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Letters

AN EDITOR'S VIEW POINT

FROM CHARLES J. PENN

I was delighted with the new coat of paint you had given your journal. The modern style adopted certainly is a great improvement on your previous style. I did, however, like the early setup quite well.

The articles you are getting in Mines are very fine and I do not think many U. S. journals can boast such interest-retaining data. I do enjoy your articles which are more or less in conversation form. A quiz article "as it were." You ran one some months ago and it was about gasoline.

Your journal though has such a wonderful reputation and such a fine circulation, I should think, that it must appeal to all mining equipment manufacturers.

Kindest regards,
Sincerely,
Editor, Canadian Oil and Gas, 36 Toronto Street, Toronto, Canada.

CHANGING POSITIONS

FROM CLIFFORD R. HORN, '33

Enclosed you will find the card showing my change of address for the 1940 Alumni Directory.

For your information I have resigned my position as Instructor in the Department of Petroleum and Natural Gas Engineering, School of Mineral Industries, The Pennsylvania State College, to accept the position of Instructor, Department of Geology and Petroleum Engineering at the Texas Technological College, Lubbock, Texas, beginning in September. There I will have charge of all work in the newly organized Production Option.

For nearly four years, I have been teaching, doing research work on the secondary recovery of petroleum, and doing graduate work at Penn State. I was granted the degree of Master of Science in Petroleum Engineering this June, at the same time Mrs. Horn received the degree of Bachelor of Science in Psychology.

Each issue of the Mines Magazine is received with a feeling of pleasure and is given a thorough "going-over" by both Mrs. Horn and myself. I am looking forward with considerable interest to your new petroleum number.

Instructor, Department of Geology and Petroleum Engineering at the Texas Technological College, Lubbock, Texas.

CONGRATULATIONS

FROM E. M. SMITH, '05

Enclosed you will find check in payment of my membership in Mines Alumni Association.

I wish to congratulate the men who have been putting time and energy into the building up of the C. S. M. Magazine and the Alumni Association thru the years. They have done a hard job in a very satisfactory way.

8629 Rainier Ave., Seattle, Wash.

Strategic Mineral Supplies

By G. A. ROUSH, Editor, The Mineral Industry
473 Pages. 5x8. $5.00

This book presents a general survey of the more important strategic mineral commodities—those of which the domestic output is inadequate to meet the demand, facing extensive dependence on imports from foreign sources. Strategic minerals are most talked about in connection with the possible emergency supply in the event of a future war, and this has tended to foster an impression that it is only in connection with possible military use that the commodity is of importance in question of paramount importance.

An understanding of the summation status of these products is of importance from the purely big industrial viewpoint, entirely aside from their value in a possible military program.

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PERSONAL NOTES

Raymond N. Abplanalp, Ex-41, Chairman for the U. S. Civil Service, is doing work in Washington and Oregon. Mail addressed to his home, 1117 West 9th St., Albany, Oregon, will always reach him.

Charles F. Allen, '34, has dropped his metallurgical work for a while and has entered the army. He is now being addressed as 1st Lieutenant, 19th Engineers, Camp Ord, California.

Arthur B. Austin, '32, Sales Engineer for Kelkar Powder Company, receives mail at his residence 1040 West 8th St., Wilmington, Delaware.

James M. Baggs, '39, is Assistant Materials Engineer in the Testing laboratory of the Wyoming State Highway Department. He resides at 3119 Pioneer Avenue, Cheyenne, Wyo.

George Backland, '22, Vice-President and Director of Bakelite Corporation, has a change of office address to 50 East 42nd Street, New York, N. Y.

Tom Bradley, '37, recently accepted position of detail draftsman for the Lockheed Aircraft Corp. His mail address is 438 San Vicente Blvd., Santa Monica, Calif.

John W. Burns, '36, as Manager of the Ainsworth Hot Springs Summer Resort, at Ainsworth, B. C., Canada, has been enjoying the summer by making other people have a good time. At this resort (of which his father is proprietor) he has unexcelled fishing, both salmon and trout; natural caves and silver-lead mines in the district are within walking distance of the hotel, making interesting trips for hikers; the resort is also in the proximity of Kootenay's famous cherry orchards—the home of the big Bing cherry.


A. F. Carper, '14, is now being addressed at Bland, Via—Domino, New Mexico, where he is General Manager of the Arizona-California Exploration Company.

Warren Caton, '35, who has been associated with the Creede Mills, Inc., at Creede, Colorado, for several years, has accepted position of Instructor in the department of Metallurgy at Miner and is now residing in Golden.

Harry Coplin, '37, is draftsman for the Vanadium Corporation of America at Ainsworth, Colorado.


John H. East, Jr., '10, at the present time is being addressed at Columbus, Montana, where he is in charge of the diamond drilling operations of the Stillwater Project No. 201 of the Bureau of Mines. It is part of the Strategic Minerals program and calls for the development of some chrome deposits at Benbow and Mount.

Ralph G. Ehret, '33, Salesman for the Seelmeier-Ehret Photo Engraving Company, has a change of residence address to 6th East 12th Ave., Pocatello, Idaho.

Ezell Flournoy, '32, is Engineer in the Mining department of the Tennessee Copper Company, at Copperhill, Tenn.

Thomas G. Foulkes, '22, has a change of residence address to 3508 Sycamore Street, Bethlehem, Pa. He is Assistant to Engineer of Tests for the Bethlehem Steel Company.

G. L. Garwood, '39, Assistant Metallurgist for the Eclipse Aviation Corporation, resides at 412 Jefferson Avenue, Hasbrouck Heights, N. J.

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Herbert Goodman, '98, is Junior Geologist for the Shell Oil Co., Inc., with mailing address in care of the Exploration Department of the company, Box 1595, Midland, Texas.

Presley Grant, Ex-33, has entered one year's service with the Army with the rank of 1st Lieutenant. He is stationed at Aberdeen Proving Ground, Aberdeen, Maryland where he is working on small arms and finding it interesting.

Raymond L. Graier, '35, has resigned his position with the U. S. Bureau of Reclamation, to take graduate work at Mines. He is now being addressed at 807-14th Street, Golden, Colo.


Frank B. Holland, '37, Junior Engineer for Shell Oil Company, Inc., resides at 2150 Pasadena Ave., Long Beach, Calif.

Lewis A. Hovey, '32, is Assistant Superintendent, OH-4, Carnegie-Illinois Steel Company, Munhall, Pa., where he resides.

Robert M. Keneen, '10, Industrial Manager of the Connecticut Light & Power Company, has as his residence address, Hartford Avenue, Farmington, Conn.

Oscar A. Lamp, '98, President and General Manager, Cia. Minera de Guadalupe, S. A., has a change of post office address to Apartado No. 59, Guanajuato, Gto., Mexico.

Morgan Leonard, '36, who recently returned from Chile where he was employed by the Braden Copper Company, has accepted a position with the New Goldfields of Venezuela, Ltd., and is now receiving mail in care of Sr. Jose Acuñata, Ciudad Bolivar, Venezuela, S. A.

George B. Mitchell, '96, is General Superintendent of the Dufferin Shipbuilding Co., Ltd., with address 445 Fleet Street, Toronto, Ontario, Canada.

R. S. Munizet, '35, is Mine Foreman for the Prescott Lease, Mercury Division, Box 144, Mina, Nevada.

Ralph W. O'Neill, '32, receives mail thru Box 6666, Odessa, Texas, where he is Assistant Superintendent for the Phillips Petroleum Company.

Ord, '16, and C. W. Parsons, '35, have a change of address to Box 497, Ardmore, Oklahoma, where they are employed by the Carter Oil Company.

R. G. Paterson, M.Sc., '37, has joined the Royal Canadian Navy for the duration of the war. His present address is: Lieut. R. G. Paterson, R.C.N.V.R., Fleet Mail Office, Halifax, Nova Scotia, Canada. Since receiving his degree from Mines he has been employed as geophysicist for The Canadian Western Natural Gas, Light, Heat & Power Co., at Calgary, Alta.

Oscar Reynolds, Ex-04, has returned to Denver after some time spent on the Pacific coast and is now being addressed at 1032 East 14th Avenue.

Joseph A. Richeliesi who received his P.E. degree this year, has changed his name to Joseph A. Rich as he has found that the latter will be of advantage to him in his sales work. He is associated with the Bethlehem Supply Company and shares Box No. 7, La Ward, Texas.

Fernan B. Smith, '21, President of Smith & Trowino, Inc., General Contractors, has moved from Peterstown, West Va., to Asheville, N. Carolina, where he resides at 22 Sherwood Road.

(Continued on page 513)
Through the addition of a complete new plant, CF&I is now making Welded Wire Fabric in a wide range of styles, readily available to the Construction Industry in this area.

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Front Cover

Wending its way over 9.6 miles of rolling topography (of which the cover photo is typical) the world's longest conveyor belt system has begun its four-year task of hauling 10,000,000 tons of vari-sized gravel that will comprise the aggregates for majestic Shasta Dam in California's Great Central Valley. Stretching from Redding to Coram, the belt was manufactured by The Goodyear Tire & Rubber Company, and installed for the Columbia Construction Company, contractor responsible for delivering sand and gravel for the project. Shasta Dam, when completed, will serve the three-fold function of controlling the flood waters of the Sacramento River, divert water for irrigation purposes over a vast area, provide hydro-electric power for many communities.

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Mines Men are bereaved because of the death of James Finch Callbreath, secretary emeritus of the American Mining Congress. He was a true friend of the Colorado School of Mines as well as its students and alumni. His life was filled with service to the mining industry. Every branch of this industry is indebted to him in some way. It was he who organized the American Mining Congress and it was the American Mining Congress, under his direction, that persuaded Congress to create the U. S. Bureau of Mines.

Mr. Callbreath was a genius in organizing and winning the support of men. His life was rich in accomplishment. The far-reaching effort of his skill in sponsoring and securing beneficial legislation for the mining industry will be appreciated more and more in the future. His outstanding career and the public nature of his service as secretary of the American Mining Congress made him a familiar figure amongst mining men everywhere. His wide acquaintance brought him a host of friends.

James F. Callbreath, as he was known throughout the country, died at his home in Alamosa, Colorado, August 4, 1940, at the age of 81. He was born in White Falls, N. Y., and came to Colorado as a young man. He attended Denver University and graduated from that institution. He practiced law in Denver for a time and was president of the Denver Chamber of Commerce in 1903 and 1904, a member of the Denver Charter Convention in 1903 and served as a member of the City Council of Denver from 1904 to 1906.

Mr. Callbreath was the leading spirit in the organization of the Gold Mining Congress in Denver in 1898 which was the forerunner of the American Mining Congress. Thus he was the father of this national organization and served as its secretary from its inception until a few years ago when he retired. He was made secretary emeritus and in that capacity assisted his successor in getting established to carry on the good work which he had started.
MODERN TRENDS OF MINERAL HANDLING

By

E. A. SAWITSKE, '40
Cement Co.
Laramie, Wyo.

Introduction

In today's world all industries are highly mechanized. In the past, before the era of the present century, industry was able to survive with slow production methods, meeting moderate demands in a moderately moving world. As time went on, demand increased; and in order to meet this demand and new markets, industry had to be stepped up. In order to step up production, there was one of two methods of approach—namely: increase in human labor or mechanized units. It was natural to follow the latter, and mass production demanded faster output than even human labor could supply.

Only within the last twenty years has the mining industry become conscious of the possibilities of modern, mechanized methods of handling and hauling ore materials. A glance into the past will show what a great problem underground haulage has always been.

The first and most primitive method of underground haulage comprised carrying minerals in sacks, baskets, or other containers on the backs or heads of men and women. Later, as an improved method of transportation, tubs on runners or wooden sleds were pulled by boys and even women in coal mines. The introduction of the wheel barrow made the work of hauling materials easier, but hauling in quantity and over extended distances could not be realized until the four-wheeled buggy or car running on a track had been developed.

At first cars were pushed by hand. This is known as trammimg. In English coal mines Shetland ponies were employed for underground hauling in 1843 after the enactment of a law prohibiting the employment of women and children under the age of ten years. In thicker seams horses were used. In 1852 dogs were hauling coal in a number of mines in the United States. Horses and mules are the only animals that are now used.

The first electric locomotive was placed on underground service in Saxony in 1882. Five years later the first electric locomotive in the United States began hauling coal in a mine in Pennsylvania. A storage battery locomotive was tried in this country as early as 1886, but the first successful use of this type of locomotive was probably in the West Virginia coal field in 1899.

Aerial tramways were first tried as a method of transporting material during the Middle Ages. However, the first important installation of an aerial tramway on mining property was made in Germany in 1860. This was a tramway of the continuous monocabable type and was followed later on by one of the continuous bicable types. Early systems of various types were developed in Germany and England and were introduced into America in 1887. They are now in operation at coal mines, metal mines, non-metallic mineral mines, quarries and in numerous other industries.

These methods were all right in their day, but they in turn are giving way to newer methods—conveyors, vacuum pipe lines, moving pipe lines, and trackless haulage, all symbolic of the twentieth century.

Increased tonnage and decreased operating margin soon forced consideration of the mucking problem as well as the transportation factor. In the early days all mucking was done by tramming freight cars to the central hoisting location or skip pocket. Now the mines are being mechanized. When mechanical haulage and mechanical mucking were first introduced, it looked like a difficult undertaking which might require expensive experimentation at the very front of operations. But when the shortage of labor, especially of unskilled labor, at a time of maximum demand seriously affected production and it was fully realized that the issue must be faced, the efficacy of mechanical handling suddenly became a live and pressing question in several mining districts and an accomplished fact in a surprisingly short time.

Now most mines are being mechanized. Where accurate and detailed cost sheets are kept, they show the effect of proper and timely mechanization. The tonnage-per-man curve shoots up and the cost curve drops sharply. The net result of this as affecting labor is not as labor fears, a reduction in the number of men employed, but rather a widening of the definition of ore, and the inclusion of material hitherto unprofitable, the expansion of operations and the consequent hiring of more men at better pay. If miners realize the benefits that have accrued in labor from mechanization they would welcome and aid every attempt in that direction.

The purpose of the remainder of this paper will be to set forth the advantages and disadvantages of some of the more modern trends of handling minerals—conveyors, pipe lines, and trackless haulage, with a discussion of the problems of installation as well as the economic factors.

Modern Methods

The modern methods of handling ore material to be discussed in the following pages include conveyors (continuous belts and shaking), moving pipe line, and trackless haulage. All of these have been tried, tested, and approved. Emphasis will be placed on mechanical description, applicability, advantages, and disadvantages.

Conveyors

Conveyors are more widely used in the modern mining field than any of the other methods to be discussed. The first of these, continuous belts, is of especial interest as a means of transporting material.

