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THE COMMERCIAL ASPECT.

The Price of Well Petroleum.—The oil shale industry, to be a commercial success, must compete in the open market with crude oil from wells. In recent years, the supply from wells has not been sufficient to meet the demand for oil and more oil. If any one has a lingering doubt about this fact, the very recent advances in the price paid by the pipe lines for crude oil in the wells should be an unanswered argument. Recent trade quotations give:

Pennsylvania crude, $5.00 a barrel (in 1915, $2.00 a barrel).

Wyoming fields, $2.00 to $3.00 a barrel (Grass Creek, $2.00; Elk Basin, $2.60; Lance Creek, $3.35; light oils in other fields: $2.35).

Mid-Continental field, $3.00 a barrel (in 1912 quoted at $3.80; in 1913 quoted at $3.00; $3.00 is the highest price ever paid for crude oil west of Chicago; this is the third increase in six weeks).

North Louisiana, $2.40 to $2.65 a barrel.

The Cost of Crude Shale Oil.—Conservatively estimated, the cost of producing crude shale oil as follows: Assume a well-equipped, efficient plant of 400 tons daily capacity, treating 400 tons of shale yielding one barrel of oil to the ton of shale:

Mining, ton or barrel: $1.25

Breaking: $0.10

Retorting: $0.35

Loading and shipping: $0.05

Amortization, interest, overhead expense, etc.: $0.10

Cost of barrel of crude shale oil: $1.65

Shale Versus Well Oil.—Crude shale oil, when produced, will naturally first come into competition with the Wyoming and Mid-Continental oils. Since the estimate of $1.65 is conservatively high, the lowest competitive price ($2.00 in the Wyoming field) and the highest price, $5.00 (in the Mid-Continental field) are both well above the danger line. If, then, oil shale retorting plants are now in effective operation on a commercial scale there is little doubt that their product would find a ready market at a remunerative price. There is, too, every reason to believe that the price of oil has only begun its upward course and much higher prices will soon be reached.

Not will the price of crude oil alone remain high. On account of the present large foreign demand, in addition to the strong domestic demand, the prices of lubricating oils and kerosene will very likely first be affected by the advance in crude oil. The shortage in the supply of gasoline is an additional factor which will help to advance its price also. Other refinery products are also due for an advance. All of which will aid materially in placing the oil shale industry on a profitable basis.

The recent coal strike has brought home to the large consumers of coal the danger of depending solely upon coal for fuel. Already many of the large New York and New England manufacturing plants are changing to oil. Many ocean steamships, as well as those on the Great Lakes, are also changing. In Chicago all of the public school buildings, in units of ten at a time, are being changed to use oil for fuel.

On railroads fuel oil is fast coming into favor on account of the low labor cost, the convenience, and the high efficiency. The following railroads now use fuel oil on a considerable part of their lines: Atchison, Topeka & Santa Fe; Southern Pacific, Kansas City Southern, Western Pacific, Northwestern and Pacific, Florida East Coast, Chicago, Milwaukee & St. Paul, Great Northern, Oregon Short Line, Texas & Pacific, Chicago, Burlington & Quinney, Chicago & Northwestern, El Paso Southwestern, Delaware Hudson (Adirondack Division), New York Central (Adirondack Division), Oregon-Washington Navigation Co., Texas Railways, Missouri, Kansas & Texas.

THE TECHNICAL ASPECT

The Retort.—The price of crude well petroleum and the general demand for oil are factors over which the individual has but little control. The construction of a retort to produce oil from shale is, however, a problem for the individual. Many unthinking persons reasoned that, since shale has been retorted in Scotland for the past sixty years, a retort of the Scottish type could be erected here, oil produced, and success would immediately follow. Unfortunately such reasoning does not hold good. The Scotch shale is
low in oil value, but high in nitrogen; the American shale is high in oil but low in nitrogen. The most valuable Scotch product is ammonium sulphate; ours will be oil. The Scotch retort is built as a double chamber; in one, oil and gas are produced at about 800 degrees;* in the others, the nitrogen at a temperature of 1,700-1,800 degrees.* The successful American retort will necessarily be one-chambered and quite distinct in plan and operation from the Scotch; hence the necessity for preliminary experimental work to evolve a distinct type or types for American shale. Some of the necessary characteristics of a successful retort are easy to state, but difficult to realize in practice, viz.:

1. The feed should be continuous.
2. The oil should be produced at the lowest possible temperature and removed at once.
3. The oil, gas, and shale residue should be continuously removed.
4. Heat should be applied uniformly.
5. The shale should not cake or gum.
6. Each retort should handle a large amount of shale a day.
7. Accessory machinery should be automatic.
8. Hand labor should be reduced to minimum.
9. A retort should be simple in construction and as near "fool proof" as possible.

Most of these specifications are based upon the principle that the production of shale oil must be on a large tonnage basis, like the porphyry coppers in metallurgy.

