The Oil-Field Geologist

How Science Has Made Gambling on Petroleum Prospects a Thing of the Past

By O. R. Geyer

THERE is no more entertaining romance of the oil fields today than that of the oil field scientist, or geologist, whose discoveries have revolutionized the oil industry of the world and who, in the immediate future, will lead the desperate battle to bolster up the production of oil until it can more closely keep pace with the tremendous demand for crude and refined oil products.

Fewer than a dozen years ago the man who professed to be able to discover the location of Nature's secret oil pools without first running the hazardous risk of sinking test wells was about as popular in the oil fields as the fool who plays with matches in the vicinity of a newly tapped gas pocket. Hardened gamblers who had won and lost fortunes by "wildcatting" for oil pools looked upon the geologist with contempt and scorn. This was especially true in the oil fields of the West and Southwest, where the work of geologists in the Appalachian fields was not regarded as a serious contribution to the work of unlocking the vast storehouses of oil so craftily hidden by Dame Nature.

Conditions have changed vastly since those days in which the Mid-Continent field of Kansas and Oklahoma first smashed all records for production. Today the oil field geologist is a highly respected expert, and so great is the demand for his services that there is not enough of him to go around. Schools and colleges which specialize in turning out full-fledged geologists able to cope with the oil game cannot graduate them fast enough these days, and it will be many years before this type of expert becomes a drug upon the market. In fact, the demand for his services will increase in the same ratio as the consumption of oil increases over production.

The conservatism and efficiency of science have long since replaced the methods of the old-time "wildcatter." The oil barons are no longer content with "hit and miss" methods and are paying exceedingly well for the services of men who can reduce to a minimum the dry holes which plague the most resourceful leaders of the industry. The commissions earned by the geologists who have been successful in discovering new oil fields mount into fabulous sums. Many of these experts have long since become millionaires, fees of \$500,000 or more belonging to the common, or garden, variety.

The discovery of the Ranger, Burkburnett and Homer pools in the Southwest can be attributed in no small measure to the work of some of the best known oil geologists in the country. The Ranger and Burkburnett fields had scarcely been converted into "proven" territory before these experts were dashing out to all corners of the world in their frantic search for new oil pools. Today there is scarcely a nation in the world which cannot boast of the presence of one or more of these experts engaged in mapping out likely fields for the work of the prospector. Because of the ever-increasing inroads being made upon the reserve supply of oil, this search is approaching the stage of desperation. Even now experts are hinting broadly that the undeveloped oil fields can scarcely supply the world's needs for more than another quarter of a century.

Fuel oil has been substituted for coal as the motive power for hundreds of steamships, and this, too, has contributed to the enormous drain being made upon the country's reserve supplies of crude oil. A year ago it was estimated that the country's oil fields would have to increase their production by 50,000,000 barrels a year to prevent further inroads into the reserve supply. The demand for crude oil and its products has increased enormously since then, making it necessary for an even greater increase in production in case supply and demand are to be kept on even terms.

Hence the importance of the geologist. Thousands of these experts are combing the world today for possible oil "structures." Alaska, Canada, Mexico, Colombia, Venezuela, Brazil, Trinidad, Cuba, Russia, Rumania, Alsace-Lorraine, Germany, Great Britain, France, and various parts of Asia and Africa today are under the watchful eyes of oil geologists. Hundreds of millions of dollars must be expended in this work of prospecting and sinking test wells in all cor-

ners of the world, and there are billions awaiting those who are successful in the prosecution of this worldwide game of hide-and-seek with Dame Nature.

There is scarcely a paying field in Oklahoma or the Southwest whose location was not known definitely to geologists long before the drill began pounding its way into the bosom of the earth. Notwithstanding the excellent record established by science in locating oil pools, it is by no means perfect as yet. In proven territory it comes very close to a 100 per cent score, because in such cases the problem is not to locate new pools but to find the most advantageous point for the sinking of new wells.