Continuous Belts

The belt is rectangular in cross-section, being about twenty times as wide as it is thick. It runs over pulleys and is continuous; in one direction it carries the load and returns empty directly below the loaded side. There are idlers, supporting the re-
tuming belt, spaced at two to ten feet intervals.

Its application is in one sense limited. The width of the belt for loose materials must be at least four times the uniform size of the material to be transported, plus six inches, or four times the average sized pieces plus six inches where such pieces are about seventy to eighty per cent of the whole. Under no circumstances should the belt be less than twice the largest pieces plus eight inches.

The capacity in tons per hour varies from seventeen tons on the fourteen inch belts, at one hundred feet per minute, of fifty pound per cubic foot material, to 3780 tons on the sixty inch belt at six hundred feet per minute of one hundred pound per cubic foot material. It must be remembered that the size of the material must be within design limits.

The power to run these conveyors is very small for the number of tons handled. Whenever an installation is made power requirements must be calculated. The factors entering in on this computation are as follows: HP for empty conveyor; HP to move load horizontally; HP to move load on incline and HP of tripper. These figures can be obtained from manufacturers' catalogues and inserted directly into the total HP formula.

Belts are ordinarily installed to carry horizontally, although most materials may be readily carried in a troughed belt at eighteen to twenty degrees to the horizontal. When designing a conveyor, the nature of the installation, weight of material and moisture must be kept in mind.

The belt must have a certain flexibility or else it will not run true, and use excessive power. The proper flexibility in belts for troughing idlers is one ply for each four to five inches of belt width, with a twelve inch belt requiring a minimum of three ply and the forty inch belt, an eight ply as a maximum for ordinary use.

The ultimate strength of the average rubber belt is three hundred and sixty pounds per inch of width of each ply, with a safe working tension of twenty-five pounds per inch width of each ply of twenty-eight ounce duck, and thirty pounds per inch width of each ply of thirty-two ounce duck. This gives a factor of safety of twelve.

The diameter of drive pulleys in good practice is five times the number of belt plies with the diameter of all other pulleys taking approximately four times the number of plies.

Another factor that should bear some weight is the loading and discharge methods as well as idler pulleys. Upon loading, one factor to keep in mind is the angle that the material makes with the belt. Heavy materials should never be allowed to strike the belt vertically. They should be batted to at least a gentle drop onto the conveyor. Ideal conditions, also, call for loading to the center of the belt and in direction of belt travel and at as near the speed of the belt as possible, thereby eliminating wear of the belt due to slippage of the material.

Belt trippers are used for unloading at intermediate points. If material is to be discharged into bins or such, a tripper is not used, but the belt is allowed to make a 360° reversal around a pulley and discharge direct to bin.

Idler pulleys are placed in such a manner that there is very little sag to the belt under full load. The spacing of idlers is from three feet for material at one hundred pounds per cubic foot to five feet six inches for fifty pounds per cubic foot material.

Some of the abuses that will wear out the belt are sharp edged materials to be carried, rubbing of edges or cover against obstructions and skirt boards, or catching of pieces of material between the belt and the pulley.

One striking example of the use of continuous belt conveyors is that at the open-pit Spruce Mine, property of the Oliver Mining Company, located at Eveleth, Minnesota. When the open pit had reached a depth of one hundred and ninety feet, the company was faced with the problem of laying the track from the mine floor to the surface in such a manner that it doubled back on itself twice. (This was due to the pit's irregular shape.)

In other words the ore trains had to reverse their direction ("switchback") two times before they reached the surface. Two switchbacks are bad enough but it was plain that a third switchback would be required if operations were to be carried deeper. So engineering brains got to work and, in the end, a new method of transporting ore to the surface was adopted.

Today ore from the Spruce Mine not only flows uphill but moves in that direction for nearly six-sevenths of a mile. The net vertical lift of the ore is three hundred and eighty-six feet.

The flow is made possible by a conveyor consisting of nine separate belts, each feeding the belt beyond it. The conveyor carries the ore upward in a steady stream—and the cliff is not a slow one—the ore moves at a rate of five hundred feet a minute, pouring over the last drive pulley in quantities totaling several hundred and fifty long tons per hour. The end of this climbing stream is a five hundred-ton, fifty-foot high receiving pocket, from which the ore is drawn off into cars for rail shipment to the ship loading docks at Duluth and Two Harbors.

The receiving portion of the conveyor at the Spruce Mine is underneath the floor of the pit. Located in a tunnel at the bottom of the ore deposit, it will never have to be moved so long as there is ore to mine.

The conveying system is unique also because it is fed by two rotating tower excavators, the first to be used in iron mining. Each tower feeds ore through a vertical shaft or chute to the conveyor below. A third shaft receives ore from dump trucks filled by power shovels.

The belt system, in combination with the excavating towers, shovels and dump trucks, has resulted in more economical removal of ore from the Spruce pit. At the same time it means more complete removal of ore. When ore is moved from a mine by locomotives and cars, it is necessary to cut benches in the sides of the pit for the railroad track. The ore underneath these ledges cannot be removed. With the conveyor system there is no need for benches along the edges of the mine. All the ore finds its way to the "river" that moves uphill.

Shaking Conveyors

The shaking conveyor is very simple in operation. It is a series of iron troughs that are suspended on hanging chains or on rollers that allow the conveyor to roll back and forth. The chute is connected to an eccentric that is run by a motor. Thus there is a balanced accelerated and retarded reciprocating motion, and, in this way, the material is carried forward.

This type of conveyor is used for gathering or loading. It can be used for the transport of any granular or blocky material—outside, in factory, or in mine. It may be used to carry fuel to boiler house, or slate to the slate bank. It will carry mine props, ashes, hot clinkers, scrap metal, saw mill refuse, and lumber. During car shortage it can convey coal from tipple to temporary storage and later from storage into railroad cars.

Inside the mine it is used to load and gather coal from the working faces to central discharge points into mine cars or main line conveyors. In this way it displaces tracks, cars, mules and locomotives. It is used in all types of coal mining systems. It is not only usable on levels and downgrades but it is possible to convey upgrade to a maximum of eight degrees.

Its greatest advantage and applicability is in room-and-pillar mining. In this method of mining it is necessary to lengthen and shorten the conveyor. If the chain or belt conveyor is used it must be cut, and this takes time. With a shaking conveyor another trough is thrown into position, two
The wear on a shaking conveyor is negligible as there is nothing to wear out, and it can be man-handled and abused with no ill effects. When it works it moves in slumps and shuffles along at a speed dependent on the grade and violence of the reciprocation; consequently there is little dust, little degradation and remarkably little sound.

A good example of the successful use of shaking chutes, or conveyors, is at the Sublet Coal Mine in Wyoming. When a bed of coal pitches at twenty degrees or thereabouts, it offers a difficult mining problem. It is so steep that it is hard to work by rooms driven on the strike. The steepness also makes it difficult and dangerous to work with cars on the pitch because any contrivance, such as a single shaft, which causes the loaded cars to pull up the empties, is likely to dislodge the posts that hold it and cause frequent and dangerous runaways. Ropes break and brakes fail to hold. Consequently any such method is rarely favored even with slopes far less steep.

A slab-like coal, on a twenty-degree grade, such as at the Sublet Mine, will not run free without a number of men aiding the movement, and it may well happen that more have to be employed to push the coal than to mine it, for it is always uncertain where the material will choke and need dislodging. For this reason the Sublet Mine uses shaking conveyors.

In the Sublet Mine the coal is mined along a hundred foot face, pitching at a twenty-degree angle. The face conveyor is placed about five feet from the coal face, and about five rows of props at five-foot centers are placed or retained back of the conveyor, and as the face advances other props are set so that the conveyor is moved forward. Two rows of props lie between it and the face without interference with the shoveling of coal.

At its right or lower end, the face conveyor discharges to a second conveyor that retransports the coal to the entry. Delivery from one chute to the other is almost at right angles; yet this is accomplished without spillage. The coal travels rapidly down the second, or pitch conveyor, and at its end enters a curved section that makes a ninety degree turn to the mine car below in a direction parallel to the track.

By using this method of conveyance, the work of mining is greatly concentrated, making less development necessary, and decreasing the area to be ventilated, superintended by foremen, inspected by firebosses, sprinkled with water, or treated for dust.

While this type of conveyor has met there are some disadvantages. There is the difficulty, with the irregular hanging wall, of drilling holes in line and at proper intervals, and adjusting the chains so that the chute swings freely. Too, on slopes of less than eight to ten degrees the ore will not move forward efficiently.

Moving Pipe Line

There is the ordinary pipe line that can be run from point to point with as many turns as is desired, and so be made to carry liquids in any and all directions, but it cannot be made to carry solids. If, however, the pipe line is made of rubber so that it can be put in motion and caused to make any desired turns by passing around pulleys, it can be filled with solids and made to convey them in any direction. That is called a moving pipe line.

The moving rubber pipe line is split into two halves throughout its length so that it can be pulled apart at any point to receive or to discharge material. These halves fit together by means of double tongues and grooves which serve to prevent leakage of material from the interior of the tube. When the halves are together as to make a whole tube, the tube is twisted much in the manner of a rope so that the halves are compressed together, causing a tighter seal and preventing the tube from opening. Endless chains embedded in ribs of each half in the rubber extend throughout the length of the tube. The full load or tension of the system is carried on these chains, the rubber serving simply as a casing to hold the material. One of the halves is fitted with disc-like partitions, or flights, which serve to pick up a full load when passing through a feed hopper. These also form individual compartments which prevent slipping and packing of the material on vertical lifts.

Due to the fact that the material being conveyed is not rehandled in making changes of direction and that it moves with the conveyor in soft rubber compartments, rubbing and breaking is reduced to a minimum.

The special rubber used is resistant to abrasion, a number of acids, and can be used to transport material that metal conveyors cannot. By the use of synthetic rubber it can handle materials that are harmful to rubber and those that contain oil. The system is noiseless and free moving. The flexible rubber tube moves around pulleys with no more effort than a rope. The pulleys are built into standard frames which are easily attached to existing structures. Because of the balanced, low-weight system, equipped with anti-friction bearings and pressure lubrication throughout, the start-
rubber lined pump lasted one month. The moving pipe line was used successfully for their entire operating system.

The one big disadvantage is obvious, a limitation of the size of material that can be handled.

Trackless Haulage

Trackless haulage is just what the name implies—transportation of material in rubber-tired wagon, or cars, moving on the ground without the aid of tracks and operating under their own motive power. Both underground and surface haulage will be considered.

Shuttle Car

The Joy Manufacturing Company of Franklin, Pennsylvania, now manufactures what they call a shuttle car. It is a four-wheeled, rubber-tired wagon to carry ore, running directly on mine bottom without track and powered with its own motor and storage battery. The Joy description of No. 320-1 is a three and a half ton car for a low vein, with six-inch side boards and a removable back for loading in low seams. Over-all height is thirty-two inches, and the weight, with the battery, is ten thousand, eight hundred pounds. The light traveling speed is five miles per hour; loaded, three and a half miles per hour, with a turning radius of eighteen feet.

The use of the shuttle car not only eliminates track in the working places, but it greatly increases the effectiveness of the loading machines by expediting the car change on one hand and reducing the number of car changes on the other. An added feature is the ease with which the operation is carried on in the loading section, ninety per cent of the noise being eliminated by not having mine cars and locomotives running on a track.

The net result of this is a greatly increased output per production unit.

The Katherine Mine of the Katherine Coal Mining Company of Lumberport, West Virginia, uses five-ton shuttle cars. The cutter loads directly into these cars and they transfer the coal to an elevating conveyor which in turn delivers it into two and one-half ton mine cars on track in a haulage entry. The coal is discharged from the shuttle cars by means of a built-in flight conveyor.

The management states "By far the greatest advancement we have made, to date, is the removal of the hazards of handling track material and the accidents due to track haulage." Rubber-paved roads with track were used for moving equipment, but under our new method all entries, rooms, and crosscuts become available for both employees and equipment. This eliminates congestion, with the result that the time formerly lost in waiting at the switch for another machine to pass and the time lost in derailments is now utilized in loading coal.

After the coal is cut and shot down, it is loaded by crawler-mounted machines with a rated capacity of two to four tons, directly into shuttle cars. From the shuttle car the coal dumps directly onto an elevating conveyor that takes it to an upper haulage level and out, via conventional track cars and locomotives.

The shuttle car floor is in reality a conveying compartment, closed at the front end into which the loading machines deliver, but open at the back for discharge purposes. This flight conveyor bottom is used to discharge the coal from the shuttle car onto the elevating conveyor. The built-in conveyor of the cars is helpful in loading as the operator of the car can move the coal toward the rear of the car while the loading machine is filling the front. This, with the mobility of the shuttle car, enables the loading machine operator to deliver a continuous stream of coal until the car has been loaded to capacity. The cars have a water level capacity of four tons but can be loaded to carry five tons.

As soon as one car is loaded it leaves the loader and a second shuttle car moves in under the loader to be filled. This car change is made in less than a minute, which is an improvement over the management's experience in changing cars on track. Furthermore, using five-ton shuttle cars in place of two and one-half ton mine track cars reduces the number of car changes, with the result that the potential capacity of the loading machines is much more nearly realized with shuttle cars than could be realized by loading directly into mine cars.

Using shuttle cars, the production per face man is 22.4 tons per seven-hour shift as compared to 16.0 tons per seven-hour shift loading into mine cars.

It is only within recent years that operators of open pit mining have realized the advantages of trackless haulage in the manner of tractor-trailer trucks. Mining men are now using these trucks for hauling ore instead of the now old-fashioned steam locomotive and railroad track. By using trucks there is less time lost as well as more ease in operation. A higher per cent road grade can be attained, thus resulting in swifter haulage, time saved in moving cars, no laying of track, and no waste left pits for benches. This all leads to larger production as well as higher per cent of extraction.

Track Units

A good example of the use of trackless haulage in open pit, or surface, mining, is at the Tiger Mine of the Hume-Sinclair Coal Mining Company of Hume, Missouri. This open-pit mine, in 1932, started using six-ton truck units, and increased the use of such units of transportation until now they are using an eighty-ton semi-trailer pulled by a two-engined butane-electric tractor with two 125 horsepower electric driving motors.

After the first six-ton tractors and trailers went to work, hardly a year elapsed before ten-truck units were installed. In 1935 they initiated twenty-five ton units, and in February 1939, the eighty-ton units were installed.

The automotive haulage was adopted as it eliminated track and track shifting in the pit that was necessary with steam haulage, the difficulties and cost of which were increased by the thickness of seams and frequent loading at several points. The thinner the coal, the more territory had to be covered by the loading shovel in getting a day's tonnage, with a corresponding increase in track laying and shifting. Greater flexibility in transportation setup resulted in more continuous service to the loading shovel. Ability to reach isolated territories easily proved to be another advantage, as well as faster loading due to easier spotting of the automotive unit.

The good roads necessary with tractors and trailers greatly increased the efficiency of supervision by providing a convenient all-weather access to the pit. Another deciding factor was the ease with which men could be reached in case of injury.