Practical Development.—For the past three years R. M. Catlin of Franklin, N. J., has been experimenting at Elko, Nevada, on a commercial scale. The shale runs about fifty gallons to the ton. The retort, manufactured by the Stearns-Roger Manufacturing Company, Pueblo, Colo. Operations on a commercial scale are expected early this spring.

The Wyoming Shale Oil & Refining Company owns 640 acres of shale land in the Bitter Creek district, in Sweet Water County, Wyoming. The shale is unusually rich and averages from fifty-eight to sixty-four gallons to the ton. The company plans to erect an eduction plant this spring.

The American Shale & Petroleum Company owns 1,249 acres of shale land in Sweet Water County, Wyoming. It intends to begin the erection of a Jensen retort April 1, 1920.

The Mt. Blaine Oil Shale Company owns 2,100 acres on Roan Creek, thirteen miles from De Beque, Colorado. The directors of the company intend to erect a Gallipoo retort this spring.

At Grand Valley, Colorado, the Consumers Oil & Shale Company of Chicago and the Grand Valley Oil & Shale Company have spent $25,000 in building roads to their property, preparing building sites, erecting buildings, all preparatory to erecting a 150-ton retort of the Stalman type in the spring. The total cost is expected to be $140,000. The installation is being done by the Petroleum Engineering Company of Kansas City, Mo., under the personal supervision of Joseph Bells, Otto Stalmann, and J. B. Jones.

The Mt. Logan Oil Shale Mining & Refining Company at De Beque, Colorado, has in process of erection a Simplex retort, manufactured by the Stearns-Roger Manufacturing Company, Pueblo, Colo. Operations on a commercial scale are expected early this spring.

The Continental Oil Shale Mining & Refining Company has completed a 50-ton plant, known as the Colorado Continuous Shale Process, designed by Hartley & Dynamm, engineers, Denver, in Rio Blanco County, Colorado, and has made a successful run. Bad weather and deep snow have, however, prevented further work until spring, when the company expects to renew operations and to run continuously on a commercial scale.

The Ute Oil Company has nearly completed a plant of the Wallace type with a daily capacity of 400 tons, at Watson, Utah. There are eighteen retorts, of one-ton capacity each. The time of treat-
Water Supply in Colorado.—A plentiful supply of water is one of the essential requirements for a successful oil shale plant. The absence of water makes the richest oil shale deposit virtually useless. R. E. McVane, a western slope engineer, is authority for the following estimate of the water supply in western Colorado:

“A reservoir covering four acres in deep is thirty-six acres feet. One cubic foot of water per second flowing three days will fill it, as will also three one-half statute inches flowing for a week. There are a thousand places on Red Creek and its branches, suitable for shale plants, where reservoirs of this capacity can be built and filled from spring run-off, summer floods and winter snow, without lessening irrigation. "S. G. S., in a recent paper before the American Institute of Mining and Metallurgical Engineers, expressed himself as follows:

The financial aspect of the oil shale industry is not a "poor man's game" in the sense that a small amount of capital invested will bring fabulous returns. On the contrary, it is distinctly a "rich man's game," in the sense that a large amount of capital must be invested before there is any return whatever. The smallest unit—and that only as a starter—should be of 100 tons daily capacity to cost approximately $100,000. This unit should be added to, till at least 500 tons a day are reached and 1,000 would be much preferable. Another point that should be emphasized is that the oil shale industry is a low-grade industry, of large tonnage, of continuous operation, with automatic machinery, and large output. "Workmen need only to be "broad in the back." The brains must be supplied in the office. The greatest need of the industry at the present moment is capital to open the deposits, erect retorts, establish refineries, organize distributing agencies, and in brief, to establish the industry on a commercial scale and a paying basis.

The Future.—While as has been the increase in the demand for crude oil and its products, yet the future holds out even greater expectations. There are now approximately 7,000,000 internal combustion engines in the United States. In ten years this number will very likely be doubled to 15,000,000. In spite of the phenomenal growth of the automobile industry, there is no indication of a slackening.

Good authorities assert that the next five years will show even a greater increase, or fully 15,000,000 motor cars in operation. The Ford plant alone will manufacture 500,000 tractors in 1920. The United States Shipping Board has ordered that all vessels greater than 5,000-ton dead weight shall be oil burners and has contracted for 31,000,000 barrels of fuel oil for 1920. France will require 8,400,000 barrels and Italy 336,000,000 barrels of oil in 1920. The potential demand for oil in the United States by 1927 is estimated at 8,000,000 barrels, and yet it is predicted that all well reserves will be exhausted by 1928. But in Colorado alone there is enough easily accessible oil shale to keep 100 plants, each treating 2,000 tons a day, in continuous operation for 800 years.

