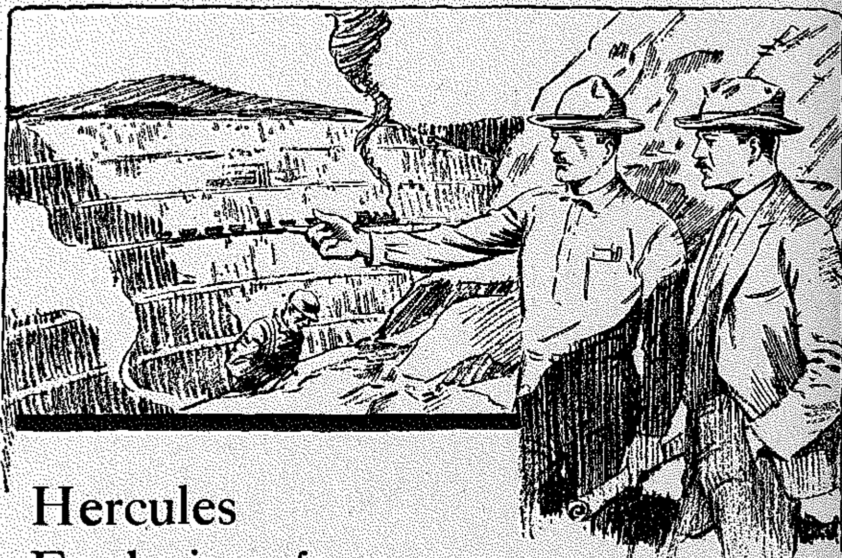
VOL. X MAY, 1920 No. 5

COLORADO SCHOOL OF MINES MAGAZINE

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



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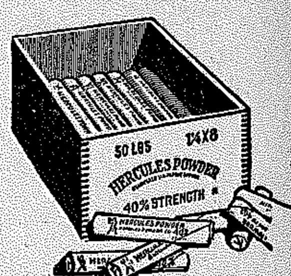

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COLORADO SCHOOL OF MINES MAGAZINE

Published every month in the year, at Golden, Colo., by the Alumni Association of the Colorado School of Mines.

C. ERB WUENSCH, '14, EDITOR.

Advertising rates on application.

Subscription Price...$1.50 per annum Single Copies...............25 cents

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THE ALUMNI ASSOCIATION OF THE COLORADO SCHOOL OF MINES HAS A CAPABILITY EXCHANGE which renders efficient Employment Service; if you want a man or a new position wire them.

"Highlights on Safety and Welfare"*

By Charles S. Arthur, '13

The slogan—Safety First, gentlemen, is symbolic of the efforts, the attainments, the idealism, the dream of the altruist, the culmination and outcome of sincere and devoted work for the protection of others and answers the Biblical query: "Am I my brother's keeper?" and gives impetus to the Golden Rule "Do unto others."

Evolution.

All ages, from the earliest to the present practiced self-preservation. Safety First manifests itself in the form of mass protection in history, as the guarding of tribal fires, the building of walls to withstand invasion, and so down the centuries to the present, where we have on the sea the lifebelts, boats and rafts, with the wireless to appeal for assistance, in our social communities the highly efficient fire, police and traffic departments, and in our industries, organizations promoting Safety First and Welfare Work.

Safety First is in another sense the inalienable moral right of every individual, to protection from danger emanating from sources over which he has no control.

Welfare work, on the other hand, can not be dismissed from our minds, as undoubtedly it is the solution of the greatest question of the hour—how to allay the present social unrest and eradicate bolshevism.

The Safety Movement is not of "ancient vintage," it is only within the last decade appreciable progress has been made and acknowledgment of the fact that accidents and catastrophies are not altogether happenstances. Preventative measures have been inaugurated and are receiving the approval and cooperation on every hand. A few short years ago the only protection afforded, in many industries, was what the statutes provided, and which were the result of the public indignation over some horrible accident or series of catastrophies, thus compelling our legislative bodies to enact laws, often in opposition to the interests affected, then trusting a repetition would not occur there, letting the matter rest. How different now—legislation is sought and welcomed which affords such protection, and efforts are constantly meeting with success, ordinances in civic communities, and amendments to the mining codes are frequent in many states.

United States Bureau of Mines.

With the formation of the Bureau of Mines, the "Apostle of Safety" of the Mining Industry appeared, Dr. J. A. Holmes, a martyr to the cause, who, as we all know, contracted the dread malady and later died as a result of exposure brought on by his devotion in performance of duties while attempting to rescue entombed miners. Intellectual, spiritual and intensely humane, a man of visions, but rational and practical; a man whose virtues, attainments and self-sacrifice is commemorated, I am proud to say, by this great state, which created the Joseph A. Holmes Memorial Chair of Safety and Efficiency at the Colorado School of Mines, and occupied by our worthy friend and pioneer of Safety, Dr. J. C. Roberts.

The fundamental principles of Safety First as expounded by Dr. Holmes have revolutionized the status of the moral obligation which binds our mining social structure, placing human life above everything, cementing our interest in the welfare of our fellow men, awakening our dormant impulse to protect others, sustaining a sublime effort to concentrate forces which tend to reduce suffering, misery and grief.

What is Life? Can it be replaced? What is misery—grief? Can they be staunched or recompensed by a handful of gold? Can a limb be replaced or features remodeled? Such are the spiritual and moral phases we must answer when our doubts assail us, when a life is snuffed, or limbs destroyed, where such have been committed to our care.

The outcome of this great work by the Bureau of Mines, now led by Hon. Van H. Manning, has been the standardization of methods pertaining to the rescue, treatment and care of entombed or disabled miners, the promulgation of organization for Safety and Welfare; research work with reference to efficiency and safety of powders; of noxious gases, where found, how detected, deleterious effects, treatment if overcome, ventilation, rock and coal dust and their physical effects and results. Testing and approving of powders, rescue apparatus, mine lamps, fuses, safety methods of mining, compilation of statistics of the mining industry; the winning of uranium for medicinal purposes from the minerals of carnotite, pitchblende and vanadium ores, all in the interest of Safety and for the protection of man; and on the other hand, the com-

* Address before Colorado Metal Mining Association, January 21, 1920.

mercial side of the industry has met with sincere co-operation; many valuable processes have been evolved, among these, one practically limited at the present time to our state—"extraction of oil from shale". In passing thus briefly, attention should be called to the Cottrell Process for treatment of smelter fumes, the greatest innovation in the smelting industry for ages.

Again, the commercial production of helium, that rare gas of which little is known, for the purpose of inflating dirigibles and balloons, which would make them comparatively safe, as helium is non-inflammable. Results, gentlemen, we can all point to with pride.

The field work of the Bureau you are all more or less familiar with—the ten cars, with trained crews which travel periodically over the various districts they patrol, subject to call in an emergency, spending their time educating employees, principally in the mining industry, in the fundamentals of Safety First. The training so given in the rescue apparatus and First Aid is standardized so a man receiving training in West Virginia is a valuable adjunct in Colorado or elsewhere; in an emergency such as a mine fire or explosion. Only men of good, sound physique are selected for this work. The First Aid training gives a man a working knowledge of the functions of the various organs of the body; teaches a rough physiology, the dangers of hemorrhage, infection, shock, and equips him with sufficient knowledge to succor and relieve injured persons with definite understanding of the reason and how to apply remedies, bandages and splints.

Classification.

From this introduction I will digress and become more specific on Safety and Welfare applied to mining; as the line of demarkation between these is not well defined they will be treated more or less collectively. The subject, for clearness, will be divided into the following:

First—Moral Application.

Second—Mechanical Appliances, uses and source of supply.

Third—Financial Value.

Fourth—Welfare Innovations and Practices.

The Moral Application of Safety First is primarily the recognition that accidents are largely preventable, that the great human trait of carelessness and indifference, and that measures must be adopted that will bring realization to the most ignorant that his life, and the lives of others as well, are valuable and must be protected. This must be accomplished by measures which do not antagonize, but appeal to that spark which every man possesses, and nurture that respect which men express in various ways.

It is true, many who follow the mining game are of rough and ready character, "roughnecks", as they often pridefully call themselves; men withal, ready at any instant to face any danger, undertake any task no matter how arduous, to aid or rescue a threatened man, as exemplified by our valiant boys of the regiment of engineers, mainly men from the mines, who, as a non-combat support to the British at Vimy Ridge, accomplished when they dropped their tools and grabbed guns from the hands of the fallen and exacted terrific toll from the Huns.

Safety First is to be best effected by taking advantage of the means offered, and the application of personal interest and sympathy by those in charge of operations.

First, clean house—put yourself in accord with the safety movement and then put into practice those features which appeal in the moral sense. Education is the greatest of all; convince those who work with you of the soundness of the principle and demand allegiance and adherence to Safety First from all. Have all men instructed in the hazards of their particular occupation—especially new or green men. Use the bulletin board, the National Safety Council supplies lessons dealing with every conceivable accident, at a nominal rate. Post features and facts pertaining to your own problems. Hang up a suggestion box and award those who tender valuable information. Many a seeming difficulty has been solved by listening to the suggestions of the layman. Put a premium on safety; issue a set of rules compatible with existing conditions and enforce them.

Organize your men and get together on this subject; have regular inspections of the working places by a committee of miners. You will marvel at the saving of powder, drill steel, air pipe, odds and ends, ever in demand, which these inspections will reveal and put back into service.

Provide for training in First Aid, and if possible in Mine Rescue work, as the danger is ever present that a carbide lamp or candle snuff will set timbers afire, or men will stray into old workings where the air is depleted by oxidization of the timbers and walls, or exudes from crevices, or be overcome by gases generated by blasting.

Safety literature is replete with the findings of physiologists, analysists and pathologists, dealing with all phases of what we can truly call "Human Engineering".

Trip Through the Mine.

As this article is titled "high lights", I will not pause but will take a trip—a brief trip, from shaft house to the workings breast, passing through old workings and stopes on the way; in this trip promulgating questions which are left unanswered:

Engine House: Are brakes in good order, cable well-oiled, over-winding device and governor in proper condition; is engineer dependable? Are moving parts guarded?

Gallows Frame and Shaft Collar: Can one fall into shaft? Are rules relating to gates and chains enforced? Is the sheave wheel well oiled and frame well anchored? When was the last time stays and bolts were tightened? Skip or Cage or Bucket: Are men afforded proper protection while riding? Are lights extinguished when men are hoisted or lowered? A burn from a carbide light or candle, while insignificant in itself, has caused many a death by the involuntary flinching and movement of the recipient, thus causing him to strike against the timbers. When were safety dogs last tested? Is the thimble or socket rusted? Is the "Humble Hook' well oiled? Are wall plates clean; do chutes protrude; are nail heads sticking out; is the bonnet down?

Shaft Station: Is the Mining Code posted and of indestructible material? Are the flash and skip signals arranged so electric shock is impossible or can be confused? Are gates in proper position? Are rules regarding crowding obeyed? Are they sufficiently lighted. Are First Aid materials available?

Haulage Ways: Are motors in good condition, rails bonded, sufficient space between car and walls to pass in safety; are shelter holes provided, trolley wire at safe height? Are lights and gongs used to warn employees?

Ventilation: How about the air; is the oxygen content such that men are able to work with maximum efficiency? Are fire doors present in case of fire? Is moisture added if mine is dry?

Toilet Facilities: Are they sanitary, sufficient, and when last cleaned? Is there an objectionable odor in the air? Diseases of various kinds are often spread by lack of sanitation.

Underground Powder Magazines: Are they littered? Are caps and powder stored together? Are boxes opened by pick, gad, an old file, or are copper chisels or wedges used? How transported—in box and hoisted by rope to the stopes and raised or carried in sacks provided for that purpose? Have they danger signs posted on them? Is smoking allowed?

Caps and Fuse: How cut and crimped, by teeth, knife, or by a proper crimper? "A bite for speed may mean the loss of many a feed." Is fuse used to suspend pipe lines, for belts, and other odd jobs?

Signs: Are direction signs posted, danger and caution signs in place where dangers exist?

Old Workings: Are these railed off? Are men allowed to wander at will through them?

Chutes: Do they protrude too far? Are nails used for holding bars? Do men climb up them under the ore to loose them? Are pasters and shots provided with sufficient fuse?

Raises: Is steel thrown down? Are the ladders overhanging? Are they staggered? Are caution signs posted? Are they railed off or covered by doors? What rules are in effect regarding the closing or replacing of guards or chains? If used as an ore chute, are grizzlies so spaced that a man could fall through?

Stopes: Are two means of entrance provided? Kept open? Is loose rock picked down? Is timber kept up to reasonable distance compared with progress of breaking ground? Is the ore pulled too rapidly? Are stopes pulled with men working above chutes? Is the air tight?

Crosscuts, Drifts and Breast: Are air lines secure? Is the set-up of the machine drill secure? Has the machine man picked down? Are there any miss-fires? How do the new holes point if such is the case? Is the ground loose requiring timber?

Blasting: Are fuses cut sufficient length? Are the shots counted? Missfires reported and recorded? Shot again—how—what time has elapsed since last shooting?

In shaft sinking: How blasted, by electric delay detonators or by fuse? Are exceptional caution rules in effect with regard to shaft firing? Engineer properly warned?

Powder: How tamped? By any old thing or by wooden sticks, or copper-headed bars?