Problems of Installation

Some of the more important problems that need attention in installing the new ore handling systems are density, size, and percent moisture contained. Of the four methods that were described in the previous pages we may omit the shuttle car, as well as the shaking conveyor, as they do not need the consideration of the above points.

Upon the design of a belt conveyor, the problem of density is important. The reason for this is that as the density per cubic foot increases, holding belt width and speed constant, there is a straight line function; but when density is held constant and speed constant and the belt width is increased, there is a sharp increase in tons per hour carried. It is obvious that the belt must have a low moisture per cent material to work efficiently, for if the material to be handled is a high per cent pulp, it will run over the sides.

The size material for belt conveyance must be within certain limits,
At the present rate of modernization of mines, the time will come when miners will take this mechanized equipment as part of their job. The transformation period is always the hardest.

Using this new mechanized equipment, it is possible to increase output without the exertion, in fact with a reduction in physical labor. To show some concrete figures on what can happen, the Katherine Mine of West Virginia will serve as an example.

Here they use shuttle cars, rubber-tired power drills, and mobile loading machines, one hundred per cent mechanized mine. This mine ran an experimental project in which the mine track car competed with the trackless shuttle car. The time study showed a decrease from ninety-two minutes to sixty-eight minutes in car changing and from one hundred sixty-seven and a half minutes to seventy-four minutes for total delays. Also one hundred mine cars could be loaded by the loading machine compared to one hundred and twenty-one mine cars filled from shuttle cars, using mine and shuttle cars as the intermediate gatherers. The loaders obtained greater efficiency when loading into shuttle cars as it takes one hundred eighty-five and one half minutes out of four hundred and twenty minutes for mine cars as to three hundred twenty-one and one half minutes with shuttle cars. This is a mean productivity increase of forty per cent by using shuttle cars. It is now at a point that one hundred and ninety to two hundred cars are loaded per seven-hour shift from shuttle cars as compared to ninety to one hundred mine cars. It must be kept in mind that the shuttle cars and mine cars under time study were used as gatherers to a loading point, the material then being conveyed by mine cars to the surface.

Now that the output is becoming greater, causing a larger supply, it is necessary to create a new and larger market or demand. The coal field is not the only field to which the new equipment is adaptable. It can be used and is being used in metallic and non-metallic mining. This equipment will enable coal mining companies in higher freight zones to compete with those of lower zones. Some of the coal fields of Wyoming can now be worked possibly to compete with some of the coal mines in and about Denver. Also, now that the United States government is prospecting our strategic minerals, which are all low grade, they could be mined at possibly a profit by incorporating mechanized handling equipment. Then there is always expected with the advancement of mechanization are these: Will the decrease in man-labor seriously affect the unemployment problem? Will the increase in output be equalized by a corresponding increase in demand, or will over-production result and an eventual stagnant market? Does the added cost of the machinery balance with the increase in production, or will the cost of production be insufficient to warrant this new equipment?

These are all problems and questions that are being met daily in the mining world—some are solved and some are not. The mine of today is a far-cry from the old, slow, tedious, hand-labor mine of yesterday. One's imagination alone can picture the mine of tomorrow.

Bibliography

Pamphlets and Catalogues


"Belt Conveyors," Jeffrey Catalogue No. 610A.


Magazine Articles


"The Katherine Mine of the Katherine Coal Mining Company," Mechanization, June 1939.

"Truck Transport Serves Tri-State Mining," by W. F. Netzband, Engineering and Mining Journal, January 1940.

"Eighty-Ton Semi-Trailer," by Ivan A. Given, Coal Age, August 1935.

"The Military, or Number Two Mine of the Hart Coal Company, Inc.," Mechanization, July 1939.

Bulletins


A VISIT TO KRUGER NATIONAL PARK

By

HARRY F. MCFARLAND, '32
Shawnee, Wyoming

[Recently returned from West Rand Consolidated Mines, Ltd., West Rand, Tvl., South Africa]

It was on our sixth drive to the hippo pool in Kruger National Park that we saw our first giraffe. We had seen other animals near Pretorius Kop, the rest camp where we were staying, but giraffes had eluded us. We were cruising along as slowly as the two-cylinder German made car would permit, my wife scanning the left side of the road, I the right. From time to time she adjusted the aperture of our cine camera to the changing light conditions so that, should a giraffe amble across our path, we should not miss getting a photograph.

"Stop!" Mildred cried. "There's one."

I set the brake of the car, holding down the catch to prevent it clicking as I had learned this noise was often the ultimate strange sound that put animals to flight.

A movement caught my eye.

"Two of them," I whispered. "Give me the camera." On my side of the road, fifty feet away, stood a second giraffe. "The light is right for this one. When they go together, we'll get both."

I raised myself in the car to get a clearer view; the grass was high by the roadside. The two giraffes decided to move farther away. The camera whirred again.

"That is enough pictures," I said. "It will be a surprise to people at home to see how beautiful and graceful giraffes appear in their natural surroundings, won't it?"

"Yes," Mildred said, "they look like long-stemmed flowers moving along in the grass, or like foliage shimmering in shade and shadow. I don't mind so much if we never see a lion, now that we have seen giraffes."

We sat and watched them until they were lost among the trees. We then continued on our way, wondering what new sight the next turn in the road would reveal.

Except for reference to car and camera, one might think he was reading of early explorer's trips into dark and unknown Africa. Except for the good roads and rest camps with high fences around them to keep wild animals out, one is in dark and unexplored Africa. Here in Kruger National Park has been preserved in its natural state a piece of the Africa that was before the arrival of the white man.

Kruger National Park is three hundred and fifty miles northeast of Johannesburg. One can start from this city in the morning while its twelve story modern buildings are casting their shadows over crowding mine dumps and in the evening be in one of the comfortable rest camps in the game reserve.

The park is forty miles wide by 200 miles long. It was established by Paul Kruger in 1898 while he was president of the Transvaal Republic. The game reserve is not fenced. Boundaries are marked by survey beacons and a clearing several hundred feet wide. Ranger patrols in all parts prevent poaching. The animals seem to know the boundaries of the park. I was told that when a herd of zebra, deer, or wildebeeste strayed out and were the target of hunters' guns, they immediately beat a retreat toward the park. Once they had gained this sanctuary, they turned and regarded the hunters with what almost appeared to be laughter.

Within the park are eight rest camps, and last year they accommodated 220,000 visitors, many from the States. The rest camps consist of cabins, called rondavals from the native name for huts, made of mud and thatched with grass; a store, and tea room, where visitors who do not want to be bothered with cooking may eat. The cabins rent for three shillings six pence (about 70c) per person per
night and include the services of a colored boy who cooks, washes the dishes, and cares for the cabin.

When outside the camps, visitors are forbidden to turn off the road or to leave their cars. It is unsafe to step out of your car for in the tall grass it is impossible to know what animal may be lurking three feet from the road. Also, animals are more frightened of persons than of cars. They have come to regard cars as harmless contraptions, noisy and evil smelling, and not good to eat. People are still their natural enemies and, in some species no doubt, an appetite for two-legged game has been cultivated.

One evening the manager of the camp was visiting with us. Several times he had to stop talking until the noise of lions roaring about the camp quieted down.

"Those lions sound as if they were just outside the fence," I observed.
"Do they ever make you a visit?"

"I've been here nine years, and only once have we had them inside camp. There was a bit of excitement in camp that day, you may be sure."

"How did it happen?"

"We never knew how they came to get inside the fence. Suppose they were curious or maybe they thought they could get at the horses in the stable. Anyway, one morning, when the Kaffir police boy came to open the gate, he saw the lion over in the corner back of those huts.

"Baa, lion in camp," he called, his eyes popping out of his head like white marbles and his face grey with fright. I didn't have a gun. I ran and woke the Colonel, who is a good shot. Colonel Hamilton has been here since the camp was opened. Nothing could excite him. He grabbed his rifle and ran back of those houses. Sure enough, there was the lion, pacing up and down the fence, trying to find his way out. Evidently he had spent the night there and was nervous at all the queer sights and sounds. When the Colonel arrived, the lion growled and flicked his tail. He leaped against the fence, trying to burst through. The fence was strong. He couldn't break through. He walked behind the bushes, then loped back and banged into the fence. The Colonel sighted. Whang! The lion screamed and rolled over dead. But the excitement was just beginning.

"The Kaffir screamed, 'lion, baas, lion!' We had all been so excited at seeing a lion in camp that it never occurred to us that his mate might be with him. Just then a lioness jumped not be with us today. As it happened, when he wheeled at the sound of the roar behind him, either a reflex action caused him to sight and pull the trigger or else he was a man of iron nerve. He pulled the trigger. The lioness rolled over dead. The Colonel never bragged or offered any explanation. He didn't need to. He walked over to the bench and sat down. We had had enough excitement for one day."

We have quite often met natives walking or riding bicycles along the roads in the park and I wondered how it came that they were not molested by animals.

"Why is it that lions do not attack natives on foot or on bicycles?" I asked the manager.

"Familiarity breeds contempt. They are seldom bothered. When they see a lion, they stop. If they stand motionless the lions will leave. It is fatal, however, if they turn and run. The lion will immediately attack them. The same instinct as a cat chasing a ball of yarn or playing with a mouse."

"That reminds me of an incident that happened at Skukuza camp; Skukuza is thirty miles or so over the hill. It was Christmas day. The natives were celebrating. They brew beer from the fruit of the Maroela tree, and it certainly has a kick. This Christmas they had made and drank gallons of this Kaffir beer. That night Old Sakabona started home. He was in high spirits. Walking along the road in the moonlight, he came upon a big black-maned lion lying across the road in front of him. He walked up to the lion. The lion regarded him..."
calmly, but made no offer to move off the road.

“Sakabona addressed the lion:

‘Look here, Mr. Lion. Most times you are the King, the GREAT King. Everybody gets out o’ your way. We Kaffirs gets out o’ your way and leaves you alone. But today is Christmas. Today is my day. I am an old timer in this park, Mr. Lion. I was here befo’ you was born. Today you get out of my way.’

“The lion was unimpressed by this soliloquy. He continued to lie peacefully in the road.

‘So, Mr. Lion. You just lays there and blinks at me. I’ll show you.’

“Sakabona raised his foot and gave the lion a smart kick in the face with his bare foot.

“It makes a lion very cross to be kicked in the face. He grabbed Old Sakabona above the calf of his leg and made off with him through the shoulder-high grass, with Sakabona screaming at the top of his voice.

“Fortunately, the lion was dull, having just eaten, and when some other revelers returning home, approached the spot with hurricane lanterns, the lion dropped Sakabona and vanished. They took Sakabona to the native hospital. He was unconscious several hours. Along about morning he suddenly sat bolt upright in bed and, to the consternation of the nurse, waved his arms and shouted, ‘The Lion is King! Christmas or any other day!’

“Did he die?”

“Oh, my no. He’s gate keeper over at Skukuza now. He limps slightly and he has a livid scar covering his leg from the calf up to the thigh.

“I asked him one day what he thought when the lion was dragging him through the grass.

‘Baas,’ he said, ‘I thought Jehovah was very far away.’

Our visit to the Park was in midsummer since my vacation from the mines came in February. This is an off-season, a large part of the park is closed, and there are few visitors as the major tourist season is in the winter months from March to October. But in the summer the game stays nearer the roads; we had enough rain to settle the dust, and the country was beautifully green and fresh. Also, the animals had their young with them, and young of any species are always amusing and interesting.

The gates of the rest camp were open at sunrise and in the early mornings we got into our car waiting by the side of the cabin under a flowering tree and cruised around the park watching baby zebra and wildebeeste capering and kicking up their heels. During the heat of the day we rested in our cabins, read, and wrote letters. In the afternoon we continued our drives around the park until sunset. We saw schools of monkeys, baboons, lion, leopards, hyenas, giraffe, buffalo, wildebeeste, antelope, hippopotami, and warthog, not to mention numberless varieties of brilliantly colored tropical birds, turtles, and snakes. The elephants live at the extreme end of the park, so we did not see them. Although it is common to see prides of fifteen or more lions strolling along the roads or resting in the shade of trees, we saw only one lion, and that one we saw on the last morning of our stay in the park.

It was early in the morning. The sun had just come up. He stood thirty feet from the road, quietly watching us. The sun lit his tawny yellow coat. He was as large as an ox, a short-legged ox, with great shoulders, massive head, and bushy black-tipped mane. After watching us a few minutes, he turned and strolled away and was lost in the grass.

Turning to Mildred, I said: “We have at least seen one lion.”

“Yes, and it was a man-sized one.”

We drove slowly back to camp enveloped in a feeling of complete satisfaction. Even without the lion, our trip to the park had been highly successful. But as a final memory, the picture of the lion, standing in the ripe yellow veld grass, made our trip complete. We had visited the wilds of Africa and all the animals, even to Leo, the king of beasts, had been politely at home.
By

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Why did the Massachusetts Institute of Technology and the University of Denver build a laboratory on top of Mt. Evans? Was it merely to have an emblem at a higher altitude than the famous "M," or to have one building so high it could not be dynamited by airplane? What kind of men work up there and what do they do? Are they just a little peculiar? Is this cosmic ray investigation an excuse for a cool summer vacation? How simple is it to construct a suitable two room laboratory on Mt. Evans? If you read far enough some of these questions may be answered.

The laboratory was placed on Mt. Evans to furnish shelter for scientists who are investigating cosmic-ray phenomena. A few words regarding cosmic rays will be necessary before it comes apparent why the particular site was selected. Cosmic rays are electrically charged particles traveling with approximately the speed of light. Most of these are electrons, positive and negative, the same particles which are given off by the cathode of our radio tube and stream across to the plate to bring us the news from Europe or recent scientific facts about dated coffee, the same particles which go through the filaments of our light bulbs give us light or the particles which bombard the target of an x-ray tube to produce x-rays. However, note the comparison of energy:

110 volts are used to send an electron through the filaments of our light bulb, 100 to 300 volts to speed the electron across the vacuum tube, in some cases several million volts impart energy to the electrons which produce x-rays while cosmic rays have an energy equivalent to several billion electron volts. Energy is the criterion which differentiates between these rays. However, there are two general types of cosmic rays, the large soft component made up of electrons and the small penetrating component made up of mesotrons. These latter particles are really energetic. While 20 cms. of lead will stop most cosmic ray electrons, the mesotrons are found at the bottom of our deepest lakes and in our deepest caves. This mesotron has a charge of electricity equal to that of the electron but its mass is approximately 130 times that of the electron.\(^\text{1}\)\(^\text{2}\) loses mass, and becomes an ordinary stable electron. The cosmic-ray electrons produce two effects as they pass through our atmosphere or other material: 1st, as in the case of an x-ray tube, matter struck by these rays gives off very penetrating x-rays or y-rays; 2nd, when they pass through matter showers of electrical particles are seen to emerge from this material. Sometimes several hundred electrical particles are ejected when a single cosmic-ray electron enters a lead plate.