George Otis Smith, Director of the U. S. G. S., in a recent paper before the American Institute of Mining and Metallurgical Engineers, expressed himself as follows:

...
seven-fold. With the rapidly mounting consumption of gasoline has increased by railroads has more than doubled; the decade, then, the consumption of fuel oil what remains above ground. In a single reserve; we also drew from storage ogists as the contents of our underground 24,000,000 barrels, or nearly one-fifth of production direct from our wells was 356,000,000 supplies are limited. In 1915 the contribu­ tion that aspires to a large part of the world's commerce imposes upon itself oil problem, for the future freedom both the sea and the air will be defined in terms of oil supply. Oil Shale Comes into Its Own.—We have all these estimates to do with the rapidly mounting cost of coal, the competitive field of oil for steam use is expanding. We lessen the increase in coal or oil at a given production of generating power by lessening the water powers of the country, but prime movers, whether driven by steam or water, require lubrication.

A most serious aspect of our oil problem presents itself when we consider the entry of the United States as a real factor in the shipping of the world. Any nation that aspires to a large part of the world's commerce imposes upon itself oil problem, for the future freedom both the sea and the air will be defined in terms of oil supply.

The Requirements of a Furnace or Apparatus for the Maximum Production of Oil from Oil Shale

Definitions of Saturated and Unsaturated Hydrocarbons.

Before beginning this discussion it may perhaps be well to give definitions of one or two of the terms to be used. These definitions are not claimed to be complete, but they will suffice for all present purposes.

A hydrocarbon is meant a compound formed by a union of the element carbon with the element hydrogen. These compounds are very numerous and some of them are very complex, large numbers of carbon and hydrogen atoms being able to combine together to form all sorts of products. Some of the hydrocarbons are gases, some are liquids, and some are solids. The simplest hydrocarbon is the gas methane. It consists of one atom of carbon combined with four atoms of hydrogen. Hence a single atom of carbon has gone its limit and united with all the hydro­ gen it can. This brings us to the consideration of another term, the term "saturated". In the case at hand the compound, or hydrocarbon, is called "saturated" because the carbon atom has taken or combined with all the hydrogen possible. Now, while a single atom of carbon can take on only four atoms of hydrogen, two atoms of carbon can unite with each other, forming a nucleus that can unite with six atoms of hydrogen. This is the nucleus of this new compound as regards hydrocarbons, and the result is again a "saturated" compound. But it can also form a stable compound without going the limit, by simply uniting with only four atoms of hydrogen, and this compound still possesses the power of uniting with two or more atoms of hydrogen on occasion. Such a compound, having a reserve of combining power, is called "unsaturated".

The position of the United States in regard to oil, can best be characterized as precarious. Using more than one-third of a billion barrels a year, we are drawing not only from the underground pools but also from storage, and both of these supplies are limited. In 1918 the contribution direct from our wells was 356,000,000 barrels, or more than one-twentieth of the amount estimated by the survey geologists as the contents of our underground reserve; we also drew from storage 24,000,000 barrels, or nearly one-fifth of what remains above ground. In a single decade, then, the consumption of fuel oil by railroads has more than doubled; the consumption of gasoline has increased seven-fold. With the rapidly mounting
Imagine an upright iron pipe, say ten feet high and one foot in diameter, closed at the bottom and filled with lumps of broken shale. Suppose, now, the lower fifty feet to be heated in a furnace that will raise the entire immersed portion to a dull red heat. It is obvious that the shale nearest the outside of the pipe will reach a decomposing temperature and begin to distill its volatile products while the interior is still undergoing decomposition. The escaping vapors, therefore, will continue to get hotter as the temperature is far above what was originally required to decompose it, while the interior shale is still giving off an abundance of volatile products. These interior products, therefore, naturally take the easiest line of escape to the top of the pipe. The hot, exhausted outer layer of shale has by this time been heated much above the temperature of its proper decomposition temperature, so as to leave a more or less open channel toward the top of the pipe and the more heat has reached. The gases coming from the interior will therefore seek this channel of escape in preference to the much more obstructed channel through the center of the pipe. During their exit, along the sides they naturally take the easiest line of escape, leaving the retort. It will be remembered that the iron pipe previously referred to was filled with shale to the top only. Hence, the shale is still further decomposed with the formation of more unsaturated hydrocarbons. Therefore, the original vapors, in escaping from the retort, will still undergo decomposition, as they come more or less condensed into liquids that are again vaporized as the place gets hotter; the result is again the formation of more of the voluminous products of decomposition.

In addition to the above, it is found that when shale oil itself is again vaporized or distilled by the direct application of heat, if the shale is still further reduced to the crude hydrocarbons and the unsaturated hydrocarbons, there is an additional decomposition, so that the retort is again charged with light gases, and the process of decomposition is repeated. In the above statements relative to the application of heat to the shale, the shale is supposed to be at rest, that is, not agitated or revolved while undergoing decomposition. This is a serious objection to the use of the original retort employed in distillation with the two-fold object of equalizing the weight of the shale as arranged in the retort, and cracking it has been one of the methods used to prevent overheating or secondary decomposition. In this particular retort or other heating apparatus employed, it is evident that if a large lump of shale is strongly heated on all sides at once, it is likely to become exhausted and overheated while the interior is still undergoing decomposition, so that the products must either be cracked or distilled in their exit from the pipe or furnace.