Many of the larger and more conservative companies have drilling records of from 75 to 90 per cent in the way of successful producers, although many of these wells have been sunk in more or less unproven territory. Geology has done this, of course, and as experience multiplies there is no reason why this record should not be improved. The importance of advance knowledge of the location of oil pools will readily be understood when one appreciates the high cost of drilling these days. In Texas, where the oil sands are located from 2,000 to 4,000 feet beneath the earth's surface, an ordinary well costs from \$25,000 to \$50,000, and failures are exceedingly trying upon the pocketbook, especially in the case of the shoestring operator.

The remarkable results obtained by some of the best known geologists in picking out likely locations for wells and in casting out the bad spots would fill a book. The success enjoyed by one Sullivan, the geologist who mapped out the immensely prolific Burkburnett pool, is only one of the striking examples of

have been formed as the result of one upheaval of rock, only to be drained by a second shock coming centuries later. Earthquakes, for instance, have a sly habit of wrecking profitable oil fields by opening up new cracks and crevices hundreds of feet down in the earth and allowing the oil to escape into new pockets and pools. The skill of the geologist is of little avail in locating these hidden mysteries.

Three important factors enter into the accumulation of gas or oil beneath the earth's surface, geologists have discovered. The first is a favorable structure—anticline or monocline. The second is a good open sand, and the third the right height of structure with reference to salt water. Of these three factors only the first can be determined more or less definitely before drilling, and there is always the chance that a freakish twist or convulsion of nature has destroyed the "scent" followed by the scientist.

The development of oil field geological research dates back to the time of Dr. I. C. White, who surveyed what are known as the West Virginia, or Appalachian, fields. His reports on oil "structures" in that field have formed to a large extent the basis for investigations in all other fields. Later other pioneers took up this work in Pennsylvania and Illinois, but the Mid-Continent fields had become the country's principal producing district before this science had gained a foothold in the Southwest. Almost all of the discoveries which made Oklahoma the greatest oil producing State for a time were the result of geological investigation. The Cushing field, which will go down into history as the world's greatest oil pool unless some new record breaking discovery remains to be made, was brought in at the insistence of geologists.

Since those pioneer days commercial geologists have been turned out in large numbers to meet the demands of the oil barons of the South and Southwest. A short course for oil field geologists, patterned after the short course idea which revolutionized farming methods in the Middle West, was established some years ago by an Oklahoma college as a means of overcoming the shortage of geologists. Since then the student roll of every college specializing in this work has been carefully scanned by the great oil companies for any possible additions to their staffs.

The rewards paid geologists who have made a success of their work in the Southwest make them the country's highest paid scientists. Fees received by some of these experts have been enormous, and it is a poor geologist indeed who cannot command a salary well up in four or five figures.

Oklahomans are fond of telling of the two Vandruffs, father and son, who stopped off in the Oklahoma fields at the invitation of one of the oil companies. The president of this concern was anxious to discover a new field which would enable his company to maintain its rate of production far into the future. The two experts, who had originally intended to locate in California, were sent into the wilds of a rough and hilly section of the State which had been scorned heretofore by oil men.

They spent weeks making a minute examination of the rock formations, and as rapidly as their work was completed lease men employed by the company followed them up, signing up all approved property at moderate sums. When the Vandruffs completed their investigations, this company had obtained leases on 6,000 acres of property which had been scorned by more conservative oil men. As their fee, the father and son received a one-eighth interest in the property. Some months later the first well was brought in and a prolific producing pool worth many millions of dollars had been revealed. The two disposed of their interest for \$500,000, a princely sum in those days.

The rewards to be gained by oil field geologists have been by no means exhausted, and will continue to mount and grow as prospectors continue their one-sided game of hide-and-seek with Dame Nature. At the present rate of consumption America must increase her production of crude oil at the rate of more than 40,000,000 barrels a year if she is to keep pace with her own needs. In 1919 more than 400,000,000 barrels of oil were required to meet domestic needs.