Up to the present, man has not been able to devise projectile guns which will produce electrons with as great energy as is possessed by the cosmic ray electrons. Since bombarding matter with cosmic-ray electrons produces some physical effects not produced in any other manner, scientists are curious about the source, nature and the interaction between these rays and matter. Here is greater energy than ever known before. It produces unique effects. Scientific and industrial progress have advanced as more energy is made available. Thus, the domain of the cosmic ray becomes the happy hunting ground of the scientist interested in original investigations. In fact 3 of the 4 Nobel Prize Winners in Physics in the United States are working in the field of cosmic rays, while the 4th is making an apparatus to produce them.

The number of cosmic rays reaching the top of Mt. Evans is five times the number reaching sea level and twice the number arriving in Golden. The number of cosmic-ray showers increases with elevation faster than...
cosmic rays. The number of certain types of showers increases by a factor of 15 in going from sea level to Mt. Evans. Hence, one can accumulate data from 5 to 15 times as fast on top of Mt. Evans as at sea level. Furthermore, since the Mt. Evans cosmic rays have invaded a smaller portion of the earth's atmosphere than their sea-level relatives, the former will be more nearly representative of the cosmic rays invading our planet. Of course the high balloon flights in which self recording instruments or instruments which report their finding by airplane can secure much more data in a short period of time. The data collected on these flights is that due to large scale effects because the duration of the flight is very short and it is impossible to control many variables. The laboratory on Mt. Evans is for the man who wishes to make accurate observations for a period of several months. Typical problems which may be investigated at Mt. Evans are: The variation of cosmic ray intensity with time, with meteorological conditions, with sunspot activity. Experimental Work Investigations at the laboratory have been carried on by the Bartol Research Foundation, Harvard University, McGill University, The University of Chicago, Duke University, The University of Wisconsin and the U. S. Weather Bureau as well as the two institutions sponsoring the project. This summer Dr. Bruno Rossi with
Cosmic Rays, Oil Wells and Medicine

It seems a long way from the top of Mt. Evans to the bottom of an oil well but there is a connection. The by-products of any research is often as important as the direct results. To investigate cosmic phenomena, meters and giving off cosmic-ray showers. Similar controls were left at Madison. He reports that the fruit flies left at Madison showed no effect due to the radiation of the cosmic-ray showers while those at Mt. Evans which received from 10 to 15 times as much radiation showed a decided increase in the rate of several mutations. There was a change in the color of the eyes, the position of the wings and the average life. All these characteristics were transmitted and new strains were developed. The usual time of radiation was 28 days. Illness prevented his return on one occasion in which case they were irradiated for 40 days. Most of them were dead, the others were able to reproduce but their offspring was completely sterile. A whole division was wiped by cosmic-ray explosions. Maybe it isn't safe for a college professor to stay too long on the mountain or maybe more of them should work there. Dr. Jollos thinks that some of the intrinsic factors of individual variations in the human can be attributed to cosmic radiation.

Explosions

We mentioned earlier that the mesotron explodes. The study of the interaction between matter and energy where cosmic rays and other high energy particles have been used as a source of energy indicates that a high energy particle might be used to start an explosion. Imagine a miner standing back with a neutron gun firing at a uranium atom to start an explosion rather than pushing a plunger. (A neutron has the mass of the nucleus of hydrogen but carries no electrical charge.) That is what is being done by nuclear physicists today. Hahn shoots a neutron at uranium 235. The nucleus splits and two elements such as tin and molybdenum are formed. These have an excess of neutrons and throw them off hitting other uranium 235 atoms and the reaction goes on. The energy released by each uranium atom is more than a million times the energy of the neutron projectile.

There is evidence, for the first time, that the energy locked within the nucleus may soon be available to man. Such energy may be released in the form of a violent explosion. The amount of uranium 235 in the world is small and it is difficult to isolate. However, other atoms may be split by this process and again pure and engineering science are interested in a common problem.

(The "Danger High Voltage" sign on the door, when translated, means "Welcome" to men from the School of Mines.)
THE EFFECTS OF REAGENTS ON DRILLING MUDS

By
HERBERT D. THORNTON, '40 and HERBERT E. TREICHLER, '40
Golden, Colorado

The importance of drilling muds in oil field technology is just being realized. With wells being drilled deeper and deeper every year the necessity for controlling the physical properties of muds, and the ability to do so, has become a major problem. To help control these factors, extensive research on the properties and effect of reagents on muds are being made. It is the purpose of this paper to review some of the work which has been done and to present the results of the research, that H. D. Thornton and H. E. Treichler have done.

An ideal or good mud should perform several different functions, these being:

(a) It must return the cuttings to the surface in an efficient manner.
(b) It must seal the walls of the well bore, prevent caving and prevent the loss of mud thru cavities in porous formations.
(c) It must lubricate the hole, reduce the friction on the drill pipe, and cool the bit.
(d) It must overcome high gas and water pressures if encountered.
(e) The viscosity must be kept low enough for the mud to be handled easily by the pump.

With all these many and varied functions to perform, it is often necessary to alter the properties of muds by chemical and physical admixtures. Some of the properties which are varied are viscosity, weight, and gel strength.

General Properties

To better understand the properties of drilling muds, it is necessary to know the structure, chemical composition, and behavior of muds. First it must be realized that muds are not true fluids, and hence, do not conform to the common laws or theories of fluid flow. Drilling muds are in reality complex fluid mixtures and as such differ from true fluids in many of their characteristics.

Most drilling muds are made from mixtures of hydrated aluminosilicates of extremely fine and variable particle size. The individual colloidal clay particles are flat and platey with enormous ratios of length to thickness. Also included with clays in muds are various quantities of dissociable metals, inert substances, and some organic matter.

The viscosities of clay suspensions in water are always greater than the viscosity of water alone. This increased viscosity of the suspension is very likely due to the interference with the normal flow of water caused by the particles in suspension. Unlike the viscosity of true fluids, the viscosity of drilling muds is dependent on the dimensions of the apparatus and the rate of flow. The definition of viscosity for a true fluid is that viscosity is a constant equal to the shearing stress divided by the rate of shear. When this definition is applied to drilling muds the quantity is not a constant, but a variable depending on the rate of shear and the past history of the suspension. Therefore, it is evident that a mud reported as having a viscosity of so many centipoises means nothing unless accompanied by a detailed description of the exact conditions of measurement.

Most authorities agree, that the term viscosity is misleading and that the word yield point or yield value is much more accurate. The yield point is found by plotting the velocity of mud against the pressure applied to the mud to produce the velocity measured. It is the shearing stress necessary to produce flow. The yield point is taken as the intersection of the straight line portion of the curve with the pressure axis. The slope of this curve gives the mobility of the mud which is akin to the fluidity of an ordinary liquid. For most determinations with complex mixtures, the velocity vs. pressure curve is a straight line, except for very small pressures near the yield point of the mud where it becomes a curve. Abraham has explained flow at values below the theoretical yield point (intersection of straight line with pressure axis) by suggesting that at low shear rates a plug or lubricated flow occurs.

Drilling muds exhibit three distinct types of flow: first, there is plug flow and at this stage the mud moves forward as a plug separated from the wall of the pipe by a thin film of water. When greater pressure is applied, the outermost layers of mud shear into telescoping cylinders, the central plug remaining intact, and finally all the mud moves forward in a manner similar to viscous flow. With still greater pressures and higher velocities the flow becomes turbulent.

The type of flow in the drill pipe and hole is another matter. The general conclusion is that the flow in the drill pipe, excluding tool-joints, is likely to be fairly near the stage at which the movement changes from the viscous to the turbulent type of flow; with slow circulation the flow will be plastic but with normal or rapid circulation, it is likely, for the average mud, to be turbulent. The flow in the annular space between the drill pipe and the wall of the hole is generally viscous, unless the mud is very thin or the circulation very rapid.

The thixotropy or gelation of drilling muds is a relatively new field of research, and the terms are not standardized. In general, thixotropy or gelation, refers to the property whereby certain muds will gradually set to a jelly-like mass but will return to a mobile fluid if agitated. This gelling, or the producing of a rigid gel structure is of great importance. Almost all suspensions display this property to a greater or lesser degree, depending on the amount of colloids present. In drilling muds it is a very desirable characteristic if properly controlled. The explanation of this phenomenon has not been fully agreed upon, but most authorities advance one of three theories, these theories being; solvated-hull or hydration theory, mechanical theory, and the attraction-repulsion theory.

The last, but not the least, important property of drilling muds, is weight. The weight of drilling muds is a direct proportion to the concentration of the clay in the water. The weight of a mud is a controlling factor when attempting to overcome high gas pressures in the hole.

The Effect of Colloids and Reagents on the Properties of Muds

The two most important factors affecting the control of drilling muds are colloidal content and reagents.
Colloids are the particles which are so small that when they are dispersed in water the resulting mixture closely approaches a true solution. It is arbitrarily considered that particles with diameters between 0.001 μ (1 μ = 0.001 mm) and 1 μ are colloids, although there is no sharp distinction at these extremes. In drilling muds colloids perform several necessary functions. A good colloidal mixture will display thixotropy to a marked degree and will also supply material for plastering the walls of the hole. The greater the colloidal content the quicker will be the formation of plaster on the wall of the hole and the thinner will be the mud sheath necessary to stop infiltration of water into the well bore. This thinness of wall plaster is important because it gives more room for circulation of mud and has a lesser chance of being broken off by the drill pipe.

The percentage of colloidal matter in a drilling fluid must be carefully controlled. If it is too high it will not allow cuttings to settle out of the mud; and it will increase the viscosity of the mud to a point where the pumps will have difficulty in handling it. About five per cent is probably the most satisfactory amount under average conditions.

Chemically treated muds display wholly different characteristics from untreated muds. This change is due to the action of the reagents added upon the colloidal particles.

Reagents tend to cause flocculation or deflocculation or colloidal particles, resulting in a change in the viscosity.
Application to Chilled Iron Car Wheels

By

C. C. DRAKE
Superintendent
Griffin Wheel Company
Denver, Colorado

There are approximately 16,000,000 wheels in railway service under about two million freight cars and engine tenders, carrying well over 80% of all freight tonnage in the United States on chilled iron wheels. In addition to this, there is an immense tonnage of chilled iron wheels and castings in industrial use.

Constant increases in loads, speeds and distances traveled per year have made it necessary for the chilled wheel industry to continually improve its processes in order to keep up with the ever-growing demands for greater wear, strength and heat resistance properties. Loads carried by these wheels have increased 300 to 400 percent, and average speeds have practically doubled in long-haul service since 1912. In industrial wheels, the trend toward expensive bearings to save friction losses has made evident the economic necessity of making and applying only wheels that have the strength and wearing qualities to justify this considerable increase in initial cost of equipment.

High quality cast iron is produced in an ordinary foundry cupola furnace by a carefully controlled technique developed through many years of experience and much research; especially the latter during recent years.

The metal is melted within a very narrow range of chemical composition and temperature. It is poured in special flask equipment in which the body, that is, the hub and plates of the wheel, is solidified in contact with sand, while the tread and wearing portion of the flange are solidified in a cast iron ring called a chiller. These chillers are machined to exact circumference and contour and, while they are used but once a day, they form and "chill" several hundred wheels each on the average. They are about 9/16" larger in diameter than the standard 33" diameter of a railroad car wheel. The "shrinkage" (1/64" to 1") of the metal, of course, accounts for the difference between chiller diameter and wheel diameter.

The standard weights of chilled iron wheels are 650, 700, 750 and 850 pounds for 30, 40, 50 and 70 ton freight cars, respectively.

The chilled wheels are taken out of the molds in from 35 to 45 minutes after the metal is poured and are placed immediately in insulated receptacles for necessary annealing. These are called annealing pits. After a minimum of three days in the annealing pits they are removed, permitted to cool to room temperature, and then sand blasted, inspected, tested, and are finally ready for shipment to railroad shops or to be pressed on axles in our own machine shops.

The only machining necessary on these wheels is the boring of the hubs for pressing on to the steel axle. In this boring operation the wheels are usually bored .006" to .009" smaller than wheel seat on axle and the wheels are pressed on the axle seats by a hydraulic press at from 40 to 75 tons, depending upon the size of axle and weight of wheel.

The wheels as cast in the chillers are not shipped if more than .031" out of round.

The test wheels from each heat, selected according to indications given by careful and extensive records taken of all melting, treating, pouring, shaking out and annealing processes, are subjected to two different types of destructive tests. These are an impact test, in which a 250 pound weight is dropped from varying heights with varying numbers of blows, according to weight of wheel tested, and the other is called a thermal test, and is made to simulate the stresses developed by heating the tread under excessive brake application. In the

Address delivered before Colorado Engineering Council May 28th, 1940.

[Fig. 1. Chill without Tellurium Treatment.]
The abrasion between a chilled iron flange and a steel rail is much less than that of a steel flange against a steel rail, and this means appreciable reduction in both train resistance and wear of rail and flange. These are items of great economic importance.

During the past ten years vast improvements have been made in physical properties of cast iron in general and the chilled iron wheel industry has carried on extensive research in its own and other laboratories, resulting in important improvements in strength and wearing values, as well as manufacturing methods. Some of these latter may be of interest to you.

The principal manufacturing improvements developed in recent years are as follows:

1. Better melting control thru cupola gas analysis, automatic air volume control, desulphurizing, standardization of chill test blocks, development of blast pre-heating, more uniform charging and determination and development of optimum melting and pouring temperatures.

2. A much improved method of controlling chill depth has recently been developed, and is now being extended to all plants in the industry. This will insure an adequate depth of chill in all wheels with very little likelihood of having excessive chill depth in any wheels. The matter of definitely controlling chill on all wheels within our narrow limitations.

3. Better strength control thru standardization of handling and annealing the wheels from time of pouring till they are cooled to atmospheric temperatures.

There have been many additional improvements in recent years, such as foundry sand control, mechanical moulding, mechanical charging, and Association inspection of the product, independent of individual plant control. However, a few of the most important improvements are all we will have time to discuss here in any considerable detail.

In operating a foundry cupola furnace, the percentage of CO₂ above the melting zone is a direct indication of the type, or stage, of combustion prevailing. By sampling these gases of combustion and passing them thru a gas analyzer or carbon dioxide determinator, the operator can make changes in the volume of blast going into the furnace as the CO₂ gets above or below the range of twelve to fourteen percent, in which, experience has shown the best results are obtained in a hot blast cupola furnace. A gas analyzer records the percentage of CO₂ every two minutes on a chart, and when an automatic volume control is used in connection with the gas analyzer, the volume of air is automatically increased or decreased as may be required.

