Carbondale chemical plant at Carbondale, Ill. He is associated with Dr. Herman Fleck, former Professor of Chemistry at Golden.

Frank T. A. Smith is at Burnet, Texas. He is with the Meadows Oil & Chemical Corporation of New York.

'17.

George Goldfain is Chief Chemist for the Great Western Sugar Co. at Fort Morgan, Colo.

Lisle R. Van Burgh left Casper, Wyo., and is now geologist for the Frantz Corporation, Wuinett, Mont.

'18.

Thomas P. Allan has gone to Alaska to assist Mr. E. R. Cooper, of New York, on a four months' examination trip.

EX-MINES NOTES.

'06.

James S. James is superintendent of mines for the Radium Company of Colorado, Inc., at Naturita, Colo.

'09.

Forrest Mathéz is now superintendent of the Silver King Coalition Mines Co., Park City, Utah.

'10.

Theodore Pilger is employed in the foreign sales department of the Allis-Chalmers Co., Milwaukee, Wis.

WHERE ARE THESE MEN?

Louis S. Cain, '13.
Chas. Adams, '04.
Ward Blackburn, '08.
Alan Kissock, '12.
Donald S. Giddings, '00.
A. F. Hallett, '09.
M. R. Valentine, '98.
W. E. Canning, '09.
Norman R. Copeland, '18.
Frank H. Jones, '98.
A. L. Levy, '06.
S. J. Clausen, Jr., '11.
A. F. Richards, Ex.-'08.
D. O. Russell, '10.
Truman D. Prier, '04.
T. H. M. Crampton, '14.
Geo. M. Lee, '10.
C. B. Hull, '09.
Van Cleave A. Olson, '15.
Joseph U. G. Rich, '08.
G. J. Wackenhut, '04.

ATHLETICS

By F. A. Litchenheld, '20.

BASKETBALL.

Mines 27; Aggies 21.

The Mines basketball team defeated the Agricultural team by the score of 27 to 21. The game was a fast one and the score very close at all times. The Mines forged ahead toward the end. The team work of the Mines was a big factor in their scoring. Dunn, Bryant, and A. Bunte, as usual, did excellent work for the Mines.

During the first half, little scoring was done. It ended with a tie, 9 to 9. The play was fast, but neither team seemed to have much accuracy in shooting baskets.

In the second half, the Mines opened up in a brilliant fashion and soon ran up a big lead. The Farmers came back strong and for a time it looked as though they would overtake the Mines lead.

Mines 23; D. U. 10.

In the last basketball game of the season, Mines defeated D. U. by the score of 23 to 10.

The game was at times very rough. Towards the end it was well played. In floor work, D. U. showed well, but when it came to putting the ball through the hoop for field goals, they could not score with consistency. In fact, the team made but two field goals.

A. Bunte was disqualified because of personal fouls; he was the best scorer for Mines, and played a splendid game. Bryant, at center for the Ore Diggers, played his usual game. Chase was D. U.'s star.

CONFERENCE STANDING.

Because of C. C.'s victory over Aggies, this gives the Mines second place in the conference. The standings of the clubs are as follows:

Club	Won	Lost	Pct.
University of Colorado...	6	2	.750
Mines	5	3	.625
Aggies	4	3	.586
Colorado College	4	3	.586
Denver	1	7	.125

DAVIS ELECTED CAPTAIN.

A. D. Davis, who played guard on the basketball team this year, was elected captain of next year's team. This is Davis' first year at Mines. His playing at guard was excellent, although he had little chance for spectacular work. He always helped to keep the opposing team's score at a minimum. He was given the honorable mention in all-conference choice as guard against such men as Brown and McTavish.

Bryant secured all-conference position and is the only Miner to get a place on this team. A. Bunte and Davis were given an honorable mention. Bryant, with Brown and Welland, of Boulder, were unanimously chosen. The All-Conference Team was:

Willard, Colorado, forward.
Bryant, Mines, forward.
Bresnehan, Aggies, center.
Brown, Colorado, guard.
McTavish, C. C., guard.

Honor Roll—centers: A. Bunte, Mines, Holman, of C. C.; guards: Schrepferman, of Colorado, Davis, of Mines, and Iliff, of Denver.

BASEBALL.

Coach Glaze is starting off the baseball season at the school with the same zest as he did in football. Four players are not eligible for the team. Chuck Schneider is barred on account of having four years of athletics to his credit. Severini, McGlone and Benjamin are the others who are barred because of the Conference "one year" rule. But in spite of this Glaze hopes to have a strong team this year. Judging from the material on hand, he should make a strong showing. So far he has no pitcher who can be called upon to deliver the goods, but no doubt he will develop one.