HOW many of those discriminating investors who try to separate the sheep from the goats when they turn to oil stocks for investment realize that they are here backing science to unlock the secrets of Nature's storehouse of liquid gold? How many of them understand the revolution in methods which has come over the oil fields in the past ten years? No longer does the "wild-catter" flourish, the man who drilled for oil because he had a lucky "hunch," or because he thought maybe oil was there. Today the geologist precedes the driller, and while he cannot show a clean score of successful predictions, he has vastly reduced the hazard of unprofitable boring. How he has achieved this and what his success means to the industry are the theme of the present story.—THE EDITOR.

the proper procedure in the exploitation of new oil fields.

Two years ago, when the rumbles of the approaching oil discoveries that were to startle all the world were heard in Texas, Sullivan was sent into what is now known as the Burkburnett district to prospect for likely oil pools. He studied this field exhaustively for miles in all directions, and mapped out what appeared to him every spot that could be drilled successfully as well as probable duster territory. Since that time hundreds of wells have been drilled in this territory, and so carefully did Sullivan select the sheep from the goats that oil men generally have scored him as a 100 per cent geologist.

The work of the geologist is based upon the anticline theory perfected in recent years. An anticline, one finds on consulting Webster, is "a fold or arch of rock strata dipping in opposite directions from an axis." Oil wells are drilled on these anticlines, commonly called drilling on "dome" or "structure." Geologists have found that the rock and sand strata in anticlines formed by the earth's convulsions are more productive of oil and gas than any other earth formation, and this has made the work of the prospector much easier than in the days of "wildcatting."

In beginning his work the geologist first seeks to find an unbroken fold or anticline of rock. He knows that in the pocket thus formed by nature he may find a pool of oil. This is by no means certain, however, for any number of things may have contributed to the lack of oil. The first and most probable is that a concealed break, hundreds of feet below the surface, may have allowed the gas and oil stored there to escape hundreds or thousands of years ago. The pool might

Improvements in Screw Measuring Machines

DR. P. E. SHAW, of University College, Nottingham, England, has further improved his screw-measuring machine, which has already been mentioned in these columns. The new machine appears to be very simple in construction and rapid in operation. All the movements are sliding, thus greatly reducing the time needed as compared with the tedious manipulation of the ordinary micrometer devices. One special merit claimed for the new machine is that it is equally applicable to plug and ring screws. There appears no reason to doubt that this claim is correct, in which case a distinct advance in metrology will have been secured, as the present method of measuring ring screws by means of standard plugs is not only tedious but requires a costly outlay for apparatus. The accuracy of the new machine is stated to be to 1-5,000th of an inch on diameters, and 1-20,000 on pitches, both in the case of plug and ring screws, thus satisfying the highest requirements of ordinary practice.

Chemistry Applied to Safety

THE National Safety Council is responsible for an investigation undertaken at the Bureau of Standards to determine the action of hydrochloric acid on manila rope. When brick work is washed down, the commercial grade of hydrochloric acid known as muriatic acid is commonly employed, the men working from staging supported by manila rope used in blocks and falls. Accidents have occurred because of the rope becoming weakened through contact with the acid or its fumes, and the action takes place without any superficial trace being noticeable to the eye. Serious accidents have resulted, hence it is now suggested that the rope be treated with some acid-resisting compound. This portion of the investigation is now under way, especially with reference to ascertaining the protection which would be afforded the rope by the use of compounds which have proven effective in protecting machinery and similar equipment from acid corrosion.

Purifying Oil by Centrifugal Action

FOR many years there has been in use in most of the large engineering works of this country a centrifugal separating machine which removes the oil from iron and steel turnings or borings, and thus permits it to be used over again. The idea which underlies this machine has now been carried further and applied to the removal of the dust and dirt which unavoidably collect in oil used in the lubricating systems of marine and other large engines. The new machine is very similar in form and operates on the same principle as the now well-known centrifugal cream separator. The foul oil is fed continuously into the machine through a strainer which catches any gross particles, precisely as milk is fed into the cream separator. The purified oil escapes continuously, while the dust and dirt collect on the inner surface of the separating drum. Provision is made by which the attendant can instantly tell when the machine is choked with the deposited impurities.