These questions are just a sample of the myriad of such that could be asked and should be part of the training and observation of every mining official. It is not the big deeds that make Safety First successful; it is observing the little minute common-place features of the day's work and assuming an attitude not of familiarity or fraternizing, but one of interest in the welfare of your men, and such efforts are repaid in many ways.

Mechanical Appliances, and Uses, Commercial Firms.

Under this head come the various appliances as indicated heretofore—on the engine, cable, shaft stations, powder magazines, which without proper education in their use are worthless and are signposts of carelessness and inefficiency.

Signs, to my mind, fill a whole volume and are heeded where often a spoken word is disregarded. Those of standard make are in recognized colors of safety—green for safety with white lettering, for danger a white lettering on red field; blue and yellow for caution. In this regard all industries owe much to a local concern, which was started by Mr. Stonehouse with one man, one sign, one room and no money, seven years ago. Today his signs are the accepted standard. Over five thousand signs in different languages are supplied to concerns all over the world. This is the result of the perseverance and faith of this pioneer of the great awakening which has manifested itself in the Safety Movement. Time will not permit an effacious explanation of the various uses of signs and tags, but one has only to visit a big plant where safety and efficiency are in vogue, to witness the inestimable value, where broken power or steam lines are tagged, and realize the difficulty to throw a switch or turn a valve carelessly.

Every mine or mining community should have breathing apparatus available, in advent of fire or presence of gases, as touched on heretofore, we never know when a calamity may overtake us. The adopted breathing apparatus for mine recovery on the market are all similar in principle; a supply of oxygen under pressure, reduced through valves, a cartridge or quantity of caustic soda to absorb the carbon dioxide and animal matter, so arranged as to make a complete circuit, self-contained, with no communication with the outside air, and differing only in construction and volume of air supply. The first machine in the field was the Draeger, then the Westphalia, both German; Fluess, the English machine, and the last the Gibbs machine—American—and approved by the U. S. Bureau of Mines.

Like Mr. Stonehouse with his signs, I wish to call attention to the commercial side and name The Mine Safety Appliance Company of Pittsburgh, represented by Messrs. Jones & Riggs in this territory. This concern started small, but today is supplying the safety requirements of mines with the Edison lamp, Gibbs Apparatus, First Aid Materials, goggles and dozens of kindred safety materials and devices, and are the premier men in the commercial field of safety. Strong, Kennard & Nutt of Cleveland have not yet entered the mining field in all phases, but nevertheless is composed of live wires who are developing rapidly and adding materially new safety and equipment. The Pacific Coast has Bullard of San Francisco and H. H. Sanderson of Seattle. These concerns deal principally with the mines. Goggles, asbestos gloves and clothing, fire extinguishers and fire fighting equipment, and playground apparatus are other items in the category of what may be said to be mechanical, as they are without power to move, and intelligent endeavor must often be used in their adoption.

Financial Value.

Heretofore I have spoken of the spiritual and moral sides of Safety First, and now I take up the question of the prosaic dollar. All can recall some accident where, if preventive measures had been taken, a fire would not have occurred, a life or number of lives would not have been lost, a mine lost or burned, a skip dropped, a man electrocuted, blasted or back or limbs broken. A preventable, serious accident, costs more than all the safety, first aid materials, signs, resuscitation devices or rescue apparatus would ever cost, and the money expended gone forever. Safety First, when correctly applied, pays returns which money is unable to purchase, the loyalty, the morale, which has no relation to the wage given, is uppermost; efficiency is promoted as it is only human to respond to kindness when secure in the knowledge others have your welfare at heart.

Insurance.

Fire insurance is good business and is considered necessary as an anchor to leeward. Safety First is practiced under the head of Fire Prevention, in construction, protection features incorporated and the posting of general instructions regarding careless practices. Compensation insurance is compulsory and all here are familiar with the history of its advent. This is another assurance to the individual of recompense in case of accident.

With the probability of a Merit Rating Schedule for Metal Mines, on which I understand a committee is working, the features pointed out in the preceding sections will bear a strong relation to the rate which will apply in determining the premium. Should this be adopted, a great impetus will be given, furthering and developing the safety work in Colorado.

Experience rating is another phase whereby results obtained from Safety First practices are recognized and based on the ratio of losses against payroll—credit given when warranted; thus we have a fixed rate with an adjustment once a year.

On the other hand, under a merit rating plan, we have a fixed base rate from which the rate applied against payroll in the determination of premium, fluctuates either up or down, based on actual existing conditions as reported by inspectors.

Recent application of experience rating to Utah mine payrolls are amazing in that from twenty to fifty percent reduction of premium was obtained.

Approximately $7,000.00 annual payroll entitles a concern for rating under this plan.

Why not obtain this for Colorado mines and mills?

A few years of reduced premiums will pay for installation and upkeep on all devices, signs and equipment necessary. Is it worth while?

Welfare.

This term is generally applied to the people of a community, and is best exemplified in Colorado by the Rockefeller Plan in vogue in the Southern Coal Fields.

Community Work, Visiting Nurses, Clinics and Dispensaries are one group. Schools for the education of foreigners, opportunity schools, meetings for training in First Aid, lectures on Safety Methods and Practices form another.

Insurances.

Blanket Accident Insurance: A term applied to compensation paid injured employes, from date of accident, or waiting period until compensation falls due.

Group Life Insurance: Wherein an employee is given a policy for his beneficiary or dependents, for a stated amount of term life insurance, free of charge while in the company employ, in addition to compensation if accidentally killed, and if death from sickness occurs, provides the family or dependents with sufficient funds to take care of the immediate future.

Both of these have features which tend to increase the loyalty, reduce the labor turnover, produce contented workmen and eliminate the abasement of requesting charity.

Direct Features Applying to the Mines Are:

A First Aid or Emergency Hospital, equipped with suitable furniture, medicines, instruments, resuscitating devices and beds, so in extreme emergency cases the doctor may operate without transferring the patient further.

Rescue Station with five or more sets of apparatus, with supplies, testing, repairing and operating equipment and trained crews subject to call at any time.

Change houses, with individual lockers and suspension cords for drying clothes, basins, showers and towels. Reading and recreation rooms—a supply of current literature, a place for congregation, a circulating library supplying the educational books desired. This eliminates to a great degree the general unrest which is present when men congregate and talk over their grievances, fancied or real.

Playgrounds and equipment and ball fields are essential as healthful outdoor exercise is obtainable and also it keeps the children occupied and away from the dangers around the mine property.

Results in the West.

In closing, I might point to the successful safety work of the Arizona State Bureau of Mines and suggest that this institution and its methods be investigated. The Phelps - Dodge Corporation has adopted many of the plans this bureau outlined, and today is making Safety First a pre-requisite to advancement among foremen by written examination on safe practices and dangers encountered in their work. The Anaconda Mining Company is now reaping the benefit of its constant efforts over a number of years in promoting this Safety Movement ably led by Mr. C. W. Goodale.

TRANSPORTATION IN PALESTINE.

Crossing the Dead Sea proved no easy task in a land where commerce is at a standstill and transportation facilities are virtually nil. A Red Cross engineer who recently returned from Palestine tells how it was done:

"It was necessary to carry a boat from Jaffa, on the seacoast, to Jerusalem in order to cross the Dead Sea to Jericho to get grain to take back to Jaffa. This journey of something more than 120 miles was over an almost impassable terrain, some of it lowland, hundreds of feet below sea level, and much of it rugged, mountainous country. The Dead Sea itself is one thousand feet below sea level.

"This is typical of transport difficulties all over Palestine."

Lacing of Belts

By E. J. Black*

Transmission belts, like delicate machinery, must be given proper care if the user expects them to give good service. This is such a self-evident truism that it would seem hardly worth repeating, and yet it is overlooked repeatedly. Belts which should be good for years of continued service are subjected to abuses which soon render them useless, and in many cases the manufacturer is blamed for having put out a defective product, when in reality the belt was faultless.

Unjustified claims for adjustments on injured belts are made frequently by disgruntled users. Every manufacturer can cite dozens of cases.

Recently the Diamond Rubber Company was asked to make an adjustment on a belt which had been torn along the length of the belt for several yards at either end. The user was vehement in his claims that the belt was defective, but when an examination of the belt was made, it was clearly shown that the only cause for the injury was improper lacing. The holes for the lacing had been punched haphazardly and with no regard for providing an even strain on the belt. The result was that when it was put in use, it ripped apart, and the belt was practically ruined.

Improper lacing is probably the most common mistake which users make, and yet it is the one which causes the most serious trouble, often completely nullifying all the knowledge and skill which the manufacturer used in making it. There is no excuse for ruining a good belt in this way. By observing the following simple rules, the belt will give the best service of which it is capable:

(1) Cut the ends of the belt absolutely square. Do not depend upon your eye or use and ordinary rule. If the end is slanted in the least degree, the pull will come all upon one side of the belt and the consequences are like to be disastrous.

(2) Make the holes as small as practicable. Use an awl rather than a punch, whenever possible.

(3) Leave a sufficient margin at the edge of the belt without holes so as to not impair its strength. In belts two inches wide to 6 inches the holes should not be nearer to the edge than ½-inch, in belts 6 inches to 12 inches wide not narrower than ⅝-inch, and belts 12 inches to 18 inches wide not narrower than ¾-inch.

(4) Make two rows of holes, in parallel lines straight across the width of the belt, and stagger the holes, so that the strain comes upon different portions of the belt.

(5) Be sure that the holes in the two ends to be joined match exactly. Otherwise there will be a "jog" in the belt, and this is likely to result in tearing the belt lengthwise.

(6) Use flexible lacing, being careful to have it proportionate to the size of the belt. A heavy lacing is likely to cause trouble.

(7) In lacing the belt, make the pulley side as smooth as possible. Rough places and ends should be turned away from the pulley.

(8) In using metal fasteners, select those which place the strain on the lengthwise strands of the belt. The crosswise strands are not as strong as those which run lengthwise.

Besides improper lacing, there are many other abuses which cut down the life of belts. Shafting that is out of line may cause an undue strain upon the belt and make it run off the pulley. Oil may be allowed to drip upon the belt and ruin it. The belt may be applied with an initial tension so great as to produce an unnecessary strain.

Many complaints regarding unsatisfactory belt performance can be traced to the fact that the wrong belt was used on the job. No matter how good a belt is or how good treatment it receives, it will fail to give satisfactory service if not adapted for the use to which it is put.

In deciding upon the right belt for any particular installation, there are eight factors to be considered: (1) distance between pulley centers; (2) diameter of the pulleys; (3) width of the pulleys; (4) use of idlers, cone pulleys, quarter turn, half turn, etc.; (5) speed; (6) horse power to be transmitted; (7) load jerky or constant, and (8) conditions such as contact with moisture, oil or other deteriorating influences.

Over these factors the belt man usually has little or no control. His problem is to take the conditions as he finds them, and apply a belt that will give the best service possible under the circumstances. Yet he may sometimes perform a real service by calling attention to a faulty arrangement, when the conditions are such that the fault may be corrected. Real economies may sometimes be

* Diamond Rubber Co., Inc., Akron, Ohio.

effected by lengthening the distance between pulley centers, increasing the width of the pulley face, or by changing the arrangement of a vertical belt so as to give a certain degree of slant.

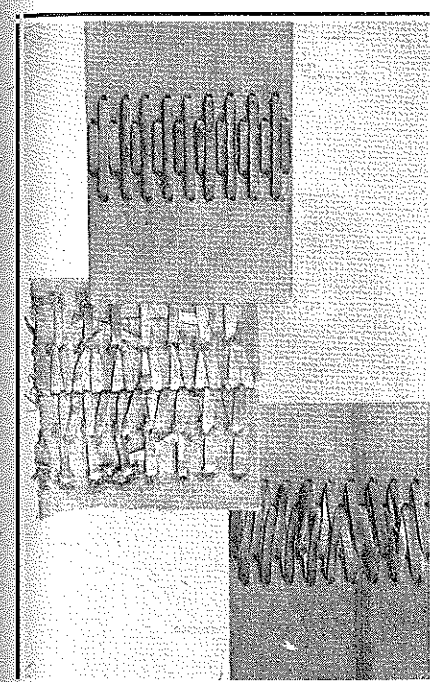
The factors which are under the belt man's control are these:

(1) The kind of belting to be used—such as rubber, leather, canvas, etc.; (2) The grade—whether cheap, medium or high grade; and (3) The weight of the belt—such as 4 or 6 ply, single or double.

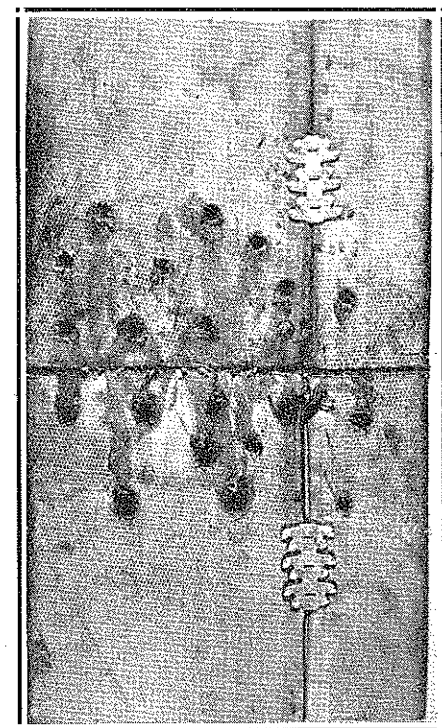
In determining the kind of belting to be used, the merits of rubber belting should receive full consideration. It is economical in first cost, extremely efficient in service, and frequently outlasts other constructions. On the other hand, in places where constant contact with oil is unavoidable, a rubber belt will not give good service. The constant use of shifters is also injurious to a rubber belt.