Mines have defeated the West Denver High School in a four-inning game with a 20-5 score. The first Conference game will be played with the Aggies on April 23. The schedule:

April 23—Aggies vs. Mines.
April 24—Aggies vs. Mines.
April 30—Mines vs. CC.
May 1—Mines vs. C. C.
May 4—Mines vs. D. U.
May 7—C. C. vs. Mines.
May 8—Wyoming vs. Mines.
May 13—Wyoming vs. Mines.
May 14—Mines vs. Colorado.
May 20—D. U. vs. Mines.
May 21—Colorado vs. Mines.

Enough hydro-electric energy is running to waste here in the United States to equal the daily labor of 1,800,000,000 men.—Franklin K. Lane, Secretary of the Interior.

WORLD'S PRODUCTION OF CHROMITE IN 1918.

In view of the record-breaking production of chromite in the United States in 1918, reported by the United States Geological Survey, Department of the Interior, it is of interest to note the part it played in the world's output for that year. The approximate output in round numbers for the country is expressed below in metric tons.

World's Production of Chromite in 1918.

United States	84,000
Canada	20,000
Cuba	9,000
Guatemala	1,200
Brazil	18,000
British South Africa.....	28,000
Turkey (Asia Minor).....	14,000
Greece	10,000
Austria-Hungary	500
Russia	16,000
India	20,000
Australia	800
New Caledonia	26,000
Japan	8,000

France, with 9,000,000 horse power, is the richest country in Europe in waterfalls.

ALMOST AS HOT AS THE SUN.

The electric furnace in actual use has reached the temperature of 3,500 degrees C. Recent experiments have, however, developed a furnace which gives a temperature of 4,500 C., enough to volatilize diamonds. A comparison of these temperatures with that of the sun, which is estimated at 5,000 degrees C., gives a striking idea of what can be accomplished in handling refractory substances with electric heat.

The Roessler & Hasslacher Chemical Co. have moved from 100 Williams Street to their new and more commodious quarters at 709-719 Sixth Avenue, corner 41st Street, New York, N. Y.

At the Annual Meeting of Midwest Forge & Steel Co., East St. Louis, Ill., U. S. A., the following new officers were elected: J. W. Eschenbrenner, President and Treasurer; C. T. Coates, Vice-President and General Manager; E. A. Eschenbrenner, Secretary. The business was established in 1885, and for the past five years has been specializing in Cement Mill and Mine Forgings, particularly Grinding Plates and Steel Balls.

PROFESSIONAL CARDS

BEELER, HENRY C.
Mining Engineer.
229 Coronado Bldg.,
Denver, Colo.

BURLINGAME, WALTER E.
Chemist and Assayer.
1736-38 Lawrence Street,
Denver, Colo.

BUTLER, G. MONTAGUE
Mining and Geological Engineer.
Dean College of Mines and Engineering, University of Arizona, Tucson.
Examinations and problems involving persistence, change in character, and loss of ore.
Diamonds and other gems secured for Miners or their friends at reduced rates.

CORRY, ARTHUR V.
Member Harper, Macdonald & Co., Mining Engineers, Butte, Mont.

DUGAN, WILLIAM F.
General Agent for Southern California.
Columbian National Life Insurance Company.
Old Line, Low Cost Life Insurance, Accident and Health Insurance.
716-718 Trust & Savings Bldg.,
Los Angeles, California.

HAMMOND, JOHN HAYS
Mining Engineer.
71 Broadway,
New York.

MILLIKEN, WILLIAM B.
Mining Engineer and Metallurgist.
918 Equitable Bldg.,
Denver, Colo.

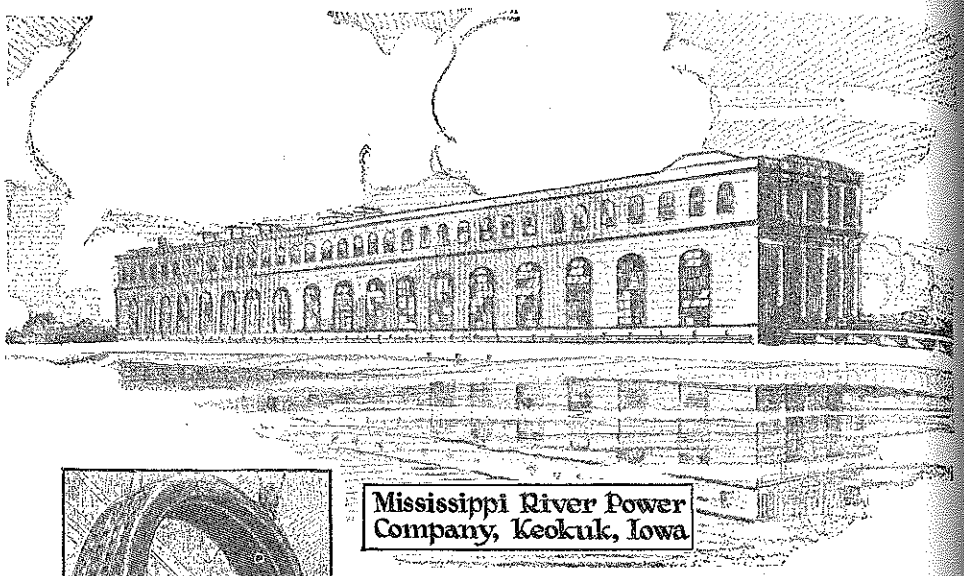
MONTANA LABORATORY CO.
E. E. BLUMENTHAL
Chemist and Assayer.
Phillipsburg, Mont.