Rotatable Coal Hopper for Locomotives

FIREMEN on big locomotives find promise of lightened work in the rotatable coal hopper that has been invented for engine tenders. This invention is so planned that the coal is kept handy at the firing deck, making it an easy matter for the firemen to reach the coal without shoveling from the rear of the tender or using power apparatus. This special hopper is in the form of a great segmental tub, or drum, having a diameter that is the approximate width of the tender. This drum is inclined toward the firing deck; it is so mounted on a ball-bearing center plate as to turn readily. In its outer wall are openings, one for each segment, through which the coal falls by gravity. As soon as the coal is emptied from the segment, the brake that controls the drum is released. Naturally the greater weight above the center of the drum makes it rotate, bringing the next loaded segment into position.

Hunting the Dinosaur Fossils

ALBERTA was the home of many terrible reptiles and mammals now known only by polysyllabic names according to W. E. Cutler, who is excavating in the Red Deer valley for prehistoric remains. He has been digging up the skeleton of a Ceratopsian (Horned Dinosaur), and has located the whole of one side and the skull. He has also obtained a fine skull of the Sterecephalus Tetus (the Armored Dinosaur), with massive plates of bone imbedded in the skin, some of the plates being an inch in thickness. Recently too he found the fossilized skeleton of a Hadrosaur or duck-billed dinosaur.

Two dinosaur beds are located in Alberta, the Edmon-

ton beds of the later period on the Upper Red Deer River near Drumheller, the coal town, and the Belly River beds commencing at Steepleville and extending twenty miles downstream on the Red Deer. The species—although a few are common to both beds—are separated by a layer of 800 feet of marine deposits which contain remains of marine creatures.

In those early days firs grew in Alberta but the land area in western Canada was small, a central ocean dividing the solid earth from the Peace River to Central America with a coast line near Field and Banff and high mountainous country to the west. Mr. Cutler believes that the silt in which the prehistoric monsters' remains are found came from this mountainous district.

He reports that it is becoming increasingly difficult to get good specimens and he advises Alberta to get some and store them until it has the proper facilities to display them. At the same time he thinks it would be a mistake to place an embargo on the export of specimens by Barnum Brown and other American explorers.

Zinc Manganese Alloy

IT is claimed that a satisfactory substitute for copper, bronze, and brass has been devised by adding not more than four per cent of manganese to zinc. The resulting metal is claimed to be about twice as hard as zinc and to have far greater resistance to impact. It is said to be possible to forge the new alloy when warm and also to stamp and roll it.

Research Scores

ALARGE body of ore discovered during development work in search of gold-bearing material was found to yield about \$3 worth of gold and silver per ton, which, notwithstanding a low cost for concentration, was entirely unattractive. The problem was put before a group of research men who have found that besides recovering the precious metals the material can be made to yield per ton \$20 worth of white sulfur and another \$20 worth of paint pigment, for both of which products there is an active demand within a reasonable freight distance. The cost of the entire operation is such that more than \$35 net per ton can be realized from a material that a few years ago would have been discarded as not worth working.

Sound Records

APROCESS for producing sound records has been patented in which a fine modeling clay is substituted for the usual wax base materials employed for recording sounds. When the record is made the clay is dried so that the exact character of impression made by the recording needle is retained. The disk is then fired in a pottery kiln and a metal matrix from which records for sale are made in the usual manner, is prepared from this pottery disk. It is also claimed that plaster of Paris or other cement just about to set may be employed.

Japan as a Buyer of Copper

ONE of the surprises of the year just past has been the rôle played by the Japanese in the American copper market. On every recession in values, buying by such interests has been an important factor and comment as to the object behind it has been general. The magnitude of this annual movement may be appreciated by the fact that last September the copper exports to Japan were nearly 60 times what they were in the ten years ended with December 31, 1918, while for the ten months ended with October, 1919, Japan is credited with 63,100,000 pounds or over 140 times as much as for the ten-year period referred to. Japanese buying of zinc, while not so striking as in copper, has also been heavy.

In other years Japan has exported about half of her own copper output. It is therefore surprising that she should have made such a complete reversal of policy. This may be partly explained by the statement that Japan's production of copper has decreased and her consumption increased. But there is something more than this.