If the CO₂ percentage is shown to be under twelve percent it is an indication that there is an undersupply of oxygen for the amount of coke being used. Our coke charges are calculated to be sufficient to supply the heat necessary for melting a given charge of metal at the required temperature and with sufficient surplus coke to prevent over-oxidation of the essential elements—silicon and manganese. These elements must be held in a very narrow range because of their balancing effect on graphitization. In case the CO₂ analysis is recorded above fourteen percent in a hot blast cupola, the operator would normally reduce the volume of air, as it would indicate too high a stage of combustion and a consequent probability of excess oxidation of essential elements. The test pieces would soon confirm the oxidation indicated by the gas analyzer by showing high chill depth and sparse, open mottle of graphite behind the chill.

In a hot blast cupola, the gases are withdrawn by a water injector from the upper gas outlets and passed thru filters to remove soot and fume. The gas is then passed thru a CO₂ gas analyzer such as the Hayes Automatic CO₂ Analyzer and the CO₂...
percentage is recorded on a circular chart.

To obviate the necessity of manual control of the blast, depending on the presence and alertness of the operator, there has been developed by the Chilled Car Wheel Association’s research engineer, Mr. F. K. Vial, an automatic CO₂ compensator for cupola control. A paper by Mr. Vial descriptive of this device was awarded first prize in an instrumentation contest sponsored by the Industrial Instruments Section of Scientific Apparatus Makers of America in 1938.

The mechanism electrically interlocks the carbon dioxide recorder with an air volume controller and automatically regulates the stage of combustion by increasing or decreasing the air volume according to the decrease or increase of CO₂ in the stack gases.

The stage or type of combustion mentioned as optimum for hot blast cupola furnace operation may be questioned as being too low for efficiency. However, when the factor of excess oxidation of silicon and manganese is considered, as compared with the cost of excess coke consumption in this stage of combustion, it will be found that the twelve to fourteen percent CO₂ analysis is most economical.

More important than this, however, in melting car wheel iron, is the necessity of uniformity in composition and structure. The comparatively strong oxidizing effect of high CO₂ percentages going with the greater efficiency of combustion means heavy and erratic losses of essential elements, including iron, whereas carbon monoxide is a powerful reducing gas.

The installation of this gas analyzer, together with an air volume or air weight control reduces erratic results from over or under oxidized elements in eliminating much of the human element regarding combustion conditions in the furnace. The principle, of course, is not new, but the application to cupola furnace control is a comparatively recent development. However, gas analyzers have not yet been adopted as a standard piece of equipment throughout the industry because of the very excellent and uniform results obtained by many experienced cupola operators.

Another improvement, The Griffin Hot Blast Air Preheater, takes advantage of the carbon monoxide content in the stack gases. This was the first practical application to cupola furnaces of well-known and long used recuperative or regenerative methods of pre-heating the air blast by utilizing the products of incomplete combustion remaining in the stack gases at the charging doors.

The stack gases are drawn thru the charging doors by suction induced by an exhaust fan. The combustion of the carbon monoxide is completed in a large refractory-lined chamber by introduction of a small volume of air, bled from the cold blast supply. The temperature developed in this refractory-lined combustion chamber is from 1600-1800 degrees Fahrenheit.

In the more generally used recuperative type blast heater, these gases are passed thru one or more banks of heavy cast iron tubes and then exhausted to the atmosphere. Meanwhile, the cold blast, instead of entering the cupola direct from its source, is baffled around the pre-heated cast iron tubes and enters the wind box at temperatures ranging from 400 degrees Fahrenheit up to twice that temperature, depending on the type of installation and operating requirements. There is very little maintenance expense to these pre-heaters.

Some of the advantages of using preheated blast in the cupola furnace are as follows:

A saving of 25 to 30 percent, or more, in coke consumption; higher temperatures in the melting zone and increased fluidity of the iron if desired for pouring thin sections; higher melting rate per hour; greater uniformity of operation and therefore better control; less limestone and, of course, less air required for the reduced coke ratio. These advantages result also in lower power and labor costs.

Another timely means of improving the composition and structure of car wheel iron was brought about by developing a chemical reaction to reduce sulphur analysis. Some years ago the ever increasing sulphur content in remelting old wheels and other cast iron scrap was a matter of growing concern. The use of sodium carbonate or fused soda ash was introduced by the chilled car wheel industry and, of course, solved the problem of controlling sulphur content, as well as finding a much wider field of usefulness in the iron and steel industries.

Car wheel service requires that the chill or massive cementite beneath the tread surface be of sufficient depth to insure maximum wear or mileage before the chilled metal is worn away, and also that the chill is not deep enough to weaken the flange or rim to a point where breakage is likely to occur. In the past this control of chill has been accomplished by additions of silicon or chromium, as may be required, to the pouring ladles. The reaction of these elements, while definitely softening or hardening the metal beneath the chilling surface, was to produce a chilled area containing a rather wide distribution of small graphitic specks in the white iron and a dispersion of iron carbides in the gray iron. This condition created a very narrow margin between a wheel that had too little chill and one that had too much. The new technique employs the simultaneous use of graphite and tellurium in correct proportion and balance into each ladle before the metal is poured.

This new method of chill control will assure us of definite depth of clear chill metal on the tread surface, and a softer, stronger metal to support the flange. Figures 1 and 2 show the type of chill produced under the old and new methods.

The improvements so far discussed have been in melting and composition control. Better determination and standardization of pouring temperatures have had an important part in improving the control of chill, both as to strength and wearing properties.

(Continued on page 516)
CONTOURS ON TOP OF HERRINGTON 100 FOOT INTERVALS.
General Electric Hook-On Volt-Ammeter Announced

A versatile, portable instrument, the Type AK-I hook-on volt-ammeter, for measuring alternating current and voltage, has been introduced by the General Electric Company. With it, alternating current can be read instantaneously on both insulated and noninsulated conductors simply by hooking the instrument around the line. For voltage readings, it is necessary only to connect two leads furnished with the instrument and then flip the thumb-manipulated selector switch to the desired voltage position on the scale.

Designed for use on conductors of 2-inch maximum diameter, the new volt-ammeter is small enough to get into tight places, light enough to be hung from a lineman's belt, and sufficiently accurate for a great variety of measuring jobs. Weighing only 3½ pounds, it is designed for easy, one-hand operation. Four current ranges, 0-15/60/150/600 amperes, and two voltage ranges, 0-450/600 volts are available at the setting of a convenient six-position snap switch. Its accuracy is within 3 per cent.

An integral part of the instrument is a C-shaped, split-core current transformer so designed that it can be operated without a trigger. To make measurements, the transformer is simply pulled open and placed against the conductor. A slight push on the handle snaps the transformer shut. The measurement completed, a gentle pull springs open the dovetail joint of the transformer and releases the conductor. The dovetail joint assures that particles of dirt, which would cause large errors in the ordinary butt joint, have almost negligible effects on the indication.

The New Eastern Model E Centrifugal Pump

The Eastern Engineering Company, 45 Fox St., New Haven, Conn., is pleased to announce another new addition to its line of Midget Centrifugal Pumps. We submit below, for your consideration, a brief summary of the outstanding features of our latest development. Model E is an entirely new design throughout. It has not been advertised or publicized in any way heretofore.

EQUIPMENT NEWS


2. Main Features:
   a. Model E is engineered to yield maximum volume and pressures for the space it occupies.
   b. It is sturdily constructed for long hour service.

3. Uses:
   Due to its light weight and small size, Model E is particularly adaptable to all installations requiring the pumping of thin liquids where weight and space involved must be kept at a minimum.

4. Performance:
   Maximum Pressure—20-25 pounds per square inch.
   Maximum Volume—8 gallons per minute.

5. General Description:
   Size: 7½" long, 3½" high, 3½" wide.
   Weight: 6 pounds.
   Motor: Universal Heavy Duty Fan Cooled, 1/20 H.P., 115 Volts, AC or DC.
   Type: Centrifugal—Total Internal Volume, 12 CC.
   Stuffing Box: Adjustable by means of hand operated adjustment wheel.
   Close Coupled: Motor Armature and Pump Impeller are mounted on a single shaft, making coupling unnecessary and assuring perfect alignment.

1500 Foot Power Beam

Recently a new type portable electric lantern known as No. 400 Ecolite Duo-Ray was placed on the market by Economy Electric Lantern Company, 3100 W. Cherry Street, Milwaukee, Wisconsin.

The M. S. A. Miner's Protection Suit consists of two pieces—a jacket and overalls. Both pieces are of black rubber, friction-coated on a strong, special rubber-imregnated fabric base. All seams are stitched, straped and cemented, with rivets at points of tension. The jacket has wide inside facings of rubberized fabric. The double front flap has Thompson style slot and button fasteners.

The overalls of the Miner's Protection Suit feature a high apron front; belt loops and three-quarter length pants with reinforced patches at the knees. The suspenders are extra wide with elastic inserts having adjustable buckles. The suit is available in three sizes.

Further information on the M. S. A. Miner's Protection Suit may be obtained by writing this publication, or direct to Mine Safety Appliances Co., Braddock, Thomas & Meade Streets, Pittsburgh, Pa.
New Model Caterpillar

Caterpillar Tractor Co. has announced a four-cylinder 60-horsepower, automotive engine, called the Model D312.

The engine is a four cylinder, valve-in-head, water cooled model with a bore of 4 5/8" and a stroke of 3 5/8". Maximum horsepower is developed at 1800 RPM, and maximum torque of 193 lbs. ft. at 1200 RPM. Piston displacement is 312 cu. inches.

Pistons in the Model D312 are of aluminum alloy. The block, cylinder head and crankcase unit are in cast alloy iron. There are five main crankshaft bearings, with a total surface of 93.5 sq. inches. Crank pin bearings are 3 5/8" in diameter and 1 13/16" in length. There is a crankshaft torsional vibration damper.

Water circulation is by pump, with the operating temperature of the water controlled by thermostat. There is an air-cooled type lubricating oil cooler provided. Pressure lubrication is provided to all main and crank pin bearings, camshaft bearings, valve operating mechanism and timing gears.

The engine fuel system is manufactured by Caterpillar Tractor Co., and features solid injection into precombustion chambers. There is an individual pump and valve for each cylinder; and the system is factory set, requiring no adjustment in the field.

For replacement installations, "Caterpillar's" Model D312 engine is offered as a complete unit, equipped with a five speed Spicer No. 2553 transmission and 13-inch single plate clutch.

A New Lightweight 60 Cu. Ft. Compressor

Ingersoll-Rand Company has just introduced a new Two-Stage Air-Cooled compressor that delivers 60 cu. ft. of free air per minute at a discharge pressure of 100 lbs. It is known as the D-60. The unit is reported to be inexpensive, thoroughly reliable, extremely compact and light in weight. It will operate most of the rock drills, grinders, paint sprays and other pneumatic tools that are in common use today with much larger portables.

This small compressed-air outfit is ideal for many small contracts and for a great variety of odd jobs. It enables municipal service departments to speed up their work by putting air tools on their jobs. On many big contracts, it will take care of the urgent here-and-there jobs, and free larger portables for other work. It is easily portable and can be taken anywhere with but little effort.

Three types of mountings are available, all built around the same gasoline engine-compressor plant.

Worthington Type "VS" Air Compressors & Vacuum Pumps

In Type "VS" units Worthington offers a line of small compressors and vacuum pumps built with the same precision methods as the large compressors. They embody advanced features of design based on the present day requirements.

M. S. A. All-Service Mask

Addition of the M. S. A. All-Vision Facepiece to the M. S. A. All-Service Gas Mask is described in a new bulletin just issued by the Mine Safety Appliances Company, Pittsburgh, Pa.

The Push-about is mounted on roller-bearing, pneumatic-tired wheels. It is well balanced and can be easily rolled on and off a truck. One man can handle it on the ground. A turtle-back cover protects the compressor and engine from the weather and provides a means of locking the wheels against theft.

The De Luxe Model is a spring-mounted, high-speed trailer unit with tool boxes for carrying equipment built into the sides of the body.

The Utility Model is mounted on a steel base and can be mounted directly on a service truck or built into the body.

Electric starting is available on the Utility and De Luxe mountings only. A six-page illustrated folder, Form 2688, contains a table listing the various air tools and the number of each that the D-60 will operate. This form is available from Ingersoll-Rand Company, 11 Broadway, New York City or any of its branch offices.
less all poisonous industrial gases, smoke and vapors—including carbon monoxide—and is the only canister mask giving this protection which is officially approved by the U. S. Bureau of Mines. A corrugated non-collapsible tube connects the face-piece to the canister. The tube, made to withstand the hardest service, is light and flexible, permitting free hand movement.

An all-rubber head harness holds the face-piece so that no metal touches the face. A strong durable harness straps the canister to worker, leaving hands free at all times. Prominent among the exclusive features on the Mask is the Timer, an extremely simple and positive device that indicates the service time undergone by the canister—eliminating all guesswork regarding its condition.

M. S. A. All-Service Gas Masks are used by a majority of the fire departments in the United States, and by mines, steel and chemical plants, gas and power companies everywhere.

Copies of Bulletin No. EA-6, describing the All-Vision Facepiece, may be secured by writing to this publication or direct to Mine Safety Appliances Co., Braddock, Thomas and Meade Streets, Pittsburgh, Pa.

Type "AM" Magnetic Separator

An unusual type of magnetic separator which utilizes alternating current for energizing the magnetic field has been designed by the Stearns Magnetic Mfg. Co., Milwaukee, and styled Type “AM.” By this method of energization with alternating current fields pulsating, the lines of force change 60 times a second, while the material affected by the magnet receives 120 pulsations of constant agitation.

This Stearns separator is particularly effective for treating finely ground powdered metal which may be contaminated by any number of impurities such as oxide, scale, charcoal, silica and other foreign particles.

Material is spread uniformly by an adjustable vibrating feeder which provides even distribution of the material on the separator belt, where it is picked up by the magnet and carried along the underside of the separating belt. The high pulsating effect of the magnet frees the non-magnetic impurities allowing them to drop out. Under ordinary conditions three products can be produced, tails, middlings, and concentrates.

While the separator is fully enclosed in a structural steel frame practically dust-tight, provision is made for removable panels by which the material can be introduced and removed without a break in production. A generous exhaust fan is directly attached to remove dust from the material while in process.

The Type “AM” alternating current magnetic separators are designed in various sizes to suit the capacity of the customer. The Stearns Magnetic Mfg. Co. maintains extensive laboratory facilities for testing and submitting separated material for analysis together with a recommendation as to the proper type of separator most effective and economical.

Auto-Raise” Thickener

A new and radical design of thickener mechanism, known as the “Auto-Raise” Thickener, has just been announced by the Hardinge Company, Incorporated, York, Pennsylvania.