In deciding upon the right grade for a particular installation, the points to be especially considered are the size of the pulleys, the presence of idlers or other unusual conditions, and the speed. Small pulleys, operated at high speed, necessitate a high quality belt. The reason for this is the internal wear between the various plies of fabric, and even between the fibers in each ply, as the belt rounds the pulley. A high-grade rubber friction is the best possible protection against this internal wear, because it protects each fiber with an elastic coating which remains uninjured and which indeed retains its life and elasticity longer when in use than when lying idle.

In this connection, it should never be forgotten that the value of a particular rubber friction cannot be determined merely by the test showing "pounds pull".



The right and wrong way of lacing belts are shown in this photograph. The top and bottom views show a belt which has been properly laced. The holes were punched evenly and the lacing was done smoothly, leaving no loose ends which might catch and injure the belt. The middle view shows a belt improperly laced. The holes were punched in some instances so close together that the lacings tore through. A belt laced like this cannot be expected to give the maximum amount of service.



This photograph shows a belt which was returned to the manufacturer by the user. It was torn along the length for several yards at either end and the user asked the manufacturer for an adjustment, asserting that the belt was defective. An examination showed that the only cause for the injury was improper lacing. The holes were punched haphazardly, and when the belt was put in use the strain upon it was divided so unevenly that it ripped.

If the plies were fastened together with glue, this test would show a very high grade belt, but we all know that such a belt could not give service.

The most valuable property of rubber friction is that intangible quality called "life". There is no known test for this but length of service.

In specifying the proper ply for the installation, the determining factors are the size of the pulleys, width of the belt, speed, and the horse power to be delivered. The belt itself should be at least one inch less in width than the face of the pulley. With this in mind, the proper ply can be determined by consulting the table of horse power and plies given on this page. To illustrate, if you have a pulley whose face is 13 inches wide, operated at a speed of 4,000 ft. per minute, with a miximum load of 100 H. P., you will find by referring to the table that a 12-inch 5-ply belt operating at 4,000 ft. per minute will transmit 109 H. P. and you will specify accordingly. In specifying the ply, it must also be remembered that the greatest number of plies to be used on a 12-inch pulley is four, on an 18-inch pulley five plies, and a 30-inch pulley 6 plies, 40-inch 7 plies, and 48-inch 8 plies.

TABLE FOR FINDING THE HORSEPOWER OF A BELT

Speed in Feet Per Minute.

Width	Ply	200	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
4″	4	1.45	3.64	7.27	10.9	14.5	18.2	21.8	25.4	29.0	32.7	36.4	40.0	43.6
	5	1.82	4.55	9.1	13.6	18.2	22.7	27.3	31.8	36.4	40.9	45.4	50.0	54.6
	6	2.18	5.45	10.9	16.4	21.8	27.3	32.8	38.2	43.6	49.0	54.5	60.0	65.5
5″	4	1.82	4.55	9.1	13.6	18.2	22.7	27.3	31.8	36.4	40.9	45.4	50.0	54.6
	5	2.27	5.68	11.4	17.1	22.8	28.4	34.1	39.8	45.5	51.1	56.8	62.5	68.2
	6	2.73	6.83	13.6	20.5	27.2	34.1	41.0	47.8	54.5	61.4	68.2	75.0	81.8
6″	4	2.18	5.45	10.9	16.4	21.8	27.3	32.8	38.2	43.6	49.0	54.5	60.0	65.5
	5	2.73	6.83	13.6	20.5	27.2	34.1	41.0	47.8	54.5	61.4	68.2	75.0	81.8
	6	3.28	8.18	16.4	24.6	32.8	40.9	49.1	57.3	65.5	73.7	81.8	90.0	98.2
8″	4	2.91	7.27	14.5	21.8	29.1	36.4	43.7	51.0	58.2	65.5	72.7	80.0	87.3
	5	3.64	9.1	18.2	27.3	36.4	45.5	54.6	63.6	72.7	81.9	91.0	100.0	109.2
	6	4.37	10.9	21.8	32.7	43.6	54.5	65.5	76.4	87.3	98.3	109.0	120.0	131.0
10″	4	3.64	9.1	18.2	27.3	36.4	45.5	54.6	63.6	72.7	81.9	91.0	100.0	109.2
	5	4.55	11.4	22.7	34.2	45.5	56.9	68.3	79.5	91.0	102.2	114.0	125.0	136.4
	6	5.46	13.65	27.3	40.9	54.5	68.2	81.8	95.5	109.0	122.6	136.4	150.0	163.6
12″	5	5.46	3.65	27.3	40.9	54.5	68.2	81.8	95.5	109.0	122.6	136.4	150.0	163.6
	6	6.55	16.3	32.7	49.1	65.5	81.7	98.2	114.4	130.9	147.0	163.5	180.0	196.0
14″	5	6.36	15.9	31.8	47.7	63.6	79.5	95.5	111.4	127.2	143.0	159.0	175.0	191.0
	6	7.64	19.1	38.2	57.3	76.4	95.5	114.6	133.8	152.8	172.0	191.0	210.0	229.2
16″	6	8.73	21.8	43.6	65.5	87.3	109.0	131.0	152.7	174.6	196.5	218.0	240.0	262.0
	8	11.63	29.1	58.2	87.3	116.3	145.3	174.6	203.5	232.6	262.0	290.6	320.0	349.2
18″	6	9.82	24.5	49.1	73.7	98.2	122.8	147.4	171.8	196.4	221.0	245.6	270.0	294.8
	8	13.09	32.7	65.4	98.3	130.9	163.4	196.6	229.0	261.8	294.0	326.8	370.0	393.2
20″	6	10.9	27.3	54.5	81.8	109.0	136.5	163.6	191.0	218.0	245.6	273.0	300.0	327.2
	8	14.5	36.4	72.7	109.0	145.5	181.9	218.0	254.5	291.0	327.7	363.8	400.0	436.0
24″	6	13.09	32.7	65.4	98.3	130.9	163.4	196.6	229.0	261.8	294.0	326.8	370.0	393.2
	8	17.4	43.6	87.2	130.8	174.4	218.0	261.6	305.0	348.8	392.0	436.0	480.0	523.2
30″	6	16.3	40.8	81.6	122.4	163.2	204.3	245.0	286.0	326.4	368.0	408.6	450.0	490.0
	8	21.8	54.6	109.9	163.8	218.0	272.8	327.6	382.0	436.0	492.0	545.6	600.0	655.0
30″	10	27.3	68.2	136.4	204.6	273.0	341.0	409.2	477.4	546.0	614.0	682.0	750.0	818.4
36″	8	26.2	65.5	131.0	196.5	262.0	327.5	393.0	458.0	524.0	589.0	655.0	720.0	786.0
	10	32.7	81.8	163.6	245.4	327.2	409.0	490.8	573.0	654.4	737.0	818.0	900.0	981.6
42″	8	30.5	76.4	152.7	229.2	305.4	382.0	458.4	535.0	610.8	687.0	764.0	840.0	916.8
	10	38.2	95.5	190.9	286.5	382.0	478.0	573.0	668.0	764.0	860.0	956.0	1050.0	1146.0
48″	8	34.9	87.3	174.5	261.9	349.0	437.0	523.8	612.0	698.0	786.0	874.0	960.0	1047.6
	10	43.6	109.0	218.0	327.0	436.0	546.0	654.0	764.0	872.0	982.0	1092.0	1200.0	1308.0

Method of Mining Coal Without Powder

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

Part II.—(Concluded from May Issue.)

How and Why This Process is a Success.

Ever since coal has been mined, inventors have endeavored to perfect a system of mining without powder. Many types of mechanical wedges, expanding bars, etc., have been developed and tried out. In **every instance** these expanding devices have been applied in the same manner as powder—that is, by drilling a hole into the face of the coal and inserting the wedge, or expanding bar, in the **same general manner** as the powder charge. In attempting to break down coal in this manner there are a number of serious difficulties to be met, two of which, at least, make this method of application impractical, commercially. One of these is a mechanical difficulty, and the other a purely scientific one, in that the forces exerted by any type, or form, of expanding device applied in this manner **cannot possibly** produce effective and satisfactory results. They are **theoretically** and **practically, improperly applied.** For over ten years the writer experimented with round type hydraulic expanding bars inserted into round holes, believing that **some** type of bar could be successfully applied in this manner. He developed and built six different types of bars, each one being an improvement in design and operating characteristics over former models, until the last type of bar fulfilled every requirement, mechanically, of a bar to be used in this manner. It is true that this last type of bar **did mine coal**; in fact, under favorable conditions, it, at times, produced very satisfactory results, and gave evidence of becoming a commercial success. The years of experimenting, however, with this type of bar finally demonstrated that it could not be made commercially practical. It did prove, however, that sufficient force could be developed by hydraulic pressure in this manner to break the coal down quickly and efficiently, and that the general theory of the application of such forces would produce **phenomenally successful results,** if the force were properly applied, and the mechanical difficulties in the method of application overcome.

Briefly stated, and without going into the details of former experiments and tests, the results have established the following general facts, and the commercial limitations, relative to the use of **round type** hydraulic expanding bars, inserted in holes bored into the face of the coal:

(A) Consider Veins Five to Seven Feet in Thickness.

To shear this thickness at the ribs, and otherwise break it down efficiently, requires an expanding force, in the hydraulic bar, of not less than 600,000 lbs., and in general this force should be 800,000 pounds. To develop forces of this magnitude, in a round bar of proper length, the bar cannot be less than five (5″) inches in diameter and should be five and three-eighths (5⅜″) inches in diameter. The pistons in this bar must be ellipsoidal in shape in order to get sufficient piston area to develop these forces, at any reasonable water pressure, and also to prevent indentation, as the pistons are expanded. This necessitates drilling a hole 5⅛ inches, or more, in diameter, and when this is attempted a great many mechanical difficulties are encountered, requiring a very heavy, cumbersome, drilling outfit, and special tubular type drills. In fact, after more than two years of experimenting with drills of every type and description, it was found impossible to drill holes of this diameter, thus making the use of a bar of this size, commercially impossible. This size bar is absolutely prohibitive. A bar of **less diameter must** be used and further experimenting developed that holes 4 inches in diameter were as large as could be drilled, and even this size required three men to handle the drill outfit and the speed at which the holes can be drilled, makes it doubtful that even this size hole is commercially possible. Any drilling outfit that has to be set up and taken down every time a hole is drilled involves the hardest kind of labor and an enormous loss of time. In fact, any type of bar requiring the drilling of holes even 3½ inches in diameter introduces almost insurmountable difficulties. Also, in reducing the diameter of the bar, the exertive forces are likewise very rapidly decreased, so that, with a bar 4 inches in diameter, less coal can be broken with each application than with a 5-inch bar, and this results in having to drill more holes to mine a given tonnage. The net result in practice would be that fully twice as many holes would have to be drilled, if a 3½ or 4-inch bar were used, as would be required for a 5-inch bar, and thus the difficulties of the drilling problem multiply. Also with bars developing inadequate force to mine the coal effectively, the results are less uniform and often the "shot" proves an entire failure. Furthermore, in bars of small diameter, unless reaction type pistons are used, the internal reactions and stresses are so great that they distort, bend and twist the bar to such an extent as to make it inoperative, **if** the bar is supplied with water at **sufficiently high enough pressure** to develop forces anywhere near adequate. Even with reaction type pistons, a small round bar must be very carefully designed to be operative at water pressures in excess of 6,000 pounds per square inch. At this pressure, bars for instance, four (4") inches in diameter, having the **ordinary type** of pistons, distort to such an extent as to **actually bind** the pistons in their chambers. The bar, simply has not sufficient rigidity to withstand the internal reactions, at this water pressure. Further, the smaller the bar the smaller must be the area of the piston surfaces that bear against the coal and indentation takes place, that absorbs the expansion of the bar without results. Any form of "liners," or extraneous bearing shoes, inserted into the hole for the purpose of preventing indentation, are simply makeshifts, that are entirely inadequate, and result in having to drill a larger hole to accommodate them. If the pistons are developing any forces worth while, thin "liners," etc., are immediately bent so that they become useless. The matter of drilling holes for the use of round hydraulic bars is, therefore, a problem that, in itself, makes the use of this form of bar impractical.

(B) Consider further a room of coal 25 to 40 feet wide under cut 6 feet, in a vein 5 to 7 feet in thickness. Except that part of the coal immediately adjacent to the ribs, the coal may be considered as suspended in the form of a "cantilever beam." If this coal were suddenly sheared off along each rib, and the back wall of support, the body of coal would, of course, fall down. Consider three round holes bored into this body of coal, one near each "rib" and a third in the center, all three holes as near the roof as possible, and a **round** type hydraulic bar inserted into one of the rib holes. As this bar is expanded it will shear off the coal along this rib (if powerful enough) and likewise when inserted in the other rib hole. The plane of the force exerted is, in each case, parallel to the "rib walls." Now insert the same bar into the center hole. The forces exerted are in the **same** plane. There have been **no definite shearing stresses** applied to shearing off the **back wall** of support. It is **just as necessary** to shear off this wall of support, as it is the side wall, if uniform results are to be obtained, and the coal broken down as far back as it is undercut. It is true that in many cases the coal will be broken off, as far back as undermined, by the expansion of the round bars, at these three points, and very satisfactory results obtained, but there is nothing definite or sure about it. It is not a strictly scientific form of application, as it involves the uncertainty that results from simply applying a leverage, or prying down action to break the coal off along the back wall, instead of applying definite shearing forces that insure this result, as is the case along the rib wall. It will be noted that in any form of round expanding bar, applied in this manner, the stresses are all applied in **one general plane only**, and that **this form of** application precludes the development of any **definite shearing stresses** along the **back wall** of support.