**Cracking.**

I have several times spoken of this secondary decomposition as resulting in the formation of undesirable unsaturated hydrocarbons, with the consequent reduction in the quantity and quality of the oil obtained. The technical term applied to this decomposition is "cracking," as the original oil breaks up or "cracks" into other substances. All of these substances are not of the unsaturated kind. Some are both saturated and desirable, and cracking is one of the methods resorted to in the process of refining to remove these. It is a method of producing more light oils as gasoline, but this intentional cracking is carried on under carefully controlled conditions, which are quite different from the undesired cracking that may occur during the distillation of the shale. This and brings us to the question: "How may this original cracking be prevented or minimized?" I have already given the answer: it can be avoided by removing the gaseous products just as they are evolved from the shale, without allowing them to come either overheated or condensed before leaving the retort. How this can be done is a matter of invention, but it apparently has been accomplished by at least one or more American processes. A second method is to control the temperature in the retort by the introduction of superheated steam. This is done in the Scotch retort. The temperature is raised by superheating and increasing the production of ammonia. I refer to the question of ammonia. While this superheated steam is much in the way of preventing cracking it overcomes the disadvantages, besides the consumption of much more heat in the distillation. It is customary to use as much as half a ton of ammonia for every ton of shale re-torted. All this steam has to be condensed, and, as it may equal in amount several times the total volatile products produced from the same ton of shale, the condensing apparatus must be correspondingly increased, with a like increase in cost. This is a serious objection to the use of superheated steam. A second objection is that the steam and oily vapors are condensed together, forming an emulsion of oil and water that may require weeks to separate. This makes the oil hard to handle, besides necessitating increased storage facilities.

On account of the disadvantages noted, it therefore appears inadvisable to use superheated steam, but it is possible to avoid it if this point may be regarded as Requirement No. 4.

Another method of avoiding overheating and cracking during the distillation, and which, according to the inventor, gives satisfactory results, is to pass the crushed shale in stages through ovens heated to different temperatures, beginning with a low temperature, where the heat is just sufficient to start the decomposition of the shale and produce the
more volatile products, and continuing through a second and third oven, with the latter sufficiently hot to completely finish the distillation. Heat is saved and the different temperatures attained under this plan by simply having one source of heat for all the ovens and passing the heat leaving the hottest oven to that of the next lower temperature, and so to the next. By drawing off the vapors separately from each oven and condensing them separately, a partial refining may be accomplished. Thus it is seen, as stated before, that methods for preventing or minimizing cracking are purely matters of invention.

Conditions Effecting the Recovery of Ammonia.

I will now pass to the question of the recovery of ammonia. Ammonia is a compound of nitrogen and hydrogen in certain definite proportions. If a complex organic compound or mixture happens to contain both nitrogen and hydrogen, it can be decomposed into its constituents—nitrogen and hydrogen. Ammonia may decompose in the shale also contains some nitrogen compounds. When heated, the hydrogen compounds in the shale will begin to decompose at about 105° F., and the nitrogen compounds will decompose at about 735° F. Ammonia will form in the mixed vapors and its quantity, slope, and degree of decomposition will depend upon the amount of nitrogen in the shale. If this ammonia is removed or drawn off from the retort without suffering overheating it will not be decomposed, but will remain as ammonia or an ammonia compound, to be subsequently easily recovered from the condensed products. It is a valuable by-product. After the ammonia has formed, it goes on to decompose in a higher temperature before leaving the retort, it is liable to be again more or less decomposed into its constituent gases—nitrogen and hydrogen. Ammonia cannot be decomposed at a temperature a little above 900° F., and will be completely decomposed at a temperature somewhat about 1,400° F. In some processes, where provision is not otherwise made for preventing overheating, steam is used for equalizing the temperature, thus, at the same time, saving the heat leaving the hottest oven to that of the next lower temperature, and so to the next. By drawing off the vapors separately from each oven and condensing them separately, a partial refining may be accomplished. Thus it is seen, as stated before, that methods for preventing or minimizing cracking are purely matters of invention.

Proper overheating the steam does not apparently assist in the formation of ammonia, but simply by equalizing the temperature, prevents its decomposition. Steam is said to contain nitrogen and hydrogen, although there will be some carbon in the form of coke. If this carbonized shale, which will still very hot, be now treated with steam, which contains hydrogen and oxygen, both the steam and the nitrogen compound may decompose; the oxygen of the steam uniting with the carbon present to form carbon dioxide, and the hydrogen of the steam uniting with the nitrogen present to form ammonia. Under the conditions, therefore, steam is useful in obtaining an increased production of ammonia, but, of course, the disadvantages following the use of steam still remain and the additional ammonia recovered may not be worth the increased trouble and expense.

Permanence Gas.

The valuable products sought in the distillation of oil shale are oil and ammonia. A certain amount of permanent gas is unavoidably produced, but as long as oil is formed, far more than the oil. Whatever gas may be produced should, of course, be utilized in heating the retort, and it may, with the maximum production of oil, be sufficient to furnish about half the heat required. The additional heat necessary may be supplied by a producer gas or otherwise, according to the conditions.