The one big unpredictable cause of trouble with a thickener or clarifier is the sudden overloading of the rakes at the bottom of the tank, due to some foreign material, like a bar or wrench dropped into the tank, or solids that have built up on the sides of the tank, or top of the mechanism, giving way and dropping to the bottom. Overload alarms and means of stopping the thickener have been employed for years, but even with these devices, many a thickener has twisted off its shaft, broken its gears or dislodged the mechanism entirely. The “Auto-Raise” principle automatically relieves the thickener of an overload in the tank, no matter whether the overload is at the periphery or in the center.

Note the principle of operation from the illustration and other important features of this new driving mechanism:

1. Rollers on scraper shaft are driven by a rotating diagonally slotted tube. Excess pressure against scrapers causes rollers to move up incline, raising shaft and scrapers.

2. Ball bearings in oil filled casing support entire rotating mechanism and dependently of “Auto-Raise” device.

3. Manual raising wheel operates independently at each end of the piston; that is, the correct volume of air to give maximum striking power is admitted behind the piston, the valve is closed and the piston is propelled by expansion of the air. After the blow is delivered, air is admitted ahead of the piston to give a return stroke with strong rotating power. Premature admission of live air ahead of the piston (which reduces force of blow) is avoided.

4. Overload alarm and power cut-off switch operates when scrapers are raised near maximum position.

5. Ball bearings in oil filled casing support entire rotating mechanism and scrapers.

The second illustration shows an arrangement of the mechanism on an I-beam supported tank in which the spiral scraper is employed, which scraper removes the settled solids from the periphery to the center in about 1/4 revolutions, thus enabling the thickener to run at a much slower speed than would otherwise be the case, with a resulting reduction in disturbance, increase in capacity and increase of density in the discharge.

A Rock Drill With Cushion Control

The latest Sullivan drill, Class L-57, is equipped with DUAL VALVE and cushion control, two new and valuable contributions to Rock Drilling Efficiency.

By means of this DUAL VALVE, air is controlled independently at each end of the piston; that is, the correct volume of air to give maximum striking power is admitted behind the piston, the valve is closed and the piston is propelled by expansion of the air. After the blow is delivered, air is admitted ahead of the piston to give a return stroke with strong rotating power. Premature admission of live air ahead of the piston (which reduces force of blow) is avoided.

This L-57 cushion control gives increased air efficiency, high drilling speed, low air consumption and ease of handling. This 57-lb., 24-inch machine drills easily to a depth of 14 to 16 ft. It is equipped with shake-proof, five position throttle handle, rubber cushioned steel puller and 4-hour capacity oil reservoir. It provides full line-pressure hole blowing and is available in dry, blower or wet types (easily interchangeable) and with various chuck sizes and rotation speeds.

The L-57 can be supplied with cradle and shell mountings, with rigid or sliding trunnion for 24” or 30” steel changes, or can be mounted on Featherweight automatic or motor feed wagon mountings for 4 ft. or 6 ft. steel changes.

Ask for Bulletin 87-H, Sullivan Machinery Company, Woodland Avenue, Michigan City, Indiana, or Claremont, N. H.
New Vertical Turbine Pump

The Pomona Pump Company, 595 East Commercial St., Pomona, California, announces the complete redesign of its line of 6" medium capacity vertical turbine pumps. As a result of improved engineering practice, particularly in the newly designed impellers and seats, the manufacturer states that the new models afford higher efficiency and better performance, resulting in lower cost for the user.

For a desired capacity of 100 G. P. M. against 110 ft. lift in a well and 50 lbs. pressure above, a 7 1/2 H. P. motor is required, as against a 10 H. P. motor with the old model. The efficiency of this particular size pump for this head capacity has been increased 65% points, the number of stages has been reduced one-fourth and finally, the initial cost of the entire unit has been lowered 20 per cent.

Other advantages of these pumps, making for extremely low operating costs, lie in the fact that they are water-lubricated, with no stuffing box below ground level; that the specially-designed semi-open impeller can be adjusted from the surface for wear and for changing capacity; and that they are non-standlocking and non-gaslocking.

Constructed of high quality bronze, the Pomona semi-open impellers operate in a cone-shaped seat in the pump bowls. Correct curvature of the impeller vanes assures maximum lifting capacity and prevents overloading of motor regardless of changes in water level.

Pomona makes every type and size of vertical pump, from the small domestic pump delivering only a few gallons per hour to the large Niagara type, delivering 100,000 gallons per minute or more. The manufacturer will be pleased to furnish copies of explanatory literature upon request. Write for Bulletin 26.

New Unit Pumper

The National Supply Company announces the addition of a new member in its line of Unit Pumpers. Designated as Type TUS 464-HD46TB, it is a twin crank unit and designed for the heavier requirements of medium pumping service. It is made with a sub-base between the frame and the reduction gear to enable the cranks and counterweights to clear the derrick floor or a flat concrete pad.

General features of the new pumper are:

- Arc welded construction for maximum strength and rigidity with less weight.
- Adaptability to either high, medium or low speed prime movers, by means of reduction gear ratio and variation in V-belt sheaves.
- Short frame base, to which an extension base with slide rails for various types of prime movers is bolted. This makes changes in the field comparatively simple and inexpensive.
- Changing V-belt sheaves is facilitated by a tapered shaft which includes a locking device and a puller for easy removal.
- Symmetrical construction prevents any tendency toward misalignment through unequal wear and distortion.
- The API peak torque rating is 113,000 inch-pounds at 20 smp; reduction gear ratio, 29:6; API safe load of walking beam, 15,100 lbs.; maximum polished rod stroke, 54 inches. Regular equipment includes National Type B Eccentric Cranks, and National Disc Type Counterweights, which give infinite and continuously variable adjustbility both in counterweight effect and in degree of lag and lead. The counterweights are of the one piece type, locked securely in position on the outside rim of the crank. Adjustment is by power, hence convenient and safe because no lifting or manual handling is required.

A more complete description of the Type TUS 464-HD46TB Pumper may be found in Bulletin No. 267, copy of which will be sent on request.

Plant News —

Synthetic Rubber

Immediate and substantial increase in facilities for the manufacture of the company's synthetic rubber, CHEMIGUM, was announced today by P. W. Litchfield, Chairman of the Board of Goodyear Tire & Rubber Company.

For the past three years the company has been developing and producing its own type of chemical rubber in its laboratories and in a small pilot plant in anticipation of national defense needs.

The new plant, with an initial capacity of 10,000 pounds per day, will be installed at Akron in space which has been made available within the company's existing buildings.

In announcing this new move, Mr. Litchfield explained that the company has complete plans for further large expansion of manufacturing facilities in the event of emergency which would threaten the nation's supply of crude rubber, more than 90% of which must be brought from the East Indies, half way around the world.

Chemigum is derived from petroleum, through a cracking process and is the culmination of lengthy and extensive work by Dr. R. P. Dinsmore, in charge of all development and research and Dr. L. B. Sebrell, manager of chemical research for Goodyear.

Under the direction of these experts, a staff comprising a score of highly trained, skilled chemists, engineers and rubber compounders cooperated for several years in the development and exploration of more than 300 different compounds involving thousands of tests before Chemigum was produced. Numerous patent applica-
(1018) MINE LAW IN A NUTSHELL, continued. 

(1019) RECORD PERFORMANCE IN PUMPING SAND. Industrial News, Sept., 1940, published by the American Society of Mechanical Engineers. 

(1020) LOAD-CENTER DISTRIBUTION of elec­

(1021) GUN PERFORATING. July-August 1940 magazine by the Bucyrus-Erie Company. 

(1022) FOR YOUR CONVENIENCE. Send your publications to Mines Magazine, 74 Cooper Building, Denver, for review in these columns. Readers will please mention Mines Magazine in any correspondence with the manufacturers. 

(1023) DRILL STEEL SHARPENERS. Bulletin D-014 by R. G. LeTourneau, Inc., Peoria, Illinois, gives descriptions, capacity, specifications, and construction details on their models D-05 and D-32 drill steel sharpeners. Information on hole punchers and other forge items is included. 


(1025) NICKELSWORTH quarterly magazine published by the Minerals Engineering Co., New York, N. Y. 

(1026) Propeller-type pumps. Precious Pump Company, Los Angeles, California, has issued its catalog on the types of these pumps. This pump is used where large capacities of water are to be produced with a low head and for drainage and dewatering. Blunt edged blades of test design eliminate cavitation and increase the efficiencies. 

(1027) ELECTRIC TRAVELING CRANES. Catalog No. 293-A by the Show Crane Co., Muskegon, Michigan, contains many interesting articles on weather, including Mapping the Weather, Life on Mars, Ultraviolet Radiation, Snow Crystals, Venus, Ultra Violet Rays, and Mapping the Weather. Publications are for the use of homeowners, schools, laboratories, and announcement of the 29th national safety congress. 

(1028) DRILLING ENGINE. Bulletin EL-123 by the Gardner-Denver Co., Quincy, Illinois, describes their 1941 model 100 roll-over-rotary drilling engine. Construction details and specifications are given. 

(1029) MINE GATHERING LOCOMOTIVES. Bulletin M-378 by the Gardner-Denver Co., Quincy, Illinois, describes their line of trolley type mine gathering locomotives. 

(1030) COMPRESSOR PORTABLE. Bulletin PC-11 by the Gardner-Denver Co., Quincy, Illinois, contains descriptions and specifications for their two types of portable compressor. Both gasoline and diesel engine models are included. 

(1031) SCRAPERS. Bulletin 4W-3 by Buckman-Erie Company, South Milwaukee, Wisconsin, describes their 4-wheel scrapers. It discusses double wheel, single wheel, rail steering, or single wheel, positive rolling erection, controlled depth of spread, etc. 

(1032) MAGNETIC DISC BRAKES. Bulletin 604-2 by Buckman-Magnuson Co., Milwaukee, Wisconsin, gives complete description, specifications, illustrations, photos, and other information valuable to users of magnetic brakes. 


(1034) MINE PITS AND CLASSIFIERS. Booklet by the Caterpillar Tractor Co., Peoria, Illinois, describes new Caterpillar and track-type tractors used to cut mining coal. Typical pictures of each tractor with work, workers, overburden removal, shovels, and miscellaneous jobs. 

(1035) TAPES AND RULERS. Bulletin by the Lufkin Rule Co., Saginaw, Michigan, contains descriptions and prices of their measuring instruments, by section, surveyors, road builders and in the oil industry. 

(1036) MINES, TRAMS AND RAILWAYS. Bulletin No. 4013 by the Morse Brothers Machinery Company describes their "Flexible" Rake Classifier for use in the laboratory. 

(1037) MACHINING HAND ALLOY STEELS. Result from Steel distributed by the International Nickel Company, New York, N. Y. 


(1040) AIR DRILL PART FAILURES. 11 page booklet by the General Electric Co., Schenectady, New York, gives 55 pages of data on their instruments for use in houses, schools, laboratories and special applications. Distributed by the General Electric Co., Denver, Colo. 


(1043) LUBRICATION. Bulletin by the Thomas Company, New York, N. Y., stresses the importance of proper lubrication on various types of equipment in order to insure longer life and lower maintenance costs. 

(1044) CYLINDER MACHINES. Bulletin C-40 by the Morse Brothers Machinery Company, Denver, Colorado, describes their line of machines for use in the mining industry. A flow sheet of a typical plant from 10 to 1000 or more tons per day is shown in two views.
Coach Johnny Mason has been in his glory the past two weeks whipping the 1940 team into shape for their opening encounter with Colorado State on the 28th.

Fifty-seven suits were checked out and it was an eye filling squad that reported for the first practice the early part of the month, a far cry from the small group of 26 which greeted Coach Mason when he came to Mines three years ago.

Fourteen letter men form the foundation of this year's gridiron and will be backed by husky newcomers from the sophomores and junior college transfers.

Don Eden, a 6-foot 2, 190-pound center from Glendale, Calif., junior college, looks the part of a fine line back up. Gene Volpi, 200-pound guard from Burbank, Calif., who also hails from Glendale junior college, and Warren Webb, 210-pound guard and another junior college product from Ohijou, Minn., have made an impression. Charles Lathrop, a watchcharm junior guard weighing 165 from Los Angeles, is a likely candidate. He didn’t see action last season.

The coaches already are saying nice things about three sophomore backs. Carter De Laittre, 190-pound fullback from Minneapolis who played on the freshmen team at Dartmouth, is a talented triple threat. His father was an all conference tackle at Mines in 1908. De Laittre is a hard-running back who passes and kicks equally well.

Harry Hallman, a baseball pitcher from Brown prep school in Philadelphia, is a fine-looking 185-pound wingback and John Seerley, 190-pounder from Chicago, is a well stacked up blocking back.

With the exception of Lathrop none of these have been assigned berths on the first string, but they’ll be heard from before long.

At the ends Mason will start two senior letter men, Louis De Goes and Clayton Creiger. De Goes is one of the best downfield blockers in the region and paved the way for many of Madden’s touchdowns last season. Backing up De Goes and Creiger are Ralph Blair, junior college transfer from Pasadena, Calif.; George Kierch and Robert Rehtmeyer, squad members last season; Pat Finn, a numeral winner, and William Van Saun, a sophomore.

Robert Pruess, who played considerably in 1939, will fill Katzenstein’s berth and pair with Dick Moe at the tackles. The 218-pound Moe was a star as a sophomore last year and he should be even better. Other tackle prospects are Darrel Muloy, 210-pounder from Grand Junction Junior college; Ted Stockmar, 210, from South Denver high school; Grover McKinney, a 220-pound transfer from Tulane, and Rolf Rohrer, 190, 1938 letter man who was out of school last year.

Wholesale depletion of the guards leaves a problem. John Gargan, only returning numeral winner, and Lathrop are picked as starters, backed up by Volpi, Webb, Pete Mullinax, squad member, Earl Spieles, 185-pound Golden sophomore, and a half dozen others.

Glen Hutchinson, who spelled Herbert Thornton at center, takes over the first-string berth with Eden, and Thurston Brandt, a letter man, next in line.

The backfield can’t be expected to have the timing and execution of last year’s all-veteran cast. Joe Berta at left half and Randy Taylor at fullback, runningmates to Madden and Torpey, return. Harold Rogers, Madden’s No. 1 reserve, and Clinton Edwards, 195 backer who filled in for Torpey, round out the first string. Edwards, Berta and Taylor are seniors.

Harry Campbell, who developed fast last year, and Johnny Michaels, sophomore, rank next to Berta. Hallman and Soph Dick Shaw are right behind Rogers. Seerley and Franz Lupton, a squad member in ‘39, will spell Edwards. De Laittre and Art Wood, a letter winner, come after Taylor.