(c) Furthermore, in round type bars the bearing surfaces of the pistons are convexly curved to conform with the arc of the section of the bar in which the piston is inserted, so that when the pistons are in their collapsed position, the bar is perfectly round. When pistons having convexly curved bearing surfaces are ejected, the forces are dissipated throughout the mass, as these forces are always in a direction that is perpendicular to a tangent at the point of contact between the arc of the piston surface and the mass. In other words, the direction of the forces is "fan shaped," and not concentrated in a plane parallel to the axis of the bar. If a bar having pistons with round bearing surfaces, which, are arcs of a circle 4 inches in diameter, is placed in a hole bored near the roof, 14 inches distant from the "rib" wall, in a six-foot vein of coal, and these pistons expended, it will be found that **fully one-third** of the force exerted by the pistons is **totally ineffective**, in that it is expanded in attempting to break down the **solid coal beyond the undermining.** The reactions of these wasted forces simply tend to shift the bar horizontally, and are of no effect whatever in breaking down the coal. In fact, the action is similar in effect to that of a wedge being driven into the mass, tending to split it, rather than to shear it off and to break it down. On the other hand, if the bearing surface of the pistons is **flat, all** the forces exerted **are effective** and in a vertical plane parallel to the axis of the bar. In the rectangular type bar, with its two sections placed at right angles to each other, the **total pressures exerted** are concentrated in **definite shearing planes,** applied to shearing the coal off parallel to the "rib" and back walls of support, at the point of application. Theoretically, the piston surfaces should be concavely curved, as in this case the forces are resolved into a **linear plane** of maximum stress, the axis of which is the center of the arc of the concave curvature. In round type bars it is, to a large extent, impractical to make the bearing surfaces of the pistons flat, as when this is done a large part of the total available piston expansion is absorbed before the piston becomes seated in solid coal. Especially is this true in small size bars. Any form of "liner" that is introduced, simply means a larger hole and does not overcome the difficulty. It has often been said that the crucial requirement of a successful mechanical means of mining coal depends upon being able to shear the coal off squarely at the "ribs." This is certainly true, and there are two reasons, at least, why this has never, heretofore, been done successfully: First—no type of expanding bar **heretofore used** has ever developed **anything near** the required forces. This is possible, practically and commercially, only by using pistons of the reaction type. Second—as far as I am aware, with the exception of the large ellipsoidal shaped pistons used in a round bar 5⅜ inches in diameter, with which the experiments were made that established some definite data as to the forces required, **all former types of pistons used have had round convex bearing surfaces,** which dissipated the forces exerted over **such a large area,** that no definite shearing plane was developed, and in addition **fully one-third** of the total force applied was **ineffective,** in that it was dissipated in trying to break down the **solid coal beyond** the termination of the undermining. In the large, round bar, referred to above, there were four large elongated, or ellipsoidal shaped pistons, each having seventeen square inches of bearing surface. This bar was 28½ inches long and weighed 218 pounds. The two end pistons had flat bearing surfaces and the two middle pistons had **concave** bearing surfaces. This bar had a normal expanding force of 600,000 pounds and on a number of occasions developed 800,000 pounds. The results obtained from this bar, thoroughly proved out the theory that the shape of the bearing surface of the pistons was of great importance in developing definite shearing planes. It repeatedly sheared off coal at the "rib" up to 8 feet in thickness. In the reaction type pistons used in the later type of rectangular bars, the bearing surfaces are all **flat**, but can be furnished with **concave** surfaces if required. When the statement is made that coal of reasonable thickness has never been sheared off squarely at the "ribs," it should be noted that an analysis of the type and capacity of the expanding bars heretofore used, precludes in itself the possibility of this being successfully done. Where bars of proper design are used, developing adequate forces, this **has been done and** can **be done** practically and commercially. (D) In all former attempts to apply hydraulic expanding bars, commercially, as far as I am aware, the pump delivering the water to the bar has been **hand operated** and attached to the bar direct. With this construction, the pump must necessarily be of very small capacity and the water pressure comparatively low. In fact, it would be impossible to use a hand operated pump for expanding any but the smallest sizes of bars, developing forces ridiculously inadequate. If a hand operated pump is used in connection with an intensifier, the pressure can of course be increased, but this is at the expense of the time required to deliver a given quantity of water. A hand operated pump **cannot possibly** be used to deliver a **constant supply** of water, at sufficiently **high enough pressure,** and in sufficient **quantity** to expand a bar of sufficient size to develop the required forces to mine coal by this means. It is also impossible to use a power driven pump directly attached to the bar for the reason that this increases the weight of the outfit to such an extent as to make it impractical. For the smallest size rectangular bar, No. 1 size, developing one million pounds exertive force, it requires at least a 2 h.p. motor to furnish the required amount of water, at sufficient pressure, to expand this bar in five minutes. For the larger sizes of bars, motors up to 5 h.p. are required. Add to the weight of the motor the weight of the pump mechanism, plus the weight of the bar itself, and it becomes prohibitive to use direct connected pumps. The only possible way to supply the necessary volume of water at sufficiently high pressure is by using a stationary pump and conveying the water to the bar through jointed steel tubing. The small capacity and low pressure of the pumps heretofore used, in connection with the small exertive force of the bars, accounts, in a large measure, for the failure of all former attempts, to apply expanding bars to mine coal commercially.

In addition to the above reasons for the failure of the successful application of expanding bars in the past there are many other mechanical, constructional and engineering difficulties to the use of former types, which need not be mentioned at this time.

In this process all these difficulties are overcome in the following manner:

(1) The development and use of the slotting machine described above, sets aside at once the difficulty, mechanically and otherwise, of drilling holes. This machine quickly and efficiently prepares the coal for the application of the hydraulic bar.

(2) The rectangular type of bar inserted in a rectangular slot sets aside all the former difficulties encountered in the round type bar, relative to the size of pistons to develop the necessary forces, size of bearing surfaces to prevent indentation, permits of external control of the speed of ejection, etc. The size of the slots can be varied in dimensions at will to receive a bar of almost **any size, design or capacity,** without in any way introducing any engineering or operating difficulties. It permits of using bars, having total expanding forces **undreamed** of in the **round** type bar. Further, it provides for very wide variations in the design and operating characteristics of the bar, so it can be furnished to fit almost any local condition, thus enlarging the field of application to include practically all bituminous and lignite mines, regardless of the hardness of the coal, height of vein, etc.

(3) The use of **flat bearing surfaces** on the pistons insures the development of **shearing planes** and the **concentration** of the applied forces in a manner that is not possible in the round type bar, except where the bar is of very large diameter. If a round type bar of such diameter as to permit of this construction is used, the drilling of the holes in the coal to insert same is **commercially impossible.**

(4) The development of the jointed folding steel tubing for conveying water at high pressure to the bar, solves the problem of delivering to bars of the proper size and design, a constant volume of water, at **sufficient pressure** to develop the necessary expanding forces. Although the present type of bar now being manufactured is designed for a water pressure of 15,000 lbs. per sq. in. (and at 10,000 lbs. per sq. in., will develop adequate forces for breaking down coal, up to at least 8 feet in thickness), there is **no reason** why bars using water pressure of 20,000 lbs. per sq. in., or even greater, should not be constructed. In fact, a bar using 25,000 pounds water pressure is practical and can beconstructed without any particular engineering difficulties. A bar using water pressure of 20,000 lbs. per sq. in. would be considerably lighter in weight, in proportion to the exertive capacity, as compared with a bar using 10,000 pounds, or if made the same weight, would have **at least 65 per cent greater** expanding force. The possibility of increasing the water pressure to at least twice that now proposed, involves **no engineering or constructional difficulties in either the pump, the jointed steel tubing, or the bar,** and opens up unlimited possibilities for the application of expanding bars for the breaking down of coal. In the near future we will be referring to 20,000 lbs. per sq. in. water pressure as standard practice. Conceive the **enormous force** that **can be developed** and **applied** by the use of water at this pressure and you **must certainly** arrive at the conclusion that the hydraulic expanding bar of the future will mine a **large percentage** of our coal production.

The Transporting of Undercutting Machines on "Caterpillar" Type Trucks.

As the last and final element contributing materially to the successful application of this system of mining, a "caterpillar chain track" type of truck is used to transport the undercutting machines about the mine in the same manner as the slotting machines. By using a truck of this type that can travel to practically any part of the mine by passing through the crosscuts, etc., on its **own self-propelling bed-plate,** eliminates any interference with the haulage system, permits empties to be dropped into rooms and loads removed, when and as desired, and delivers the undercutting machine **directly to the "face"** of the room, thus saving time and annoyance and also enabling the undermining process to be carried out much more rapidly, and in **conjunction** with the slotting and breaking down process. This truck travels at the same rate of speed at the "rail type", is driven by the same sprocket wheel on the undercutter, and as each side, or chain track, can be operated, varied in speed, or reversed independently, the truck can be easily manipulated to follow any course, and in avoiding or passing between "props". The "chain tracks" of the bed-plate are also provided with flanges so the truck can be run on the

rails when desired. The transporting of the undercutting machines in this manner is of great importance in accelerating the speed and efficiency with which both operations can be carried out.

The Theory of Application of Mechanical Forces for Mining Coal.

The general results that can be obtained by applying a slowly expanding force for breaking down coal were demonstrated over 65 years ago, when unslacked lime was tamped into a hole bored in the coal, water introduced, and by the expansion of the lime, the coal was broken up, and made to fall. This method is still in use in some of the deep, "gassy" mines of England, where powder is prohibited. In general, the theory is that of, "the dissipation of applied forces throughout a mass that **is not** homogeneous". This is the condition of coal, as it is composed of seams and stratifications that vary in density, hardness, thickness, etc., and this change in general characteristics occurs in both vertical and horizontal planes. Also, in the early stages, when coal was in the process of making, it was at one time in a plastic or semi-plastic state, and while in this condition, the earth strata were shifted by volcanic action, or by the intrusion of dikes, etc., disturbing this plastic mass, with the result that many definite cleavages planes, or "slips" were produced in the mass, which will be noted by observing any pile of coal, as the faces of these slips have a smooth, glassy surface. When the forces exerted by the expansion of the hydraulic bar, are applied to a mass of this character, the difference in the hardness of the different strata and the fact that it has such a large number of definite cleavages, or "slips", causes the forces to dissipate themselves in shattering the mass, along these strata and cleavages, as they offer a path of less resistance. Also, the theory of the "resolution of forces", known as the parallelogram of forces, seems in many cases to apply. In this action the downward forces strike a stratum, or "slip," of less resistance and are shunted off along this path, the downward force resolving into a transverse, or semi-transverse component. The result is that when the coal falls it is **always** broken up along strata of different hardness, or density, and along the natural slips, so that it can readily be picked apart and loaded out. The speed with which the forces are applied also has a great influence on the degree to which the coal is broken, and the amount of coal that can be broken down at one application. If the forces are allowed to increase slowly, up to the point where fracture occurs, it will be found that the entire mass is broken and fractured to a surprising distance from the point of application. As an illustration of this effect, some years ago, a **round type** bar was tested out in a 7 to 8 foot vein of well stratified coal, containing very smooth "slips", both horizontal and vertical, varying from 10 to 40 inches apart. The roof cleavage was also very "clean", the coal parting from the roof freely. The rooms were from 30 to 35 feet wide. In this coal three holes were bored, one at each rib and one in the center. When the bar was applied in one of the rib holes, and the forces slowly increased, very often the coal would shatter for a distance of 10, 15 and even up to 20 feet distant from the "rib," and occasionally the entire room of coal would fall, thoroughly broken up, by using the two "rib" holes only. Also, on account of the vertical and horizontal "slips" in this coal, it would fall in long square blocks, often 12 to 15 feet in length, and from 20 to 40 inches square. These long square blocks were simply broken up into 3 feet to 4 feet lengths and loaded out. The pit cars loaded with this coal looked as if the blocks had been cut by a saw mill. In using powder, the same results have been observed. When the use of black powder was allowed, the percentage of lump coal produced was greatly in excess of what it is with the so-called "permissible powder". This is due to the fact that the black powder is much "slower", giving time for the forces to be dissipated throughout the mass, while with the permissible powder, which is much faster, the forces are more instantaneous. If a charge of T. N. T., sufficient to produce the same exertive force as the powder charge, were used, there would not be any lump coal at all, as the forces would simply blow out a comparatively small quantity of coal and this would be in small fragments. The quantity of coal brought down with a charge of black powder was also greater than the "faster" powder, in proportion to the forces exerted by the charge. The same general theory as that stated above is found in the breaking of wooden beams. If a beam is loaded to the point of breaking it will be found that the beam is shattered along the "grain" or natural "slips" in the wood, often its entire length.