I have made no mention of the shape, size, or material of construction of the retort or heating apparatus, as these variables depending upon the process proposed and other considerations. I have also taken up any questions relating to recovery of the products, and their refining as being foreign to the subject at hand.

Resumé.

In view of the foregoing, the requirements of a furnace or apparatus for the maximum production of oil from oil shale may be summarized as follows:

Requirement No. 1. Avoid overheating the original vapors produced, during the escape from the retort or furnace, as thus, as much as possible, prevent cracking and the consequent loss, both in the quantity and quality of the oil recovered.

Requirement No. 2. Avoid the re-evaporation of the vapors before leaving the retort, thus forming liquid oil which will require to be again vaporized before extraction. Use the re-evaporation results in cracking and loss.

Requirement No. 3. Study the proper thickness of the body of shale to be distilled, so as to attain the most economical cracking conditions, that is, the least expenditure of time and heat.

Requirement No. 4. Avoid the use of steam unless considerations of the process used absolutely demand it, as steam occasions much extra trouble and expense.

In the above discussion I have made no attempt to go into the subject exhaustively, but have aimed rather to present the more salient requirements in as simple a form as possible, that those interested, but perhaps unfamiliar with the subject, might have a better understanding of the situation.

Diamond Drilling, the Ideal Method of Sampling Oil Shale Deposits

By C. Erb Wietensch, "14.

Impossibility of Sampling Shale Deposits from Roughs.

We are in the habit of conflicting statements made as to the "oil content"** and thickness of the oil shale strata of Colorado and Utah. The truth is, no one as yet knows! Shale beds in private empires who have taken numerous samples are in accord, in that, it is absolutely safe to assume that there are thirty feet of oil shale strata, in beds thicker than three feet thick, that will yield one barrel (42 gallons) of oil to the ton. These figures are given to be well within the limits of conservatism. Others who are not so conservative have gone so far as to say that there are at least two hundred feet that can be mined in one body and which will yield an average of better than one barrel per ton.

The reason for these discrepancies is easily explained when one considers the multitude and inaccessibility of the main oil shale strata in the middle member of the Green River formation. Where the whole formation is exposed in escarpments it is invariably two to five hundred, or more, feet thick, and the accessible slopes. Hence it is a physical impossibility to sample more than a few feet at the base. If the formation happens to be exposed along an accessible slope, the shale is most frequently of the "topo" variety which is not representative of the solid, unsalted material that will be found at some distance from the outcrop. In any event, it is a fact that no one vertical section of the whole formation can be accurately obtained from the surface and outcrops of the cliffs.

Applicability of the Diamond Drill.

From this, it must not be inferred that it is beyond the range of human possibility to accurately sample the shale deposits in its. The shale beds lie practically flat and the tops of the shale cliffs composed of gently rolling hills and relatively level expanses, called mesas. Practically every one of these mesas has at least one accessible trail to the summit over which it would be possible to use pack animals. Because of these topographical features, the logical method of sampling the oil shale deposits is by the use of the diamond drill. The diamond drill can be set up on tops of the cliffs and vertical holes bored through the whole formation below.

Brief Description of Diamond Drilling for the Uninitiated.

The diamond drill is nothing more than a series of hollow rods that are screwed together in five or ten foot sections, and at the bottom of which is attached a bit, or cutting tool which is set with diamonds (horts). The rods are rotated by a suitable engine, which for work of this sort is usually driven by steam. As the rods are rotated the diamond bit cuts a circular groove in the rocks and leaves a solid section of rock, or "core," within the center of the rods. At intervals the rods are withdrawn and the core removed. A "core-barrel" is placed in the section of rods adjoining the bit. This
holds the core within the hollow of the rods while the latter are being withdrawn from the hole.

The diamond drills for this sort of work are sectionalized, so ordered that the individual parts are light enough to be easily handled by men. It is possible to take a complete and accurate core and a core-drilled through the hole down to the depth. The water removed to cuttings which enables the bit to efficiently operate against the solid rock, thereby preserving the water to keep the bit and diamonds cool.

**Technical Data on Diamond Drilling Oil Shale Deposits.**

Although there is no actual data on the results of diamond drilling oil shale deposits, there is considerable data available relative to diamond drilling coal deposits. Since the rocks encountered in coal and oil shale fields are practically identical, what applies to one holds equally true for the other, with perhaps one exception. In prospecting for coal it is not always possible to make a large recovery of coal except of the coal itself. In drilling oil shales it will be necessary to make as much core as the whole formation is not drilled. In order to secure a large enough sample to make tests of the various strata, it will be advisable to use a drill which will make a two-inch core drill under the conditions prevalent in the oil shale fields.