H. N. STRONCK
Consulting Industrial Manager.
Problems of Finance, Organization, Production, Labor and Accounting.
743 Conway Bldg., Chicago, Ill.

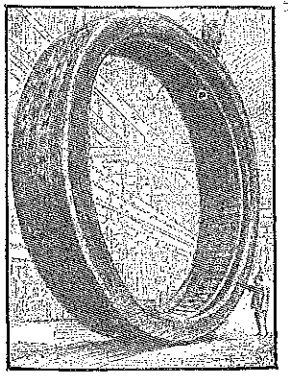
TAYLOR, FRANK B.
Geologist and Oil Expert.
Reports and Investigations.
Box 325, Casper, Wyo.

WALTMAN, W. D.
1215 First National Bank Bldg.,
Denver, Colo.
Phone Champa 5236.

WOLF, HARRY J.
Mining Engineer.
42 Broadway,
New York.



Mississippi River Power Company, Keokuk, Iowa



A casting for one of the huge water-wheel driven generators installed in the Mississippi River Power Company's plant at Keokuk. This installation will ultimately consist of thirty of these machines, giving a total capacity of 216,000 kilowatts (300,000 horsepower). It is the largest hydro-electric development in the world. The General Electric Company builds generators for water-wheel drive in sizes ranging from 37½ to 32,500 kilowatts and the aggregate capacity of G-E units now in successful operation is in excess of four million horse-power.

Utilizing Nature's Power

ELECTRICAL energy generated by water power has grown to be one of our greatest natural resources—and we have only begun to reach its possibilities. It mines and refines our ores, turns the wheels of industry, drives our street cars and lights our cities and towns. The power obtained from Nature saves many million tons of coal every year.

At first the field of its utilization was limited by the distance electricity could be transported. But soon research and engineering skill pointed the way to larger and better electrical apparatus necessary for high-voltage transmission. Then ingenious devices were invented to insure protection against lightning, short-circuits, etc., which cause damage and interrupt the service. And now all over the country a network of wires begins to appear, carrying the magic power.

The General Electric Company, with its many years' experience, has played a great part in hydro-electric development. By successfully co-ordinating the inventive genius of the company and its engineering and manufacturing abilities, it has accomplished some of the greatest achievements in the production and application of electrical energy.

The old mill wheel of yesterday has gone. Today the forces of immense volumes of water are harnessed and sent miles away to supply the needs of industry and business and the comforts of the home.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

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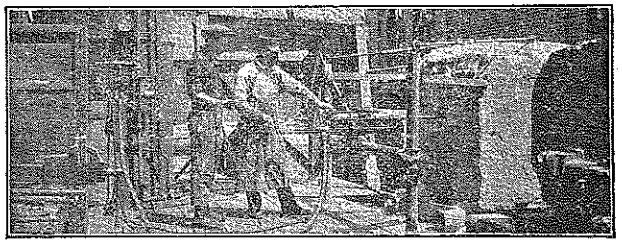
MINES MEN TO MINES EMPLOYERS

And Preferred Service to Mines Men and Mines Employers Everywhere
WIRE or WRITE US REGARDING YOUR OPENINGS
Stating Requirements of Position and Salary Paid
We Will Report Upon Best Men Available Immediately



"Setting the Pace"

YOU hear miners everywhere now-a-days saying that Waugh drills "set the pace" for all mining drills. They know that since first entering the rock drill field Waugh drills have taken and held the lead.

One reason for this is that before they are shipped from the factory these drills are thoroughly tested in hard granite and have proven their ability to keep on holding the lead and "setting the pace."

Is your mine "all-Waugh" equipped yet?

THE Denver Rock Drill Manufacturing Co.

DENVER, COLORADO

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