Some Economic Considerations.

A purely mechanical means for mining coal and the elimination of the use of explosives effects the general operations, and results in economies in production, that can hardly be appreciated, even by the experienced mining engineer or operator. This is due to the fact that, although the idea is old, the possibility of its ever being accomplished, has, in the past, been so remote that it has never been seriously considered. The saving of life and property by the elimination of explosions and mine fires; the prevention of accidents in general; the improvement in the sanitary and working conditions due to the elimination of powder smoke and fumes; the saving in ventilation cost; the preventing of blowing out of timbering and the subsequent cost of cleaning up the "roof fall" that usually results; the saving in costs due to the elimination of "shot firers" and other highly paid labor; the saving in timbering costs due to the elimination of all vibration and shattering effects to the roof strata by powder explosions, are all features which, when taken all together, become a great consideration. What these mean to the coal miner, depends upon his point of view. If you are an operator and have lost a mine in which you have invested a half million dollars, by a mine fire started by a powder explosion, and which may have caused the death of a number of your employees, relatives or friends; or if you are a mine superintendent or pit boss and you have been injured by a roof fall due to the continual effect of powder explosions; or if you are a coal miner and have worked half a day in the choking fumes of powder smoke, all of these things will appeal to you quite forcibly. How much they are worth, in dollars and cents, depends solely upon local operating conditions, and upon your personal point of view. One operator recently said that he would pay the **entire cost** of operating this system of mining for the elimination **of powder smoke, alone.** He picked one only, how much are the others worth? There are two things, however, that can be more definitely estimated, first—the reduction in the amount of slack coal produced as compared with present methods; and second—how and to what extent does a continuous mechanical process effect the economic production of coal? As to the first, in a six foot vein the underminings, which are all slack coal, amount to 8% of the total, on the average. The cutting of the slots for the use of this process will produce less than 1% more, or a total of 9%. This process in itself, will not produce, on the average, more than 5% to 7½% slack, in the ordinary bituminous coal, and in the softer coals, or coal highly stratified in "sheets", not more than 10%, so that the total slack produced, including underminings, will, on the average, be approximately 15%, and at the most 20%. On this basis the increase in the "mine run" value at present market prices, as compared with the average percentage of slack produced by present methods, 39%, runs from 40 to 65 cents per ton for the Northern lignite fields, and from 50 to 80 cents per ton for the higher grades of domestic, bituminous coals of the Southern fields. Add to these figures what you please for any other advantages of this system of mining and then estimate how much it would be worth to you.

Second—a continuous mechanical process of mining effects every operation in the mine, and goes back into every item of production cost. Although the elimination of explosives and the many advantages incident thereto—the reduction in the percentage of slack, etc.—are really big things, separately and collectively, yet **they all combined** do not effect the general production costs to the extent that will result from being able to mine coal continuously. This one operating advantage **alone overtops** any and all other economic considerations. To get a brief idea of what this does, consider in connection with this process, that the mining operations are concentrated in "panels", containing twelve to fifteen rooms each, and the production costs, under these conditions, are affected in general, as follows:

(1) Coal is being produced for loading out continuously, and **new coal** broken down **as fast** as it is loaded out.

(2) This means a **continuous, uniform output** for each hour the mine is working, and an **increase of at least 25%** in the daily output.

(3) The mine can be operated, loading out coal, continuously twenty-four hours per day, if desired, instead of being restricted to eight hours, practically, as under present conditions. This will enable the operator to take care of "peak demand" at any time, without having a large developed territory from which coal is extracted but a few months per year, thus saving interest on a large investment, and enormous costs in maintaining this "peak demand" territory in working condition.

(4) Conceive of each room in the panels having **loading tracks on both "ribs", four men** loading out coal in each room, and as soon as one room is cleaned up, move the four loaders to the next room that has been broken down. Also, equip the undercutting machines with self-propelling, "caterpillar tractor" type trucks, thus enabling the mining machines to be transported from room to room through

the crosscuts, without interfering with, or interrupting, in any way the removal of the loaded pit cars, or the distribution of empties, and you can **practically** and **economically extract at least twice,** and in all probability two and one-half to three times as much coal from a given territory, as under present methods. It is simply one continuous repetition of loading out, undercutting, and breaking down. Each of these operations, constituting the entire process of extraction, is **purely mechanical.** The output per room is limited only, practically to the rapidity with which the loads can be taken away and replaced by empties, or simply to a question of transportation. **What** does this do to production costs?

Driving the rooms up at least twice as rapidly as is possible under present conditions, will, to a large extent, prevent the development of "squeezes" on both room and chain pillars, thus increasing the percentage of extraction and **saving large amounts** in maintenance and general operating costs.

(6) The concentration of underground operations into a comparatively small territory for a given output, will result in better supervision, lessening of accidents, greater output per dollar invested for equipment and development, and other savings, due to increased efficiency, all of which will effect a material reduction in production costs.

(7) New territory can be developed with great rapidity as compared with present methods. If the new development work is fairly well concentrated and three 8-hour shifts employed, entries and narrow places can easily be advanced four "cuts" every twenty-four hours. A great many coal companies would be in existence today and paying dividends had this been possible in the past.

In addition to the above, many other conditions affecting production costs could be mentioned. If you consider simply the above you will arrive at some startling conclusions that, in themselves, **justify a complete revolution** in present methods and operations in the mining of coal.

The coal industry today is in a critical state. The increase in production costs has been so enormous, and has occurred so rapidly, that the operator has failed to adjust himself to these new conditions, and to appreciate what these new costs and selling prices really mean. When the "mine run" production cost was 80 to 85 cents per ton, and domestic lump coal selling at from $2.00 to $2.50, the introduction of a mining process that would reduce the production of slack coal approximately one-half, would have resulted in saving a few cents per ton. What is this saving now, when the same coal is selling at $4.60 to $5.50 a ton. These selling prices, under present cost conditions, in all probability will increase, or at least remain at these figures for some years to come. If you will make up these figures, applied to present mining conditions, you will certainly arrive at the conclusion that you are justified in going to what would be considered extremes a few years ago, in **doing anything and everything** possible to increase nut and lump coal percentages, and in reducing production cost. Also, make your own figures on the cost of mining coal by this new process, and you will find that, even under the most adverse conditions, it is but a few cents more per ton than present cost, **and** if you give proper credit for the cost of powder; the saving in timbering; the increase in daily production; the increase in percentage of extraction; the saving in the cost of ventilation, etc., and at least something for the many other incidental and intangible benefits, you will find that the cost is **actually very much less per ton** than under present conditions, **using powder.** The additional mine run value of the product, due to the decrease in the percentage of slack, which at present prices will amount to an average of **at least 50 cents per ton,** will be a clear and absolutely **net** additional profit. **Add** to this amount the **enormous saving,** resulting from a continuous process of mining and the figures representing additional net profits that are simply astounding. In addition to all these monetary advantages, the mine will be safe and sanitary, and in every way more satisfactory to operate, than is possible under present methods and conditions.

WHAT IS THE FINAL RESULT?

A recapitulation of the mechanical and operating characteristics of the appliances used in this process of mining, and the economic advantages that result, justify the following conclusions:

(1) The development of the "slotting machine" solves the problem of a rapid, efficient, labor saving means for preparing the coal for the application of the hydraulic bar, setting aside all the serious operating and labor difficulties that formerly made the introduction of **all other forms** of mechanical appliances for mining coal **commercially impractical.**

(2) The mounting of the slotting machine on a self-propelling tractor type bed-plate, producing a self-contained, independently operated unit, that does not interrupt, interfere with, or conflict with

any other process, or operation in the mine, sets aside all objections and overcomes all difficulties incident to the introduction of a new and additional mining appliance.

(3) The cutting of a rectangular slot in the coal, instead of a round hole, permits of using a hydraulic bar, rectangular in cross section, having much greater strength, and permitting of much better mechanical construction **than is possible** in a round bar.

(4) The cutting of a rectangular slot permits of the insertion of a **type of bar** that produces a **definite shearing stress** along, and parallel to, the **back wall of support** which is impossible in any other form of application. By carrying the width of the slot and also the size of the pistons, any force necessary to perform this function can be obtained.

(5) The mounting of a power driven pump on a separate truck, and conveying the water from the pump to the bar through **folding steel tubing,** provides an efficient, reliable means of supplying water to the bar for the expulsion of the pistons, at very high pressure, thus developing forces of a magnitude that can be obtained in no other way. This construction also permits of using a high pressure pump of standard design, having large working parts and mechanically adapted to the requirements.

(6) The combining of the slotting machine, the hydraulic bar, the high pressure pump, etc., into one self-propelled unit, permits the entire process of breaking down the coal to be done rapidly and in one operation, resulting in a saving of labor and avoiding the loss of time and efficiency, that would occur if the two appliances were divided, and the equipment necessary for each, conveyed about the mine as separate machines.

(7) The mounting of the undercutting machines on self-propelled "caterpillar-type" trucks **enables** them to be transported with the same rapidity and efficiency as the slotting machines; permitting this part of the process to be carried on without retarding, interrupting, or interfering with any other operation, or with transportation, and to **co-ordinate** with the breaking down process in such a manner as to result in a rapid and continuous process of mining.

The combination of all these elements results in a practical, purely mechanical means of mining coal, a process insuring safety and increased earnings for every man employed; a constant and continuous output for every hour the mine is operated, and in economical and operating advantages to the mine owner which

School News

1920 COMMENCEMENT.

The Commencement Address was delivered by Mr. John Barrett, Director-General, Pan-American Union, of Washington, D. C., who discussed the Pan-American Union and the relations of the United States with South American Republics. There was a huge attendance. The honorary degree of Doctor of Science was conferred upon Mr. E. P. Mathewson of New York City, the foremost copper metallurgist of the world.

Faculty Resignations and Appointments.

Mr. Thomas O. Walton, professor of mathematics; Mr. C. W. Botkin, associate professor of chemistry; and Mr. S. Z. Krumm, assistant professor of metallurgy, have resigned to accept other positions.

Mr. A. J. Franks, fellow in chemistry, has been appointed chemist at the Experiment Plant.

Mr. Rodney J. Bardwell, prominent Denver attorney, has been appointed a member of the Board of Trustees to succeed Mr. Frank Willis, who has resigned.

Alumni News

The annual meeting and banquet of the Alumni Association was held at the Metropole Hotel on May 8. There was an attendance of about 60 alumni and seniors. Mr. R. B. Paul, President of the Association, presided. Among the speakers were Dr. Regis Chauvenet, Mr. Max W. Ball, '06; Mr. F. C. Carstarphen, '05; and Mr. C. M. Schneider, '20.

The following officers were elected for the year 1920:

President—W. H. Coghill, '03.
Vice-President—A. V. Corry, '98.
Secretary—W. P. Simpson, '01.
Treasurer—R. T. Sill, '06.
Executive Committee—E. R. Ramsey, '12.

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

TECHNICAL REVIEW

GENERAL.

Engineering Council Accomplishments. (M. & M., April, 1920.)

The field of activities of Engineering Council includes all matters of general interest. In the past two and a half years Engineering Council has furnished men for war service; organized employment bureaus; promoted a Department of Public Works; drafted a general law for the registration of engineers; and assisted the State of New York in reorganizing its government. J. A. H.

Stabilization of the Bituminous Coal Industry. By Edwin Ludlow. (M. & M., April, 1920.)

This report on the discussion of the subject by the A. I. M. E., reviews the criticisms of the industry at present, and the suggested remedies. 1. A change from half time to full time must be gradual. 2. Proper development cannot be assured as long as small speculators are operating mines with a view only to profit. 3. An unnecessary surplus of men, with a corresponding increase in cost of production is due to the policy of the labor unions. Lack of co-operation between mines and railroads is blamed for much of the trouble. Underwater storage was shown to be safe and efficient, if the mines would encourage it by offering lower prices during the summer. Shipment of 50,000 tons extra during the summer months would stabilize the industry. J. A. H.

Annual Meeting of the Canadian Mining Institute. (M. & M., April, 1920.)

The question of licensing mining engineers was considered unfavorably. Nickel coinage was advocated as being superior to silver as alloys. The formalities of the meeting were ended by a smoker, a banquet, and trips to the Goodyear Tire and Rubber Co., and to refinery of the International Nickel Co., of Canada, Ltd. Mr. Donald H. McDougall, a member of the A. I. M. E. finished his term as president of the Canadian Institute. The newly elected president is Orton E. S. Whiteside. J. A. H.

The Sterilization of Water by Means of Ultra-Violet Rays. By Walter L. Decker. (C. & M. E., April 7, 1920.)

This article is founded upon the fact that impure drinking water is the cause of all epidemics. Pure water contains no disease-producing bacteria, or excess of organic material of any kind. Micro-organic life grades together so imperceptibly that it is difficult to distinguish between animal and vegetable forms. The four types of bacteria, spherical, rod-shaped, spiral, and filamentous, live upon oxygen, and increase by splitting one cell into two. Bacteria in water may be determined quantitatively by mixing a sample of the water with a culture medium and allowing the germs to incubate until they are sufficiently numerous to be counted. The writer became specially interested in this problem at Wyandotte, Michigan, where impure water was causing much disease. His experiments showed that water passed around tubes producing ultra-violet rays was freed from all harmful bacteria. J. A. H.