Diamond drilling is the ideal method of sampling oil shale deposits. It makes it possible to take a complete and accurate sample of the whole oil shale formation at any point. Every bed can be sampled, and their richness and thickness absolutely determined. The operator will be able to figure whether it will be most profitable to mine the individual seams of richer shale, at a higher cost of mining and a lesser recovery of the total amount of oil available, than to mine the whole formation, stripping the barren material and mining lower-grade shale, with a lower mining cost per ton handled and a higher recovery and he will know beyond a doubt the amount and grade of oil shale that lies around each individual core-drilled together and to place them in the future operations. In addition to this, he will have obtained this information in the quickest possible time with a minimum of expense and accuracy. Now is the time to do this work.

The logical way of doing this work is for a number of companies to co-operate in drilling, so drilled by any one individual than if this work were attempted separately by each company.

**ELECTRIC FLASHES.**

Electrical and compressed air core-cutting machines are shortly to be introduced into some of the coal mines of England, according to recent reports.

Electricity is being widely used in the North Sea mines. Many of the mines are sunk very deep, and have tunnels which, when trenched, are liable to explode. Special electric cables several hundred yards long are being used to explode these mines at a safe distance from the boat.

Electric plows are being tried out in Italy, and the trials have proved so satisfactory that it is probable electric plowing will be employed. Work has been shown to be less than one-third of the cost of the ordinary tractor work, and the fact that most of the fields are small and comparatively flat, so that the necessary power is available in practically every section of the country, makes it especially suitable for this experiment.

The Norwegian Fishery Administration is considering using electrically propelled boats in his fishing fleet. A considerable sum has been allotted for conducting research along these lines.

Electric heat is becoming more and more widely adopted in industrial processes—such as Japan baking of automobile bodies, and brass melting furnaces—because of its numerous advantages over other kinds of heat. Some most evident advantages are the greater working temperatures obtainable, the absolute control of the heat, and the evenness of heat distribution.

**Shale Oil Bibliography for 1919.**

**JANUARY.**


**Pearce, A. L.:"Oil Shale." Mining and Scientific Press, Denver, January 18, 1919.


**FEBRUARY.**


**March.**


**Oil and Gas Journal.** Tulsa, Oklahoma, March 28, 1919. "Salt Lake Mining Review—Salt Lake Oil Shale."

**APRIL.**


**Salt Lake Mining Review—Salt Lake Oil Shale.**

**MAY.**


**Coal Age.** New York, May, 1919. "Electric Heating." 21 Low Temperature Carbonizing."


**July.**

**Bella, Joseph: "Elaboration Information on Oil Shales." Oil and Gas Journal, Tulsa, Oklahoma, July 22, 1919. "Recent Work on Large Scale Planned by United States Oil Shale Corporation."


**The American Journal of Oil Shale.** "Proceeding of First Annual Meeting of United States Oil Shale Corporation."


**Lyon, Leon: "Shale Oil."

**August.**

**Bureau of Mines, Department of Interior.** "The Oil Shales of Northwestern Colorado." Bulletin No. 5, Denver, August 1, 1919.


on the seacoast about five miles west of the port of Winniebah.

The outbreak of the war put a stop to the operations, until they were renewed in 1918, under circumstances more favorable.

Newly were at least four or five companies now in operation upon these deposits or hold options on them.

F. A. L.


A descriptive article dealing mainly with the romance and accidental discovery of the valuable property by two prospectors returning from a futile two-years' search. Exceptional returns from preliminary shipments bring wealth to the owners and inspire adjacent leasers to active development.

W. S. L.


An illuminating account of improved methods of drilling and blasting at the property of the North Butte Mining Co.

The following topics are ably discussed:
1. Adjusting the machine so as to obtain best results.
2. Discrimination in the selection of powder for breaking different kinds of ground.
3. Attention to ventilation as an important factor in producing results.

Illustrations of the instruction and requisition cards issued to miners working on development headings. Results indicate that a high standard of efficiency has been reached by this company in its drilling operations.

W. S. L.


Four general groups of prospects comprises the Divide area which bears a certain geological similarity to the Tonopah district. Description of the general exploration and development methods followed are given, together with mining, supply costs, and other data.

W. S. L.

METALLURGY.

Differential Flotation of Zinc-Lead Sulphides by Metallizing the Blende. (E. & M. J., December 27, 1919.)

The results of the experimental work of C. C. Freeman, of Broken Hill, on the differential flotation of lead-zinc sulphides are embodied in U. S. Patent 1,301,551, April 22, 1919. Dilute carbonate of soda solution used as a frothing agent was found to give different results; a great improvement was noted when zinc sulphide particles had been specially coated with certain other metallic sulphides as copper. The metallizing of the zinc sulphides is the result of electrolytically depositing copper on one of the salts, or a metal electropositive to copper, in contact with the flotation pulp. On the invention, says the patent, is unnecessary in the first stage, as it helps to float blende along with the pyrites thus forming the lead concentrate. The process is claimed to be of particular commercial value when the zinc predominates in a concentrate and when pyrometallurgical treatment is necessary.

The article is well illustrated. Several tables and diagrams are included.