Berta, Campbell and De Laittre are triple threats. Rogers and Edwards are kickers and Hallman a passer.
**Defeated Kansas City Medics**

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<th>Score</th>
<th>Opponent</th>
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**Lost to Aggies**

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<td>Colo. U.</td>
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</table>

**No Game C.C.**

1893 Denver Athletic Club 36

1894 Mines 20 Denver U. 10 Colorado U. 0

1895 Mines 0 Colorado U. 20 Mines 0 Colorado U. 0

1896 Mines 40 Colo. Coll. 0 Mines 0 Colorado U. 0

1897 Mines 0 Denver U. 6 Mines 0 Denver U. 6

1898 Mines 0 Colorado U. 14 Mines 0 Colorado U. 14

1899 Mines 41 East Denver H. S. 0 Mines 5 Denver Wheel Club 6

1900 Mines 49 Colo. Aggies 5 Mines 5 Denver Wheel Club 6

1901 Mines 47 Colo. U. 25 Mines 5 Denver Wheel Club 6

1902 Mines 0 Colorado Coll. 23 Mines 0 Colorado Coll. 23

1903 Mines 5 Denver Wheel Club 6 Mines 0 Colorado U. 14

1904 Mines 0 Denver U. 6 Mines 0 Denver U. 6

1905 Mines 0 Colorado U. 14 Mines 0 Colorado U. 14

1906 Mines 5 Denver Wheel Club 4 Mines 0 Denver U. 6

1907 Mines 0 Denver U. 6 Mines 0 Denver U. 6

1908 Mines 5 Denver Wheel Club 4 Mines 0 Denver U. 6

(Continued on page 511)

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Photo Courtesy The Denver Post
BAGUIO  
L. W. Lennox, '05, President; Frank Delahunty, '25, Vice-President; T. J. Lawson, '36, Secretary-Treasurer, Box 252, Baguio, P. I. Monthly dinner meeting third Wednesday each month.

BIRMINGHAM  
Tenney C. DeSollar, '04, President; W. C. Chase, Ex-'08, Vice-President; Hubert E. Risser, '37, Secretary, Flat Creek Alabama. Meetings upon call of secretary.

BAY CITIES  
Ronald S. Coulter, '19, President; R. P. Obrecht, '34, Vice-President; Leslie E. Wilson, '27, Secretary-Treasurer, 215-7th Avenue, San Mateo, Calif. Four meetings per year, 2nd Monday, March, June, September and December.

The Bay Cities Section of the Colorado School of Mines Alumni Association held a meeting in Oakland, California, on August 9th, 1940, for the purpose of electing new officers for the coming year. The outgoing officers who have been hard at work all year are: Frank Hayward, '32, President; W. J. Hupnik, '29, Secretary-Treasurer, (now transferred to Los Angeles.) The newly-elected officers for the coming year are: Ronald S. Coulter, '19, President; R. P. Obrecht, '34, Vice-President; Leslie E. Wilson, '27, Secretary-Treasurer.

Following the dinner, Steven S. Dettman, '31 showed motion picture of the Upper Narrows Dam on the Yuba River, California, in color, taken in 1940, and followed this with a motion picture trip from San Francisco to New York by air, including shots of boat racing on the sound, and of the New York World’s Fair. A contribution for the Mines scholarship was made by those present.

Those in attendance:

CHICAGO  
A. L. Lynne, '06, President; M. E. Frank, '06, Secretary, 4537 Drexel Blvd., Chicago. Meetings upon call of secretary.

CLEVELAND  
K. D. True, '35, President; R. J. Maloit, '37, Secretary, 9701 Lamont Ave., Cleveland, Ohio. Four meetings during year, 4th Friday, March, June, September and December.

DENVER  
Dent L. Lay, '35, President; R. J. McGlone, '27, Vice-President; A. L. Mueller, '35, Secretary, 430 E. 11th Ave., Denver, Colo. Four night meetings per year, July, October, January, April.

HOUSTON  
Clark W. Moore, '32, President; R. J. Schilthuis, '30, Secretary, 305 West 9th St., Los Angeles, Calif. Four meetings during the year, 2nd Monday of month, January, April, July and October.

LOS ANGELES  
R. S. Brummett, '26, President; William Dugan, Ex-'12, Secretary, 315 West 9th St., Los Angeles, Calif. Four meetings during the year, 2nd Monday of month, January, April, July and October.

MANILA  
A. F. Duggleby, '15, President; Ralph Keeler, '31, Secretary, Box 297, Manila. Dinner meeting, first Friday each month.

NEW YORK CITY  
C. L. French, '13, President; Ben W. Goodes, '37, Secretary, 1112 University Terrace, N. J. Meetings upon call of secretary, Western Universities Club, New York.

SALT LAKE CITY  
Otto Herres, '11, President; Kuno Doerr, Jr., '27, Secretary, 700 McCormick Bldg., Salt Lake City, Utah. Meetings upon call of secretary.

SEATTLE  

PHOENIX  
Two meetings in year, second Saturday in April and October. T. E. Giggy, '34, President; A. F. Hallert, '07; Percy Jones, Jr., '08, Vice-Pres.; E. M. J. Allenus, '23, Secretary-Treasurer, Box 2751, Phoenix, Ariz.

PITTSBURGH  
S. L. Goodale, '04, President; A. M. Keenan, '35, Secretary, Box 146, Pittsburgh, Pa. Meetings upon call of secretary.

TULSA  
John R. Evans, '23, President; D. H. Peaker, '32, Secretary, c/o The Carter Oil Co., Tulsa, Okla. Meetings upon call of secretary.

WICHITA  
Thomas H. Allan, '18, President; John T. Paddleford, '33, Secretary-Treasurer, 215 First National Bank Building, Wichita, Kansas. Meetings upon call of secretary.
WEDDINGS

Vaughan-Goudé

Irvin T. Vaughan, who received his degree from Mines this year and Miss Natalie Mae Goudé were married at the home of the bride in Golden the evening of July 27. Robert Allen, a classmate of the groom, served as best man.

After a several weeks honeymoon the couple went to Pueblo, Colorado, where Mr. Vaughan is employed as chemical engineer for the Colorado Fuel & Iron Corporation. Their residence address in Pueblo is 217 West 6th Street.

Morgan-Bergeman

Stanley W. Morgan and Miss Dorothy M. Bergeman of Wheatridge were married Saturday evening, August 3, at a candlelight service in the bride's home.

Mr. Morgan, a nephew of Dean Morgan, attended Mines for two years being of the class of '35. He then transferred to Denver University from where he was graduated. He is now associated with the Temple H. Bueli & Company, architects of Denver. The couple are making their home in the Glen Creighton district of Lakewood.

(Continued on page 514)
**WEDDINGS—**
(Continued from page 513)

**Ryan-Eberhardt**

William J. Ryan and Miss Shirley Eberhardt of Denver chose August 17 as the date for exchanging marriage vows. The ceremony was performed at 4:30 in the afternoon at Christ Methodist church in Denver. Fred MacLean, '38, was best man. After a reception at the bride's home, the couple left on a honeymoon and are now at home in Denver.

Upon his graduation from Mines this year Mr. Ryan accepted position of engineer for the Eberhardt-Denver Company.

**Mann-Vail**

Miss Viola Vail and Robert E. Mann, '38, were married in Denver, Saturday evening, July 27, at the home of a mutual friend in the presence of a small group of relatives and friends.

Mr. Mann is now doing mapping work on the Castle Rock Quadrangle for the U. S. Geological Survey. His mailing address is 706 Mining Exchange Building, Denver.

**BIRTHS**

Mr. and Mrs. Hugh Miller are receiving congratulations upon the birth of a son. The proud father writes: "The little fellow has a good pair of lungs and is already yelling, 'Give 'em Hell, Miners.'"

Mr. Miller of the class of '25 is assistant chief plant engineer for the American Viscose Corporation at Meadville, Penna. The family home is 953-B Street.

**IN MEMORIAM**

Donald E. Salsbury

Donald E. Salsbury of this year's class passed away at St. Anthony's hospital in Denver, Monday morning, June 17, following an operation for acute appendicitis. He was taken ill while at Wild Horse Park on a geological field trip and was brought to Golden for medical attention on June 7.

He was a native of Los Angeles, coming from Glendale, California in 1935 to enter Mines. While here he was prominent in campus activities and was an outstanding player on both the basketball and baseball teams and was interested in other intercollegiate sports. He was a member of the Alpha Tau Omega social fraternity; of the Theta Tau honorary engineering fraternity; the A. I. M. E.; and the "M" club. He served as treasurer of the student council and house manager of the A. T. O.

He is survived by his mother, Mrs. Muriel Salsbury, and several brothers and sisters of Glendale, California. His mother and a brother, Earl, came to Golden when his condition became critical. Interment was in Golden cemetery.

Patrick M. Kinney

Mines Men who knew "Pat" Kinney, '27, will be shocked to learn of his death on August 2, 1940, which resulted from head injuries received at the property of Braden Copper Company, Rancagua, Chile.

"Pat" was a native of Scottsbluff, Nebraska, where the early years of his life were spent. When he was in High School his parents moved to Denver where he entered the South Denver High School, graduating from there in 1922. He entered Mines the fall of that year.

Immediately upon his graduation from Mines in 1927 he entered the employ of the Braden Copper Company in Chile, with whom he had since been associated, holding the position of mine foreman at the time of his death.

In April 1930 he was married in Chile to Miss Petra Ocariz who, with three daughters and a two-year old son, survives. He is also survived by his father and mother, Mr. and Mrs. S. M. Kinney of Scottsbluff, Nebraska, two sisters and a grandmother.

Burial will be in Scottsbluff.

**WAR**

"Waste of muscle, waste of brain,
Waste of patience, waste of pain,
Waste of manhood, waste of health,
Waste of beauty, waste of wealth,
Waste of blood and waste of tears,
Waste of youth's most precious years,
Waste of glory, waste of God—
War!"

STUDDERT KENNEDY,
From Colorado Transcript, Golden.

**PRIZE OFFER**

Check the errors found in Mines Magazine as you read it. The reader reporting the most errors receives FREE one year's subscription to the magazine. The winner will be announced in the magazine the second month after publication. Send list of errors to Mines Magazine, 734 Cooper Building, Denver, Colo.

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MINES MAGAZINE
734 Cooper Building
Denver, Colo.
### Sports Watch —

(Continued from page 511)

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<th>Year</th>
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**PRIZE WINNER**

The prize this month for finding the most errors in the July issue of MINES MAGAZINE goes to James A. Hollywood, Ex-'37 of Red Bank, N. J. He listed 34, on ten of which we could not agree with him. It is strange he did not find nine others which were listed by other contestants and in some instances were very close to those he noted. Anyway, he receives credit for a year's subscription to the Magazine.

---

**PRIZE WINNER**

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ASSAYERS

LOS ANGELES
Tellurium

(Continued from page 500)

They have also improved the structural properties of the body of the wheel. The uniformity which has been enforced in timing the castings between pouring, shaking out, and pitting, has also had a marked effect in improving these properties.

One of the greatest improvements in many years, however, is the development of an ideal cooling curve for the chilled iron wheel and the evolution of a type of annealing pit that would stand up under car wheel pitting conditions and give a uniform rate of heat loss that would conform to the cooling curve established. In using the term “annealing” we do not imply, in this industry, the use of supplementary heating followed by cooling, although some plants have been, and now are, equipped with oil fired pits that would accomplish this if desired.

Best results for this type of chilled casting have been obtained from placing the wheel, immediately after it is removed from the mould at maximum safe temperatures, in an insulated receptacle which will permit a uniform heat loss of eight to ten degrees per hour. The type of soaking pit now generally used is lined with six inches of diatomaceous earth bonded with asbestos fiber. These pits are sixteen feet in depth and designed to hold twenty-four standard railway car wheels. They are sealed immediately after filling, by a cover equally well insulated. The minimum cooling cycle is three days.

At the time of pitting, the temperature throughout the body of a car wheel ranges from 1400 degrees Fahrenheit at the chilled tread surface to not much below the temperature of solidification in the hub section. The objects of this annealing, or controlled cooling, are:

(1) To prevent the formation of cooling stresses.

(2) Refinement of structure both in the chilled and the gray iron sections of the wheel.

The pouring temperatures and the time the castings are left in the mold have a decided influence in fixing the initial temperatures at which the wheels are pitted and these temperatures raise or lower the cooling curve accordingly. The weights of wheels being cast ranging from 650 pounds to 850 pounds each are also an important factor. The cooling curve is therefore a function of the pouring temperature, shake-out temperature, and total weight of metal pitted.

When a chilled car wheel cools too rapidly there are all kinds of stresses produced. There is radial stress that tends to pull the plate apart, circumferential stress that tends to pull the tread apart, and transverse stress that tends to split the tread in the center. These stresses are relieved by equalizing the temperature well above the critical range and limiting the subsequent cooling rate.

The effect of this exactly controlled cooling gradient is to equalize the temperature throughout the car wheel above the critical range and prevent the formation of potential internal stresses while structural transformations are being completed. This is in the range of 1450 degrees to 1250 degrees Fahrenheit. In this particular, the structure of the tread is modified to give a much greater comparative toughness because of changes in one of the forms of the iron carbide.

On page 500 are shown two photomicrographs: “A” illustrates the structure of the tread metal before annealing, and “B” after annealing.

The most important function, so far as refinement of chill structure is concerned, is the complete spheroidization of the pearlite in the chill. There is, of course, no graphitization of the massive cementite, which constitutes over half of the chilled structure, at these temperatures and cooling rates.
Magnetic Measurements:  

Magnetic gradient maps of the above areas are given. The regional geological influence as given by them appears to agree well with known subsurface geology and to have developed some new points. Discussion of the positive and negative magnetic trends shown brings out that in Illinois certain shallow sedimentary formations must carry enough magnetite that their thickening toward the center of basins overshadows the decrease in magnetic intensity resulting from greater basement depth. Detailed magnetic surveys on two local oil structures in Michigan are presented. Such maps may be of aid in understanding the subsurface of geology in areas where it is not well understood and especially in foreign countries according to the writer.—D. W.


A reply to a discussion on the subject previously printed in the Journal in March 1939. Both discussion and reply refer to author's paper under the above title written in the Journal Dec. 1938. Numerous points are taken up.—D. W.


An account of geophysical exploration in the Sudbury Basin by F. Mc I. Galbraith and R. C. Hart appearing in the October issue of the Canadian Min. and Met. Bull. The work was undertaken for the Falconbridge Nickel Mines Ltd. and the not at all completely checked by the drill, one new ore body was found. The physiographic and geologic conditions in the basin are discussed and it is noted that the situation as almost ideal for geophysical work.

The methods used of detailed geologic mapping and magnetic traverses are described and sections and locality map of the above discovery are given. The article gives an example of the use of geophysics in mining.—D. W.


A proposed new method of core orientation is described in which a fluid suspension of magnetic particles made to adhere firmly to the formation at the bottom of a well before a core is taken. This involves drilling a small pilot hole in which a core is run and which will solidify is placed. The magnetic particles line up with the direction of the earth's magnetic field so that such a core when obtained can be readily oriented by means of a magnetometer.

Several interesting points are brought out in discussion.—D. W.