Mineral Production of Canada During 1919. By J. McLeish. (M. & S. P., April 17, 1920.)

Although the end of the war brought the expected suspension of many mineral industries, production is again being increased and is expected to be normal this year. The 1919 copper and nickel production, as compared with that of 1918, fell to one half. In 1919 the gold production increased about one and one-third million dollars, while the silver production decreased almost two million dollars. Lead production dropped one and two-thirds of a million dollars in 1919, and zinc about a half million. The other products more intimately associated with war dropped in an even greater proportion. Petroleum was produced in such small quantities that the country had to rely chiefly on importations. J. A. H.

MINING.

The Levant Disaster. Report by H. A. Abbott. (Mining Magazine, April, 1920.)

This report is published to give the official data on the accident at the Levant Mine last October, when 31 men were killed and 19 injured owing to the breakage of the man-engine. Diagram of the mine shows how the accident occurred, resulting in one of the strangest of its kind ever known. F. A. L.

Air Pump for Condensing Equipment. By Frank R. Wheeler. (A. I. M. E., April, 1920.)

The selection of air pumps, capacities and sizes has always been shrouded with considerable mystery, and methods em-

ployed should be given more publicity. The author gives several graphs showing (1) quantity of air to be removed from surface condenser with light system; (2) weight of water vapor; (3) estimated quantity of air to be removed from jet per 1,000 gallons per minute. The article treats the air pump condenser in a technical way as applied to practice rather than from the salesman's viewpoints.
F. A. L.

The Mining Industry of Bolivia. By George W. Schneider and Benjamin L. Miller. (E. & M. J., April 3, 1920.)

Bolivia's greatest industry is the mining of silver, gold, copper, tin, bismuth, tungsten, antimony and lead. To handle the exportation of these minerals, more railroads are being built and the acquisition of a Pacific port from Chili is being agitated. Tin, silver, bismuth, and tungsten ores are usually found in such close association that it is impossible to divide the country into districts based on the leading mineral. J. A. H.

New Mining Fields in Eastern Nicaragua. By Louis Garbrecht. (E. & M. J., April 3, 1920.)

In spite of adverse conditions such as scarcity of labor, earthquakes, and revolutions, Nicaragua has increased its gold exportation to over a million dollars in 1919, with favorable chances of doing even better in the future. Sedimentary rocks are not common, the great mass of the country being composed of granite and andesite, which carry great numbers of gold-bearing quartz veins, averaging about $5.90 a ton. J. A. H.

Hanging-Wall Support on the Far East Rand. By S. W. Macer. (M. & S. P., April 10, 1920.)

This article is a discussion of the difficulties in timbering deep-seated stopes compared with the timbering of coal mines, and an explanation of the fundamental differences between the two cases. Aside from helpful variation in the construction and design of cribs, the remedies suggested are concrete packs, natural pillars, and discarded iron pipes reinforced with concrete and lengthened slightly with wooden pegs. J. A. H.

METALLURGY AND ORE DRESSING.

The Analysis of Aluminum, its Compounds and Alloys. By J. E. Clennell, B.Sc., Assoc. Inst. M. M. (Mining Magazine, April, 1920.)

This article is concluded from March issue, page 157. It gives in detail the Gasometric methods of determining metallic aluminum of alloys and powders. It also takes up the evaluation of reducing and precipitating power of Aluminum Dust.

The article is accompanied by illustrations of apparatus used and problems with reaction. The article also contains other valuable information about Aluminum Dust and its uses. F. A. L.

Aluminum Rolling Mill Practice, IV. Slabbing. By Robert J. Anderson and Marshall B. Anderson. (C. & M. E., April 7, 1920.)

The standardization of aluminum rolling mills has worked its greatest advantage in making it possible to operate two or more mills from one main drive so as to form a train. In this article, descriptions of the appearance and operation of breakdown, roughing, finishing, and strip mills are given. Specifications are given for the equipment of a rolling mill having a capacity of 25,000 pounds of finished aluminum per day. The number of men in a hat mill crew and their duties are given. The metal is rolled at a temperature of about 425° C. The common practice in rolling is to roll the ingots until they have a length equal to the desired width of the finished sheet, and then roll them at right angles until the proper thickness is reached. Hat mill slabs are generally slabbed cold to about one-half of their original thickness. Slab-shearing, if not made excessive by wrong calculations, wrong cleaving, and poor breakdown practice, should not cause more than 10.1 percent. J. A. H.

Methods for Analytical Control of Electrolytic Zinc Production. By H. F. Bradley. (C. & M. E., April 7, 1920.)

The writer puts forth in a very intelligible form the methods in use at the electrolytic zinc plant laboratory of the Judge Mining and Smelting Co., Park City, Utah. A very exact analysis of the leach solution before its purification by agitation with zinc dust is given. A similar description is given for the analysis of the pure electrolyte after the displacement of ions electro-negative to zinc. "Cell Tail" solutions are similarly analyzed. J. A. H.

The Present Status of the Stamp Mill. By Allan J. Clark. (E. & M. J., April 10, 1920.)

In refutation of the idea that the stamp mill is obsolete, the author points out that three-fourths of the world's gold supply comes from ore reduced by stamp mills. This type of mill originated with the ancient gravity type and has been developed along with the improvements in separating gold from the native rock. While the stamp mill was better adapted to amalgamation, the ball-mill prepares the ore much better for cyanidization. The stamp mill, however, is more flexible and permits a greater range of adjustments. The writer quotes six reports on the adjustments of stamp mills in different places, and the efficiency with which they performed their work. J. A. H.

Mine and Flotation Plant of the American Graphite Company, near Ticonderoga, New York. By C. E. Chaffin. (M. & S. P., April 17, 1920.)

This property was opened about 1870 and has been operated profitably since then. The deposit consists of two veins of quartz-schist, one of which averages six percent of graphic carbon. Mining is done through a haulage tunnel, by the room and pillar system, as in coal mines. The ore is concentrated in an up-to-date mill driven by steam, before being sent to the refinery. J. A. H.

Formulas for Determining the Tonnage of Products from Metallurgical Operations. By A. H. Heller. (M. & S. P., April 17, 1920.)

These include formulas for obtaining the daily tonnage of three products from complex ores when conditions are such that actual measurement cannot be applied. Other calculations determine the tonnage of matte, flue-dust, slag, and gas.
J. A. H.

The Bunker Hill Enterprise—VIII. The Crescent Mill and Its Operations. By T. A. Rickard. (M. & S. P., April 10, 1920.)

Ore is delivered into a storage bin, thence through crushers and over automatic scales to one or the other parts of the mill. From this distributor it is sent over jigs and classifiers, the former of which are built at the mill after a special design. The first type of jigs produce no concentrate worth shipping; the other three jigs produce concentrates of from 65 per cent to 77 per cent, middlings averaging about 10 per cent, and tailings. The middlings are sent to rolls or to the fine-concentration department, where it is treated by a settling tank, a pebble mill, and a classifier. Thirty-six concentrating tables discharge a finished concentrate averaging 73 per cent lead. In the flotation department, the pulp is dewatered and treated with pine-oil. The Old South Mill has been remodeled by the installation of slatted screens, standard jigs, two Hardinge pebble mills and an Aitken classifier. J. A. H.

The Electrical Equipment of the Mill. By B. B. Beckett. (E. & M. J., April 10, 1920.)

From his experience in the Consolidated Mill at Goldfield, Nevada, the writer believes that in general, the slipring motor is to be preferred to a combination of plain motor and friction clutch. Standard high-speed motors of similar design are recommended because interchangeable parts simplify repairs. The highest efficiency and highest power factor will be obtained when the motor used is not much larger than the work it is required to do, except when this work has a wide range of variation. Starters for electric motors are explained, especially the feature which prevents damage when the normal current is exceeded. Starters are necessary under some conditions and are recommended for all higher powered motors, as they cost little more than a safe switch and are much more efficient. Questions of wiring, transformers, and voltage must be solved with proper consideration of conditions. Failures of motors are attributed to loss of bearings, also soaked winding, and crystallization due to vibration. Many motor troubles may be eliminated if the electrician makes inspection trips at regular intervals. J. A. H.

The Economics of Ore Concentration. By R. J. Hancock. (E. & M. J., April 10, 1920.)

This is a discussion of previous papers on a similar subject by A. P. Watt and R. S. Handy, which have appeared in the Engineering and Mining Journal. The author finds fault with the term "economic extraction", as used by Mr. Handy, on the ground that its meaning is indefinite. The mixing of low-grade material with rich concentrate may be advisable if it tends to keep ore from the tailings. Formulae are given for the percentage of metallurgical efficiency, and their application to both rich concentrates and middlings is shown. These formulae are based on the proportion of metal rather than mineral in the ore, as the composition of the mineral may vary. Tables are given to show that neither concentrating in one operation, nor redressing the ore has much advantage over the other system. The one-operation concentration, however, is quicker and cheaper.
J. A. H.

GEOLOGY.

The Economic Geology of Brazil—A Review by Benjamin L. Miller of an Important Paper Published by Dr. J. C.

Branner in Bulletin 30 of the Geological Society of America. (E. & M. J., April 3, 1920.)

Mr. Miller hails Dr. Branner's paper as the foremost geologic article on Brazil. It includes the geologic data collected by Dr. Branner himself as well as what he has learned from other geologists. The various geologic periods are tabulated, with descriptions of the formations representing them. The article ends with a list of the Brazilian states, giving the important formations and economic products of each. J. A. H.

Asbestos—a Canadian Specialty. By F. C. C. Lynch. (M. & S. P., April 10, 1920.)

Before the war 87 percent of the world's asbestos came from a comparatively small area in Quebec. It is of the variety chrysatile and can be spun into fine thread, composed of fine filaments numbering about 25,000 to the linear inch. Geologically, olivene was metamorphosed to serpentine, and asbestos was deposited in shrinkage cracks, averaging three-eights of an inch in thickness. Excellent transportation facilities and an apparently unlimited supplies of chrysatile indicate that the industry will have a long life. Operations were begun near Thetford in 1877, and the industry has rapidly expanded. J. A. H.

OIL.

Canadian Oil Exploration and Prospects. (Canadian Mining Magazine, April 23, 1920.)

This article points out the petroleum situation of the world and what is expected of Canada to remedy the oil scarcity. Maps showing the known and possible oil resources of the world and Canada accompany the article. The following items are described:

1. Canada's Annual Production.
2. Area of Possible Oil Fields.
3. The Western Provinces.
4. Commercial Value of Tar Sands.
5. Scientific Study of Structures.
6. The Peace River District.
7. South Alberta.
8. South and Southeast Edmonston.
9. Kootenay and Vancouver Districts.
10. The Fields of Eastern Canada.
11. The Maritime Provinces.

F. A. L.

DISCUSSION

The Editor:

The article, "The Status of Gold," by Col. Chester T. Kennan, in the March, 1920, issue of the Magazine, has created some little discussion among my colleagues, and I desire to make a contribution to the discussion which I hope the article will create.

At the outset, I wish to state that I have no political propaganda to push nor "axes to grind," and further that my mind is open to logical argument on the subject, and that I do not take the position of an incontrovertible authority on it, but am only pointing out those things in the article which seem to be untenable from the standpoint of the principles of economics.

The position of the gold mining industry is of importance at this time, and it is almost needless to say that I heartily approve of any justifiable and economically sound procedure that will insure the continuity of that industry on a profitable basis, for most assuredly the world needs gold; and I certainly do not agree with those economists who place the blame for our present high prices on "the overproduction of gold."

Col. Kennan advocates the re-standardization of gold" or as I would state it, the re-definition of the dollar, our standard monetary unit, for three reasons: First, to stimulate the gold mining industry; second, to keep in agreement with the present high wages and prices of commodities with apparently the hope that they will become stabilized and kept from going higher; and, third, as a means of helping to pay the huge debts of the nation contracted largely because of the war. Analyzing these three arguments in turn, it seems highly improbable that any of them could be attained by redefining the dollar.

First. The gold mining industry will quickly recover its pre-war status, which was eminently satisfactory as to profit, if wages and prices of supplies descend. The expressed opinion of most economists is that while they probably will not drop to the pre-war level, they should come down to somewhere within 30 to 50 percent above the 1914 level, and this will be quite a drop, as we are now about 131 percent above that level. At the level anticipated the gold mining industry will be able to resume at good profit. The demand for gold at its present standardized price will help to make prices drop, whereas to re-define the dollar by approximately halving the amount of gold in it will decrease the demand for gold and so remove that as a stimulant to the industry. To summarize: The continued demand for gold will reduce wages and prices continually to where gold mining is increasingly profitable until there is a sufficient supply of gold to meet the demand; there is a natural supply, and demand balance, and to disturb this by the artificial condition of re-defining the value of gold or the dollar even once will tend to bring on periods of greater fluctuation, with higher peaks and lower valleys, both in the production of gold and in prices.