The machine and process present the following characteristics expressed in brief:
1. It maintains the physical and metallurgical conditions of the present-day practice.
2. The energy of the distillation is generated within the charge itself.
3. It is a large unit furnace, the handling of material will be done in cranes.
4. Probable costs have been calculated which show a marked reduction over present costs.
5. The process can be applied to zincores, even to the so-called complex ores.

W. S. L.


In addition to the circulating production of copper in the blast furnace, the remaining fractions of the blast and in the plant are often called upon to treat a wide range of metallurgical by-products from outside sources as well as miscellaneous copper-bearing scrap material. The author discusses the methods of sampling and analyzing these products entering the refinery, their treatment in regular or special furnaces, with a discussion of the commercial possibilities of recovering some of the impurities as metallic by-products.

W. S. L.

A Contribution to the Study of Flotation. By H. Livingston Sulman. (The Mining Journal, November 22, 25, and December 6, 7, 1910.)

This article, although published in other magazines, is more completely printed from the original copy read before the Institute of Mining and Metallurgy. It is written in technical form and is very clearly described by sketches and diagrams.

All the questions connected with flotation that the Mineral Separation, Ltd., have made such a success, are clearly brought out by Mr. Sulman. The article is continued in four numbers of the Mining Journal.

W. S. L.


In the second installment of this article the author deals with the commercial control of the petroleum industry by various countries. The names of the companies operating in different parts of the world are given. American, British, and Dutch interests control most of the world's oil. The author states that the United States is supreme in the Western hemisphere, but deplores the aggressive foreign nationalistic policy similar to other foreign governments.

W. S. L.

Geologic Distillation of Petroleum. By Bally Willis. (A. I. M. E., Jan., 1920.)

In 1882, Peckham put forward a provisional hypothesis to account for the distillation of petroleum. He did not formally state the hypothesis, but discusses facts drawn from many fields. He tried to point out "fractional distillations" produced under high pressure, and consequently at a comparatively high temperature.

The object of this paper is to test Peckham's hypothesis and the contributions to it made by White and Johnson, by considering the geologic activities of Appalachian province in the light of the present-day knowledge.

W. S. L.


The basis of this article was issued in mimeographed form for Government use only, and after the armistice, the remaining copies were released to the general public. The article summarizes briefly and concisely information relating to:
1. Geological strata in which oil is found.
2. Geographical distribution.
3. Future prospects in various countries.
4. Political control of the present production.

W. S. L.
PERSONALS

'95.
C. Terry du Roll is now residing at 4125 Innomar St., N. W. (Chevy Chase), Washington, D. C.

'98.
Mr. Fred Johnson, formerly Supt. of the A. V. Smelter, at Leadville, has removed to Pueblo, where he is connected with the A. S. & R. Co.

'01.

'07.
Warren C. Prosser is a member of the firm, Prosser & Huyes Engineers, 715 S. Ohio Street, Wichita Falls, Texas. They specialize in oil field work.

'08.
Russell R. Bryan is with the Sunnyside M. & M. Co., Eureka, Colo.

'09.
Burr J. French has been transferred to the South Bend Plant of the Studebaker Corporation, address 906 E. Donald St., South Bend, Ind.

'09.
E. W. Enriquez is General Supt. for the Compania Minera del Mirasol Cusihuira, Chihuahua, Mexico.

'12.
John Davenport, Metallurgical Engineer, of 5 Custom House St., Boston, Mass., has recently been issued a U. S. Patent for the production of pure sulphur dioxide from smelter smoke. Davenport is also consulting engineer for the Wau­ner Abrasive Company, of Chicago.

B. T. Hager is at present operating a chromite mine and mill in San Luis Obis­po County, California, for the L. H. Butcher Co., of San Francisco.

We have received the sad word of the sudden death of Paul Hildale’s wife, at Salt Lake City, Utah, on February 5th. She had been a model woman, a loving and devoted mother, and a devoted daughter.

J. M. Frankel has changed his residence from Marencol to Clifton, Ariz., P. O. Box 645. He is still with Arizona Copper Co., Ltd.

L. G. Traheurt has resigned his position with the Arizona Copper Co. to become Superintendent of a new copper property in northern California.

'14.
Adolph Brems was married on December 31, 1914, but we have been unable to obtain further details. His address 136 W. 84th St., New York City, is 15.

Thomas T. Couch is now head of the physics department at the Peking Acad­emy, Peking, China.

Fred M. Nichols and Mrs. Eunice M. Dickman were married on January 13th at Butte, Mont. Mr. McNichols, on February 1st for Colombia, South­ America, to become Superintendent of the Chicago Mine, at Puerto Andes, Arequipa.

'15.
B. C. Essig is Field Engineer for the U. S. Bureau of Mines and the State of Colorado. The Bureau and the State are operating in making a survey of the minerals of Colorado with the view to solving some of the ore-dressing problems.

J. A. Burns is with the Butt & Perior Mining Company, Butte, Mont.

H. E. Mum was made Manager of the Sunnyside Coal Mining Company operating mines at Strong, Colo. Mum divides his time between the Denver and the mines.