The author treats the effect of the air surrounding a torsionally vibrating magnet, suspended on a fiber, as it affects the period of vibration. Since such a scheme is used in measuring magnetic horizontal intensity this effect is of interest. Examples show that the influence of the air, if not 5% may account for errors of the order of 10 gamma in measurements of intensity at different observatories.—D. W.

Observations of Radioactivity:


The meter described reads directly the average rate of appearance of pulses on a counter. New to radioactive substances. Improvements made on the original circuit are covered.—D. W.

SHANKLAND, R. S. and TIPPLE, C. H. The Efficiency of Geiger-Müller Counters, Phil. Mag. 28 (190), 562-570, Nov. 1929.

Describes experiments to determine the influence of voltage and counting rate on the efficiency of Geiger-Müller Counters. Such information is necessary for precise intensity measurements. Efficiency appears to depend on the constants of the coupling circuit. The counting rate and total voltage and that for high rates, efficiency will be increased if a vacuum tube is used to quench the counter discharge.—D. W.


Reports the radium analysis of core No. 3 obtained in 1936 at a position east of Halifax, Nova Scotia, off the Newfoundland banks. The core was 235 meters long of uniform character lithologically and chemically being about 50% calcium carbonate, 5% sand and silt. Examination showed no decrease of radium content with depth and a radium content about that of granites or 1.6 x 10^-8 gr. Ra per gram. Core was apparently failed to reach the glacial zone and it cannot represent a period in excess of a few thousand years. The method of radium determination, and depth phases of the study are discussed.—D. W.


A description of tests on the radioactive of rock samples using a Geiger-Müller counter. Samples taken from known geologic horizons along two traverse lines some five miles apart showed good correlation of degree of radioactivity. Examination of a 120 ft. length of core from the Bradford sand indicated marked zones of high radioactivity and mineral separations showed zircon and associated heavy minerals always present in these zones. It is held that such tests give an additional tool for stratigraphic correlation.—D. W.


A paper on the use of radioactivity as a parameter for stratigraphic correlation, a method in practical application within the last two years. It deals with the deposition of radioactive material in sedimentary rocks and discusses examples of this work using two profiles across Silurian strata in Pennsylvania are given. Geiger-Müller counters are used for radioactivity measurements. The writers suggest that the growing literature on "Radioactive Stratigraphy" shows that radioactive methods are finding their place in geophysical work applied to structural geology. 15 references are attached.—D. W.

Seismic Methods:


Reprinted from Physics of the Earth VII Internal Constitution of the Earth, edited by B. Gutenberg, chapter IV.

A summary and discussion of pertinent data on elastic properties of earth crust materials. The compressibility of minerals and of rocks are treated separately; tables of values for each being given. The relation between the compressibility of rocks and that of their constituent minerals; porosity, the effect of temperature and other phases are covered. Rigidly and Poisson's Ratio; wave velocity as determined by measurements of elasticity are also taken up.—D. W.

HOUStON, C. E. Seismic Paths, Assuming a Parabolic Increase of Velocity with Depth. Geophysics 2(4), 242-246, October 1939.

Various forms of a velocity depth function for seismic waves and the equations for same are briefly given. These results give a means of judging the significance of refraction and reflection travel-time curves. The paper treats particularly the cases of velocity increasing parabolically with depth is assumed. The paths are expressed in parametric form. A graph of reflection and refraction curves vs. dimensionless coordinates is given.—D. W.


The physical process by which the reflected wave is generated is discussed. It is observed that some 5 factors govern the intensity of this wave in refraction prospecting. These factors cover such items as: 1 The elastic constants of the two media traversed by the wave; 2 The distance of the source from the interface between these media; 3 Velocity variation within the lower medium; 4 Configuration of the interface. It is held that an understanding of the process treated in the paper can improve the interpretation of refraction data and the proper wave path use in computations.—D. W.
A plan of refraction shooting is described. Applicable in areas where suitable high speed marker horizon or horizons exist. The arrival of waves following refraction trajectories and traversing a high speed bed are observed and the travel-times measured on refraction set-ups with detectors located at suitable spread distances. At each such refraction location the sum of two “delay times” (time of travel of wave in layers above high speed medium) can be determined. Using an interlocking and geometric arrangement of shot points and receiver spreads the depth to the marker horizon can be determined at “offset positions.” An offset position is the distance in the spread direction from shot point or from first receiver point at the surface directly above the spot where the wave first reaches the high speed bed. These offset positions are made common to successive interlocking and geometric refraction spreads. Several different arrangements for this purpose are described. In effect the procedures apply on a large scale the methods as now conducted are commercialized and the vicinity there-off. New procedures of sample taking and analysis and other phases of the work are described.—D. W.

**STORMONT, D. H.** Gulf Coast Field is Opened on Soil Survey Information. Oil and Gas Jnl. 38(10), 28-29, July 20, 1939.

A new field, the East Marlin pool, in San Patricio Co., Southwest Texas, that was favorably recommended by a soil survey made just after the discovery well was spudded is described. As shown by the Liquid Hydrocarbon map and the Mineralization map of the field which are represented an idea of the extent of the field is given by the Soil Survey, according to the writer. The location of the test well was not made on the basis of the Soil Survey however. The relations of the subsurface concentrations of oil and gas fields based on soil analysis surveys and their interpretation is enlivened by written discussion.—D. W.


An hypothesis of the origin and accumulation of oil and gas fields based on data from soil analyses together with evidence in support of same is presented. Hypotheses of the hypothesis cover points such as: 1 Subsurface concentrations of hydrocarbons (oil and gas fields), are genetically very much the same; 2 Source materials of such fields are the hydrocarbons gases leaking from the basement complex; 3 Saturated hydrocarbons result in gas fields whereas unsaturated hydrocarbons are synthesized or polymerized to form oil fields.

An explanation is offered of different concentrations of subsurface waters in different geologic provinces. The hypothesis also seeks to explain variation in types of accumulation in relation to depth and deformation of sediments in which it occurs.

The writer goes deeply and critically into the basis of the soil and gas analysis procedure and gives evidence and examples of its value as a method of exploration.—D. W.


Searching for oil and gas seeps, is noted as one of the oldest forms of oil prospecting. A second type, soil gas analysis is of record for some 10 years and involves microanalysis of interstitial soil air. A third technique soil analysis is thoroughly discussed which depends on the separation, identification, and highly accurate determination of significant constituents in soil samples. These constituents range from hydrogen through gases, liquids, and solid hydrocarbons and their derivatives.

The article is replete with examples of soil analysis surveys and their interpretation and is enlivened by written discussion. The writer concludes that soil analysis is a valuable aid in prospecting for petroleum deposits and applicable to both structural and stratigraphic traps.

—D. W.

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The tread section is cast in a hardness and depth of chill in the chilled car wheel. These improvements in process have enabled the fifteen individual manufacturers operating a total of 48 foundries in the United States and Canada to increase the time guarantee on railway car wheels from the four to five year guarantee in effect several years ago, to a seven year guarantee of service two years ago, and now to ten years service, which is just being placed in effect. These are concrete evidences of increased strength and wear properties resulting from improved processes.

Drilling Muds—
(Continued from page 497)

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All of the fundamental valuable properties of the chilled car wheel, viz., the machinable hub, the strong, resilient plate, and the extremely hard tread metal are being constantly improved by modern technical developments. Other outstanding features are its comparative low cost, its tread resistance to plastic deformation, its plate resistance to transmission of vibrations, its remarkable economy in connection with rail wear, brake shoe wear, train resistance, and high coefficient of friction in brake application. These are only part of the economic properties attributable to the chilled car wheel.

The exact circumference of the wheel tread is an indication of the hardness and depth of chill in the metal. The tread section is cast in an accurately machined chiller and the above or below normal that is indicated in the exact circumference. The improvements in control effected in recent years have reduced the variations in shrinkage exceeding ½ inch above or below the normal circumference from 30% in 1935 to 10% in 1939 in all plants of one manufacturer.

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Drilling Muds—
(Continued from page 497)

The viscosity at 600 r. p. m. This relationship as determined for Pierre Shale (Figure 1) proves to be a straight line for the range of the experiments and hence the viscosities reported are valid.

The same mud was used in all experiments. The mud was made by grinding Pierre Shale to the desired particle-size. When the particle-size is reported, for example, as 48-mesh it means the particles would pass thru a 48-mesh screen but would not pass thru a 65-mesh screen. The suspension resulting from dispersing Pierre Shale in water was slightly alkaline and had a P H of eight.

Density versus Viscosity and Yield-Point

Pure bentonite is largely composed of the clay mineral montmorillonite. Bentonite has the ability to absorb large quantities of water and swell. Due to its colloidal properties, it is an excellent suspending medium for other particles. The effect of bentonite in the experiments proved it was particularly valuable in holding the Pierre clay particles in suspension at the lower densities. It is sold under the trade name "Agujel" by the Baroid Sales Company.

Reagents
1. Sodium hydroxide: small amounts of sodium hydroxide caused deflocculation of the mud, while large amounts caused flocculation.

(Continued on page 521)

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(Continued on page 521)
PUMP PISTON. Patent No. 2,208,461, issued July 16, 1940, to Edward St. Elmo Kilby, Yatala, Q 17 17, Australia.


ROTARY WELL DRILL. Patent No. 2,208,528, issued July 16, 1940, to Leon F. Thomsen, Honolulu, Hawaii, assignor to Thompson Tool Co., Inc., Iowa Park, Texas, a corporation of Texas.

ELECTRICAL LOGGING OR EARTH FORMATIONS. Patent No. 2,206,863, issued July 16, 1940, to Paul F. Hawley, Tulia, Texas, assignor to Standard Oil and Gas Co., Tulia, Oklahoma, a corporation of Delaware.


ELECTRICAL LOGGING OR EARTH FORMATIONS. Patent No. 2,205,892, issued July 16, 1940, to a corporation of Oklahoma.

SOUNDING APPARATUS FOR WELLS OR THE LIKE. Patent No. 2,205,892, issued July 16, 1940, to Homer Soumacchi, Oklahoma City, Oklahoma, assignor to Oil Equipment Engineering Corporation, Oklahoma City, Oklahoma, a corporation of Oklahoma.


VALVE FOR ROCK DRILLS. Patent No. 2,203,491, issued July 30, 1940, to William A. Smith, Jr., Cleveland, Ohio, assignor to The Cleveland Rock Drill Co., Cleveland, Ohio.


WELL DRILLING FLUID. Patent No. 2,205,391, issued July 30, 1940, to Charles Douglas Borne, San Francisco, California, assignor to Union Oil Company of California, Los Angeles, California.

CABLE TOOL DRILL. Patent No. 2,203,619, issued July 30, 1940, to Charles E. Wilcox, Compton, California, assignor to Byron Jackson Co., Vernon, California.

WELL DEVICE AND OPERATING MEANS THEREFOR. Patent No. 2,203,627, issued July 30, 1940, to Leonidas C. Miller, Dallas, Texas, assignor to Ertman Oil Well Survey Company, Dallas, Texas.


DRILL BIT. Patent No. 2,210,077, issued Aug. 6, 1940, to Benjamin Hanly, Oklahoma City, Oklahoma, assignor to Redding Roller Bit Co., Houston, Texas.


GUN PERFORATOR FOR WELL CASINGS. Patent No. 2,210,155, issued Aug. 6, 1940, to Edward F. Raymond, Redondo Beach, California, assignor to Lane-Wells Co., Los Angeles, California.


MEANS FOR TAKING WELL CORES. Patent No. 2,210,464, issued Aug. 6, 1940, to Charles M. O'Leary, Los Angeles, California.

ROCK EXTRACTING DEVICE. Patent No. 2,210,532, issued Aug. 6, 1940, to Albert Feucht, Garfield Heights, Ohio, assignor to The Cleveland Rock Drill Co., Cleveland, Ohio.

PROCESS OF SEALING OPENINGS IN THE EARTH. Patent No. 2,210,545, issued Aug. 6, 1940, to Andrew C. Hamilton, Jr., Dallas, Texas, assignor to United Oil Co., Corpus Christi, Texas.


METHOD FOR THE EXTRACTION OF PETROLEUM BY MINING OPERATIONS. Patent No. 2,210,582, issued Aug. 6, 1940, to Karl Gross and Gunther Schlicht, Wietze, Kreis Celle, Germany, assignors to Deutches Petroleum-Aktiegesellschaft, Berlin-Schoneberg, Germany.

FEEDING MECHANISM FOR ROCK DRILLS. Patent No. 2,210,926, issued Aug. 6, 1940, to Albert Feucht, Garfield Heights, Ohio, assignor to The Cleveland Rock Drill Co., Cleveland, Ohio, a corporation of Ohio.

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Drilling Muds—
(Continued from page 519)

2. Sodium Hexametaphosphate: this material caused a deflocculation of the clay. The complex radical tended to produce a greater change in the viscosity of the fluid than an equal amount of sodium hydroxide.

3. Sodium Chloride: salt caused a marked flocculation in the mud which resulted in a greater viscosity. Further addition of sodium chloride did not cause a material change in the viscosity after the maximum point was reached.

4. Tannic Acid: Tannic acid as a mud deflocculant has been used considerably on the Pacific Coast. It, however, did not appreciably lower the viscosity of the mud, but large amounts caused flocculation.

5. Hydrogen Chloride: Hydrochloric acid also caused flocculation of the mud, but the change in viscosity was less than that caused by sodium chloride.

As would be predicted the change in viscosity was directly related to the P H of the solution. Flocculation as related to P H seemed to be favored by the increasing acidity of the mud while deflocculation in most instances was greater as the alkalinity of the mud increased. The P H of the various muds after addition of the reagent are given below:

- Sodium Hydroxide: 9.4
- Sodium Hexametaphosphate: 8.1
- Sodium Chloride: 7.6
- Tannic Acid: 7.8
- Hydrogen Chloride: 7.5
- Mud (blank): 8.0

In conclusion, a review of the properties of drilling muds shows:

1. Drilling muds are mostly clay, which are hydrated aluminosilicates.
2. Viscosity measurements are valid if accompanied by sufficient data.
3. Colloidal particles have an important effect in muds and are responsible for gelation.
4. Flocculation of colloidal particles causes an increase in viscosity and deflocculation the reverse.
5. That electrolytes have an effect on viscosity by either flocculating or deflocculating the colloidal particles.
6. There is a definite relationship between P H and changes in viscosity.

No attempt was made to cover the entire field of mud chemistry. Rather the experiments were conducted to obtain knowledge of the reactions of Pierre Shale which is used extensively as a drilling mud in Colorado.

References

7. Woolgar: Connection Between Yield Point and Viscosity of Rotary Drilling Fluid, Oil and Gas J., 1935.

General References


J. F. Dodge, and A. C. Frietsche: Recent Study of Rotary Drilling Fluid Reveals Interesting Characteristics, Oil and Gas J., March, 1935.
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