Second. Prices of commodities and wages (which follow prices fairly closely), are but a result of the combination of supply and demand, and the relative desire of the human family for any commodity compared to the desire for gold, which always has been the natural standard and has been made the legal standard in most of the industrial nations. I have shown above that changing this standard will not stabilize prices and wages, but will cause greater fluctuations. Col. Kennan's proposal is analogous to the proposition that because some seventy or eighty years ago a person could travel only twenty or thirty miles in a day, by stage-coach or the then new trains, and we can travel now, by airplane, possibly two thousand or three thousand miles, the large figure of present-day travel is out of all proportion, and we should therefore re-define the mile as having not 5,280 feet, but, say, 26,400 feet, so that the figures for the present-day high-speed travel would then be around forty to sixty "miles" as re-defined. As to the value of such a procedure, your guess is as good as mine! There would be introduced this unsatisfactory condition, moreover, that a standard had been changed, with the result that the standard vanishes, for to be a standard it must remain constant and not be subject to variation. If we change the standard of gold value, gold will soon lose its rank and its value to trade as a standard, and not only would nothing be gained in stabilization, but we would be left without any standard or ideas of the use of a standard.

Third. Eliminating the somewhat caustic language, and references to "conscientious objectors," and confining the discussion to principles of economics, Col. Kennan's statement that the same $3,000,000,000 in gold in the United States will not be enough to pay the interest, let alone the principal, of our na-

erty Bonds, is erroneous to this extent: That the payment of those bonds is made from money collected by some form of taxes by the federal government, and these taxes are collectible in gold, and this can be enforced against those who demand payment of Liberty Bonds and interest in gold. If at the time of the earliest maturing Liberty Loan, some persons demand gold in payment, all that the government need do is to insist on the payment of taxes in gold for a few years, and so gather that gold in readiness for the payment of the issue maturing next. Assuredly, I would like to see a larger gold stock in this country, as well as more circulation of gold coins, for people then would better appreciate the value of both it and money. Col. Kennan's proposal to re-define the dollar so that public debts could be paid with about half the amount of gold called for by the present standard, is equal to nothing more or less than a proposal to pay off the debts to about half their face value with gold of its present standard, and call the transaction settled. I believe that far more than a majority of the holders of Liberty Bonds are patriotic enough to accept half of the face value of their bonds as full payment could it be shown them that it would be for the country's good to do so; there would be very little need for anybody to "step forth and face the firing squad tomorrow morning at daylight." I personally would vote to have everybody accept half payment, or even to cancel the obligation altogether, rather than lose our standard of money by mischievous meddling. We, the people, you, I and all the rest of us, are paying ourselves—you, me, and all the rest of us again, for the Liberty Bonds we own by paying these high taxes, and it is fairly accurate to say that we are paying taxes about in proportion to the bonds we hold, so there would be very little unfairness to any individual to cancel the debt altogether, if it can be shown to be for the good of the country to do so. Moreover, in this period we should not lose sight of the fact that the war has been indeed costly in suffering and lives lost, and that consequently we should use every endeavor to minimize future possibilities of war so far as is humanely possible, and our payment of these high war taxes may thus have a beneficial effect in the long run.

If "business" at present seems to have no standard, can we help it any by demolishing the standard of money with which all business is transacted? Again, Gold has so nearly disappeared from circulation for two reasons: First, the system of credit has taken its place because it is easier and cheaper to do business with it than with gold coin because it is cheaper to ship a paper slip or two from one bank to another than to ship gold coins, and the "counting" of the paper slips can be done on an adding machine with less chance of inaccuracy; and, second, because the majority of people seem to prefer its paper substitute; try to pass out a $20 gold piece instead of a "yellow-back" at any bank in the East. I know, of course, than any system of credit should be "secured" to a large extent of its face value by gold as coin or bullion, and the present extent of "security" should be increased, but that is no sign that we need an extensive circulation of $20 gold pieces between merchants and banks.

I hope that other readers of your Magazine will contribute to this highly important as well as interesting subject so that the people of this nation, at least those of them that read the Magazine, will have their minds fully alive and prepared to meet a proposal fully as futile, and possible more so, as the "free silver" proposal of 1896. Fraternally yours,

WM. R. CHEDSEY,
Professor of Mining, School of Mines,
The Pennsylvania State College.

PERSONALS

'83.

W. H. Wiley has recently returned to Los Angeles after examination of zinc-lead-silver mines in Hunan Province, China.

'93.

Wm. B. Milliken has moved from 918 Equitable Bldg. to 709-10 Mining Exchange Bldg., Denver.

'95.

Burt C. Stannard is Superintendent of the Selby Smelting and Lead Co., San Francisco, Calif.

Word has just been received that George A. Kennedy is at present in St. Joseph's Hospital, Denver, recovering from an operation necessitated by the injuries he received when shot by a bandit in Mexico. Mr. Kennedy was with the W. C. Laughlin Co., La Colorado, Sonora, Mexico.

'96.

Fred McL. Strout has moved from Cripple Creek and is located at 1453 High Street, Denver, Colo.

'99.

Sidney B. Tyler is superintendent of the Ferro Alloy Co., Denver, Colo.

'01.

Hugh C. Watson, formerly with the Newman M. M. & L. Co. at Aspen, is now manager of the Michigan-Colorado M. Co., Bedrock, Montrose County, Colo.

'05.

R. L. Hallett is chemist in the Research Department, National Lead Co., Brooklyn, New York.

L. B. Eames, formerly of Pueblo, is now engineer for the Stearns-Roger Mfg. Co., Denver.

Homer D. Ford is superintendent of the Gilson Asphaltum Co., Watson, Utah.

'06.

Albert J. Koerner is general manager of the Koenitzer Tinning Co., 1122 South Michigan Ave., Saginaw, Mich.

'07.

C. L. Colburn of Washington, D. C., was a Golden visitor recently.

'08.

Wm. R. Chedsey, professor of mining at the Pennsylvania State College, has just returned from the annual junior trip through the anthracite fields and the iron and zinc concentrators of the East.

Samuel C. Sandusky has resigned his position with the Nevada Packard Mines Co., Oreana, Nevada, and is now in charge of the Zuma Mining Co., Eureka, Utah.

B. W. Knowles is mine superintendent for the Hedley Gold Mining Co., Ltd., Hedley, B. C., Canada.

'09.

Clarence T. Emrich is assistant superintendent International Smelting Co., Miami, Ariz.

Dudley M. Wilson is construction engineer with the Texas Construction Co., Dallas, Texas.

Harold C. Eddy has accepted a position as chief engineer with the Petroleum Rectifying Co. of California, at San Francisco, Calif.

'10.

F. A. Goodale has just returned from examining an alluvial mine in Queensland, Australia. His present address is Colfax, Calif., care You Bet Mining Co.

George M. Lee has been transferred from Grand Forks, B. C., to Anyox, B. C. He is with the Granby Consolidated Mining, Smelting and Power Co.

John B. Carman has been transferred from Denver to the Yak Mines of the A. S. & R. Co., Leadville, Colo.

A. E. Perkins was an entertaining guest at the Alumni Banquet on May 8.

In the absence of C. Erb Wuensch, Robert M. Keeney is acting as editor of the Magazine.

'11.

P. M. McHugh has been made General Sales Manager of the Dorr Co. and has moved to New York. His address is 101 Park Avenue, New York.

Samuel R. Brown Jr., has left Kimini, Montana, and his present address is Montrose, Colo.

John V. Harvey's address is Minas de Matahambre, Pinar del Rio, Cuba. Mr. Harvey is mine superintendent.

'12.

Earle D. Andrews is sales engineer for the Mitchell Lime Co., Chicago, Ill.

E. R. Ramsey has been made Western Sales Manager of the Dorr Co., Cooper Bldg., Denver, Colo.

Edwin E. Hand Jr., is assayer at the Asarco Plant, A. S. & R. Co., Asarco, Durango, Mexico.

Donald Dyrenforth is general superintendent of the Akron Mines, Whitepine, Colo.

'13.

Chas. S. Arthur is with the Great Western Sugar Co., 500 Sugar Bldg., Denver, Colo.

Edmund Stein's present address is R. F. D. No. 1, Option, Pa.

H. M. Cronin has resigned as chemist at the Experimental Plant to enter private practice.

Chas. E. Prior's address is Cherry Creek, Nevada.

'14.

S. Z. Krumm has resigned as Assistant Professor of Metallurgy to enter private metallurgical work.

C. Erb Wuensch, editor of the Magazine, is making mine examinations in Central America, and will return to Golden in September. His address is El Salvador Mining Co., Divisadero, Dept. Marazan, El Salvador, C. A.

Arthur Krohn was a Golden visitor recently. He is at present stopping at the Standish Hotel, Denver.

Joe H. Woolf ("Tuffie") has returned to his home in Greeley, Colo., after a stay of four years in Korea. He left Korea February 1 and made a tour of Japan, China and the Philippine Islands. While in Peking he met Chick Ho, '13, who is now head of the Department of Geology at the Chinese Government University. A Mines re-union was then held with the following present: S. Y. Wang, '13, Mine Expert, Chinese Government University; Thomas T. Gow, '14, Professor of Physics, Peking University; Ping See, '14, of the office of the High Industrial Commissioner; H. Lee, '16, of the government employ. Mr. Woolf was accompanied by his sister, Miss Mabel Woolf, and a friend who went to the Orient to make the return trip with Mr. Woolf.

Albert W. Smith is Superintendent, Open Hearth, Youngstown Sheet & Tube Co., Youngstown, Ohio.

'15.

Keith Roberts is Field Engineer for the Bakra Syndicate of New York. He is at present at Cottonwood Falls, Kansas.

Alfred F. Duggleby is General Superintendent of the Alleghany Mining Co., at Alleghany, California.

F. Eugene Heatley is geologist and vice-president of the York Production Co., Denver, Colo.

'16.

Lieut. Frank E. Briber is still confined in the Walter Reed Hospital, Washington, D. C., suffering from injuries received while with the 314th Engineers in France. He would like to hear from some of his old friends.

'17.

Roscoe H. Clarke has resigned as chemist for the Burro Mt. Copper Co., at Tyrone, New Mexico, and is at present in Denver.

Walter Goodwin Swart has moved from Duluth to Babbitt, Minnesota, where he is General Manager of the Mesabi Iron Co.

'20.

J. C. Benbow, Prentice F. Brown, Luther J. Buck, Albert A. Klamann and Howard T. Flint have accepted positions in the mill testing department of the Anaconda Copper Co., Butte, Mont.

Nicholas F. Gallucci has accepted a position as engineer with the New Sabinas Co., Cloete, Coah., Mexico.

George V. Dunn, William S. Levings and William B. Case have accepted positions as geologists with the Midwest Refining Co.

John S. N. Davis will sail from New York the latter part of May for Rancagua, Chile, S. A., where he has accepted a position with the Braden Copper Co.

Arthur C. Kinsley has accepted a position with the Minerales de Metales Co., Monterrey, N. L., Mexico.

Myron L. Sisson has accepted a position with the U. S. Fuel Co., Mohrland, Utah.

Edward J. Krier expects to leave soon for Raton, New Mexico, where he has accepted a position with the St. Louis, Rocky Mt. & Pacific Co.

ATHLETICS

By F. A. Lichtenheld, '20.

Mines 13; C. C. 6.

Colorado Springs—April 30.—Bunching hits with Tiger errors in the third inning after two were out, the School of Mines baseball team scored seven runs and assumed a comfortable lead that the Collegians did not threaten throughout the game, the Miners winning by a score of 13 to 6. In this inning Briggs misjudged Newman's liner and it sailed to center field for a home run, while MacDougall and Flegal bobbled, putting the Ore Diggers in position to score when solid hits followed.

Krause kept the Tiger hits well scattered and struck out seven batsmen. Newbold pitched a strong game in spots but on two occasions when his teammates failed to take care of easy putouts, he was touched up for the necessary hits to produce runs.

Hughes, star boxman for the Tigers last year, will hurl the game. This will be his first appearance of the season. Score:

MINES.

	AB	H	PO	A	E
Dunn, 2b.	6	3	2	4	0
Bailey, ss.	5	2	1	4	1
Strock, 3b.	4	1	1	2	0
Serafini, cf.	4	1	4	0	0
Bunte, rf.	4	2	0	0	0
Henderson, lf.	5	2	1	0	0
Fenzel, 1b.	3	1	11	0	1
Newman, c.	5	3	7	1	1
Krause, p.	3	0	0	4	0
Totals	41	15	15	27	3

COLORADO COLLEGE.

	AB	H	PO	A	E
Bliestein, 2b.	5	0	6	3	0
MacDougall, ss.	5	3	3	3	1
Flegal, rf.	5	1	1	0	1
Hughes, c.	4	1	13	5	0
McCool, lf.	3	0	0	0	0
Kyffin, 1b.	3	0	5	0	0
Briggs, cf.	4	3	0	0	1
Wilkin, 3b.	4	1	0	4	0
Newbold, p.	2	0	0	3	0
*A'worth	1	0	0	0	0
Totals	36	9	27	18	3

* Batted for Newbold in ninth.

Summary—Two-base hits: Briggs 2, Henderson. Three-base hits: Dunn, Briggs, MacDougall. Home runs: Strock, Newman. Sacrifice hits: Newbold, McCool. Stolen bases: Dunn, Bailey, MacDougall, Briggs. Double play: Newbold Krause 7, by Newbold 10. Bases on balls: Off Krause 1, off Newbold 6. Wild pitches: Newbold 2. Umpire: Newhouse.

Mines 11; C. C. 4.

Colorado Springs, May 1.—Mines repeated her victory of the day before, subduing the Colorado College diamond pastimers this morning by a score of 11 to 4. The Diggers bunched their hits in the first and sixth innings, while Henderson was pitching steadily for them.

Coach Parsons started Park in the box for the Tigers and he was rapped for two singles, a triple and a home run by Strock, which gave the Ore Diggers an early lead of four runs.