Fred M. Nichols has returned from Peru, South America, and is now at 3153 Red St., Denver, Colo.

S. A. Newhirt has been promoted from Asst. Engineer to Engineer, Coronado Division, of the Arizona Copper Co. He is now at Mescal, Ariz.

Russo R. Parker has arrived safely at Tashketo, Kasai District, Congo, West Africa, care of Fororiniere.

D. B. O'Neil, ’98, is Managing Engineer at the mine.

OBITUARY

Anne Fuller Hildale, wife of Paul Hildale, 1912, died of influenza February 4th, at Salt Lake City. She leaves a daughter, Katharine, 3 years old.

The Hardinge Conical Mill Company Changes its Name.

The Hardinge Conical Mill Company will henceforth be known as the Hardinge Conical Mill Company, according to a change in name announced by the company.

The velocity with which electricity travels is even greater than the velocity of light. Experiments have demonstrated that electricity travels at the rate of 186,247 miles per second. Thus electricity could travel to the sun and back in less than 30 minutes.

ATHLETICS

The Colorado School of Mines defeated the Colorado College team in the second Rocky Mountain Intercollegiate Wrestling Contest at Colorado Springs. Mines won six out of nine matches. Some very fine mat work was presented; no boxing bouts were scheduled. The summary of the events is as follows:

First match, 115 pounds—Won by Weinstel, Mines, over Lase, C. C., in 34 minutes with tawבינ and croch hold.

Second match, 2. 5 pounds—Won by Kay, Mines, over Carter, C. C., in 6 minutes with scissors and half nelson.

Third match, 135 pounds—Won by Benis, C. C., who was given decision over Kaufman, Mines, after 10 minutes with a fall. Benis had Kaufman in a scissors and head hold and nearly down when the whistle blew. Ten seconds more would probably have scored for Benis.

Fourth match, 183 pounds—Won by Terry, Mines, over Hinton, C. C., in 8 minutes with a scissors and head hold. This
boat was very fast and both men displayed much science.

Fifth match, 145 pounds—Won by Serefinni, Mines, over Daywalt, C. C., who got a decision in 10 minutes with no fall. Serefinni confined himself mostly to the scissors and head holds. The men were very fast.

Sixth match, heavyweight—Won by R. C. Crawford, Mines, who threw Brunswick, C. C., in 7 minutes. Brunswick played in rather hard luck. He attempted to head spin out of a head hold, but got too close to Crawford, his shoulders striking his opponent's body. Crawford fall on Brunswick, and was given the verdict.

Seventh match, 168 pounds—Won by Elliott, C. C., who threw J. W. Crawford, Mines, in 7 minutes with a head and scissors.

Serefinni confined himself mostly to the field, and was given the verdict.

Fifth match, 145 pounds—Won by Serefinni, of Mines, over Thompson, Mines, in 10 minutes with no fall. Serefinni was the aggressor all the way through, and was given the verdict because he was the top man for 45 seconds.

Ninth match, 168 pounds—Won by Denistein, Mines, who threw McCool in 9½ minutes with a head hold. Denistein was given the decision over Thompson, Mines, in 10 minutes with no fall.

All of the wrestling events were scheduled ten minutes, and the boxing contests were scheduled for three rounds.

A wrestling contest held in Denver, Colorado, in the lightweight wrestling by a fall in 11 minutes. Kay, of Mines, defeated Chapin, of Colorado, in the featherweight wrestling by a decision. Lovelace, of Colorado, defeated Thompson, of Mines, by a decision in the 13 pound wrestling.

The surprise of the evening was when Ferguson, of Colorado, won over R. F. Crawford, of Mines, in 7 minutes with a head and scissors.

The Mines scored another boxing and wrestling victory for itself. In its meet with the University of Colorado they won six out of ten matches. Two were a draw and two matches were won by Boulder.

The second semester commenced January 12th, with total of 335 students enrolled. Seventy-six scholarships were cancelled and only 135 freshmen are left out of 199 that completed the first semester.

The Colorado School of Mines is giving the following popular lectures on Petroleum Technology:


Wednesday, February 18—III. The Composition and Properties of Oil and Gas. By F. M. Van Tuyl.

Wednesday, February 25—IV. The Origin and Occurrence of Oil and Gas. By F. M. Van Tuyl.

Wednesday, March 3—V. The Method of Prospecting for Oil and Gas and the Development of Oil Fields. By F. M. Van Tuyl.

Wednesday, March 10—VI. The Oil and Gas Fields of North America and Western Territory of Promise. By F. M. Van Tuyl.

Wednesday, March 17—VII. The Origin, Occurrence, and Distribution of Oil Shale. By F. M. Van Tuyl.


Wednesday, March 31—IX. The Refining of Crude Petroleum. By A. H. Low.

Wednesday, April 7—X. The Production and Refining of Shale Oil. By A. H. Low.

The lectures will be given in Simeon Guggenheim Hall at eight o'clock on the evenings of the dates announced.

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