Ed Hughes, star pitcher of the Tiger team of last year, was tardy in appearing on the field today for his first game of the season and he took the rubber in the second. He pitched effective ball in the sixth, when the Miners bunched four hits with a pass and error for six runs. Had Bleistein handled Dunn's rap in this inning, the side would have been retired without a score.

Although the Collegians touched Henderson for ten hits, he kept the blows well scattered and it was not until the eighth and ninth innings that the Tiger attack was forceful enough to prove threatening. Williamson's poor pegging resulted in nine stolen bases for Coach Parson's men.

MINES.

	AB	H	PO	A	E
Dunn, lf.	5	2	3	0	0
Bailey, ss.	4	0	0	2	0
Strock, 3b.	5	1	1	1	1
Serafini, cf.	4	2	2	0	0
Bunte, rf.	4	1	0	0	0
Henderson, p.	4	1	1	2	2
Williamson, c.	4	2	1	0	0
Ward, 2b.	3	1	1	4	0
Frenzel, 1b.	3	0	8	0	0
Totals	36	10	27	9	3

TIGERS.

	AB	H	PO	A	E
Briggs, cf.	5	0	1	0	0
MacDougall, ss.	5	0	2	1	0
Flegal, rf.	5	3	1	0	0
W. Hughes, c.	5	3	6	0	0
Bliestein, 2b.	5	2	2	1	2
Kyffin, 1b.	4	0	8	0	0
McCool, lf.	3	0	1	0	0
Wilkin, 3b.	3	0	2	2	1
Park, p.	0	0	0	0	0
E. Hughes, p.	3	1	0	3	1
*A'worth	1	1	0	0	0
Totals	39	10	†23	7	4

* Williamson out, failed to touch 2nd.

† Batted for Hughes in 9th.

Mines .... 4 0 1 0 0 6 0 0 0—11

Summary—Two-base hits: Flegal, Bunte. Three-base hits: Serafini, Williamson, Bleistein. Home run: Strock. Sacrifice hits: McCool, Bailey. Stolen bases: MacDougall 2, Flegal 2, Hughes 2, Bleistein, Kyffin, Ainsworth, Serafini. Struck out: By Hughes, 5; by Henderson, 9. Bases on balls: Off Hughes, 2. Hit by pitched ball: Ward, W. Hughes, Wilkin. Hits: Off Park, 4 in 1 inning; off E. Hughes, 6 in 7 innings. Umpire: Newhouse.

Mines 1; D. U. 8.

Denver University's baseball team came back yesterday afternoon. It defeated the School of Mines in one of the best played baseball games seen on a Colorado field this year. The game took place at University Park. Score 8 to 1.

The game result was never in doubt. In the third inning D. U. jumped into the lead by scoring three runs, a lead the team maintained throughout the remainder of the game.

In the sixth inning, Watkins was sent in by Glaze to take Krause's place as pitcher. Watkins held D. U. for the remainder of the game.

MINES.

	AB	H	PO	A	E
Dunn, 2b.	4	2	4	3	1
Bailey, ss.	5	1	2	1	2
Strock, 3b.	5	2	1	3	0
Serafini, cf.	4	0	0	1	0
Bunte, rf.	4	1	0	1	0
Henderson, lf.	3	0	2	1	1
Frenzel, 1b.	3	0	8	0	0
Vro'an, c.	4	1	6	3	0
Krause, p.	4	0	0	3	0
Watkins, p.	1	0	0	0	0
Bunte, 1b.	1	0	0	0	0
Robb, cf.	1	1	0	1	0
Ward, 2b.	1	1	0	1	0
Totals	40	9	23	18	4

DENVER UNIVERSITY.

	AB	H	PO	A	E
Phillips, 3b.	3	1	0	2	0
Flint, ss.	2	0	2	2	1
Allen, 2b.	4	3	1	2	0
Liggett, c.	3	0	12	1	0
Mohana, cf.	4	2	1	0	0
Russell, lf.	4	1	1	1	1
Cook, rf.	4	1	3	0	0
Chase, 1b.	4	1	7	1	2
MacKenzie, p.	3	1	0	0	0
Geer, cf.	0	0	0	0	0
Hewl'g, rf.	0	0	0	0	0
Graham, lf.	0	0	0	0	0
Totals	31	10	27	9	4

Mines .... 0 0 0 0 0 0 1 0 0—1
Denver University. 0 0 3 1 3 1 0 0 x—8

Summary—Stolen bases: Phillips, 1; Strock, 3. Sacrifice hits: Phillips, 1; Liggett, 1; MacKenzie, 1. Passed balls: Liggett, 2. Struck out: By MacKenzie, 12; by Krause, 2; by Watkins, 2. Bases on balls: Off MacKenzie, 4; off Krause, 2; off Watkins, 2. Hit by pitched ball: By Krause (Chase, Flint); by Watkins (Geer). Left on bases: Denver University: 4; Mines, 10. Umpire: Cassidy. Time: 2:50.

MINES LOSE AT TRACK WITH C. C.

Colorado Springs, May 1.—Piling up 9 points, the Colorado College track squad easily defeated the Mines team in a dual meet here this afternoon. The Mines scored but three firsts in the fourteen events.

Sensational performance of Mal Graham, Tiger sprinter, in the 220-yard dash, was the feature of the meet. He stepped the distance in 21:3 and was not pressed.

The Tigers scored firsts in the 100-yard dash, the 220 dash, the quarter, half mile and two-mile runs, the high hurdles, the pole vault, high jump and broad jump, and javelin throw. Gallucci won the shotput and the discus hurl for the Miners and Davis finished ahead of Hughes after a close race in the low hurdles.

Colorado College won the mile relay in 3:42. Graham and Gallucci tied for individual honors with two firsts each.

NEW ATHLETIC COUNCIL FOR NEXT YEAR.

At a mass meeting of the school, held in April by the Athletic Council, Prof. A. E. Bellis, Don L. Bailey and R. M. Schade were elected to the Athletic Council for the coming year, while the following managers were named: W. L. Jones, football; H. Fidel, baseball; Herron, basketball; Pratley, track; Bilheimer, boxing and wrestling. A great deal of credit must be given to the outgoing men who served so well in the past year.

SECOND MINES ATHLETIC BANQUET.

Mines held its second athletic banquet May 5, 1920, at the Albany Hotel. Food, speeches and entertainments made up the bill and everybody had a glorious time.

OBITUARY.

Ex-'00.

E. M. Stewart, Ex-'05, was killed in an automobile accident April 5. It is supposed that he fell asleep while driving, causing the machine to run off the road and turn over. He was one of the most

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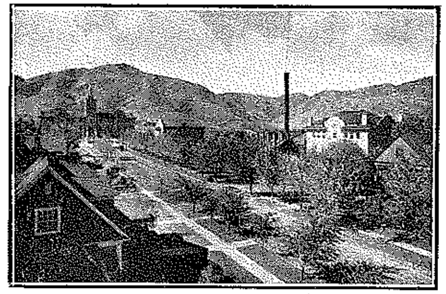

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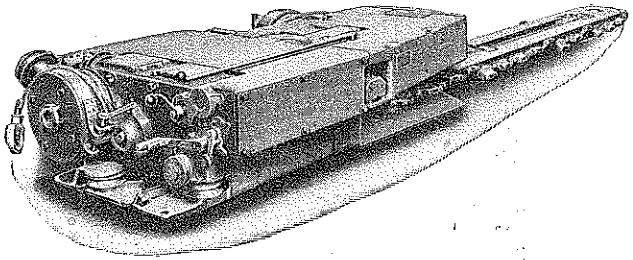

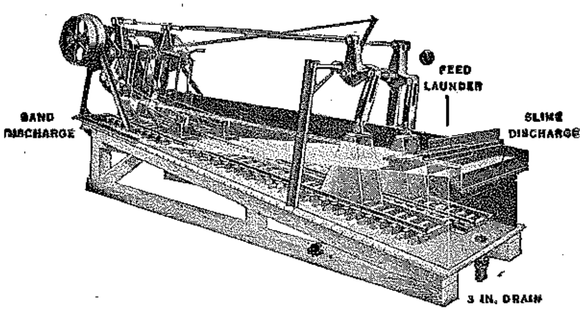

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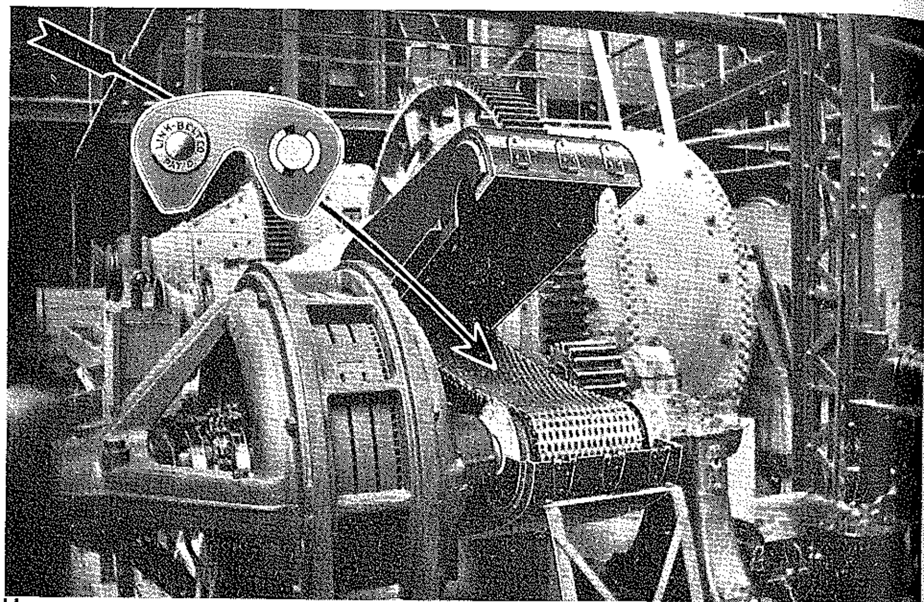

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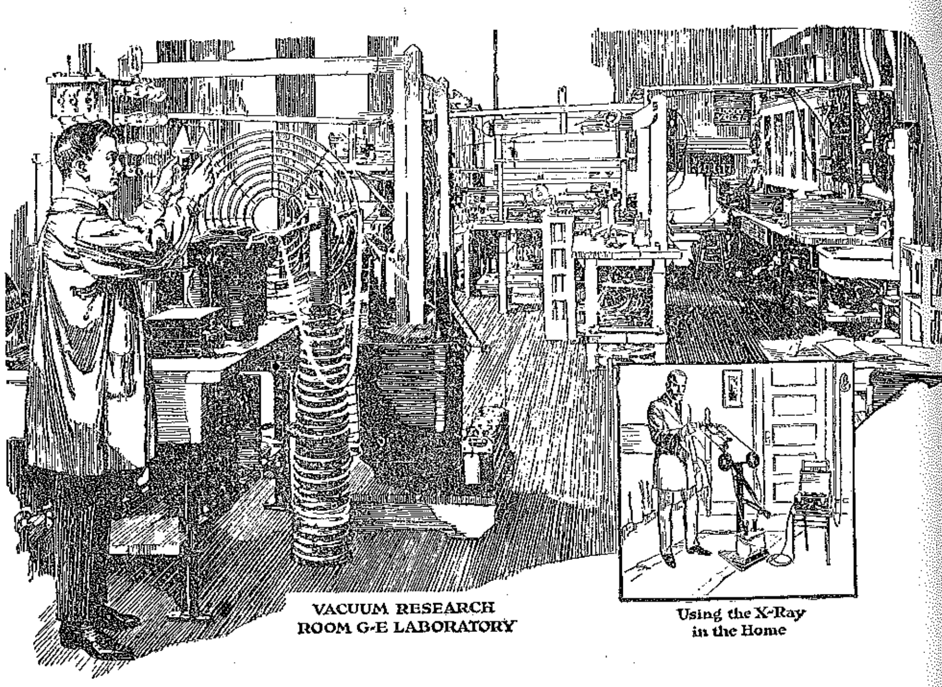

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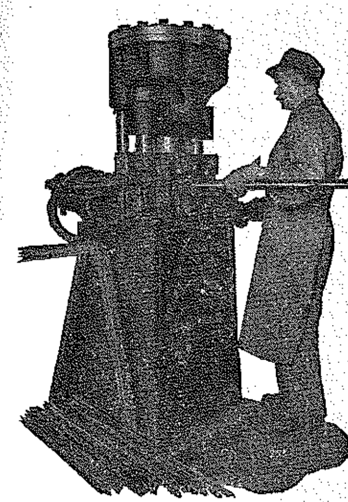

"The Waugh Way Wins"

MR. SMITH, THE SMITHY, is a "mighty man" in the mine blacksmith shop.

EVERY MINER regards him as a magician. He is a magician, too—what is known around the mine as "the Waugh Wizard."

THE SECRET of his magic lies in the marvelous Model 8 Waugh Drill Sharpener that he operates. With it he sharpens sharp and well, and he makes all sorts of forgings useful around the mine—all in the twinkling of an eye.

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In finding sharpeners worthy of our steel."

THE Denver Rock Drill Manufacturing Co.

DENVER, COLORADO

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VOL. X JUNE, 1920 No. 6

COLORADO SCHOOL OF MINES MAGAZINE

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