Japanese manufacturers and laborers have learned how to produce in mass and the country has undoubtedly started on an era of great industrial expansion. One view of the situation is that because Japan had a thorough training in munition work, this expansion is making its first appearance in brass making. Japanese merchants are said to have discovered that Germany had prior to the war an extensive export trade to the Far East and to South America. To capture this may be one explanation of the recent buying of copper.

Whether or not, as not a few think, this heavy buying of metals and other materials portend the existence of a Germany of the Far East, it is certain that it means that Japan with her cheap labor and great imitative power, will be or already is a most important factor in the world's international trade.

A Marsupial Rhinoceros

AS the result of an examination of a nearly complete skeleton of the extinct marsupial *Nototherium* Mitchellii, hitherto known only from fragmentary remains, found near Smithton (Tasmania) this year, Messrs. H. H. Scott and Clive Lord have come to the conclusion that the *Nototherium* was a marsupial rhinoceros. The structure and shape of the horn are matters for conjecture as no remains of it have been found but the specially constructed cervical vertebrae, the structure of the nasal regions and the curious nasal cartilage—all point to the conclusion that the animal possessed a rhinoceros-like horn. If so it is a curious case of parallel evolution for the true rhinoceros belongs to a different and "higher" group than the marsupials, none of which at the present day possesses anything remotely resembling horns, nasal or otherwise.

Tuna Fish Oil

ACCORDING to a circular issued by the Paint Manufacturers Association excellent results have been obtained with tuna fish oil indicating that this product can be utilized, in whatever quantity produced, by the paint industry. Comparative drying tests have shown that tuna fish oil dries more rapidly than most grades of raw linseed oil. The gravity, iodine number and saponification value of the oil are similar to the constants of linseed oil, while the high iodine value, 184, is of unusual interest since it is actually higher than that of most linseed oils.

Yellow tail fish oil is another product supplied by the Bureau of Fisheries for these tests. It gives results almost as satisfactory as linseed oil.

Improvement in Cement Manufacture

AUNITED STATES patent has been granted covering what is claimed to be an improvement in the wet process for manufacturing Portland cement. It frequently happens that the slurry sets to such an extent as to prevent its efficient handling in the usual apparatus. The object of the invention is to provide a setting preventive which will facilitate the use of the wet process and subsequently be destroyed in the kiln. One quarter of one per cent of sugar has been found satisfactory, since it prevents setting in the slurry and is of course eliminated during the clinker operation. Molasses, oxyacids, oxy-aldehydes, and oxy-ketones are examples of other suitable materials.

American Potash

IT may be well to again remind those who have looked forward to the purchase of cheap German materials that times have changed throughout the world. German potash is now being quoted to the German farmer at from \$2.70 to \$3 per unit for the same material which formerly was sold to the American farmer, transportation paid, at 60 cents per unit wholesale. Now, on this basis the American bill for German potash used in agriculture, calculated on the imports of ten years ago, would be 75 millions in place of 15 millions as formerly.

In view of these facts, we should be very slow in discarding the beginnings that have been made toward supplying potash to American farmers from American sources. As it is now, the American industry has been discouraged and under the conditions prevailing abroad we can expect little from the old sources for some time to come. The situation as it now is was outlined by J. W. Turrentine during the recent meeting of the American Chemical Society.

Raising a Train Shed

THE Delaware, Lackawanna & Western Railroad has nearly completed a project of raising to its original level its Hoboken, N. J., station train shed, the supporting columns of which had sunk irregularly from 5 to as much as 14 or 17 inches in places. This shed is the first ever built of the Bush type with slots for the locomotive smoke stacks. It is 360 feet wide and 630 feet long, covers 14 tracks and an area of about 5 acres and weighs 18,000,000 pounds. It is supported on 207 cast steel columns each set on a concrete foundation resting on 80-foot wooden piles which had settled. The shed was raised in 4 sections by means of jacks at each column in the station to bring the roof to its proper level. The concrete platforms have also been built up and the tracks raised to their original level. The old scheme of wire-glass roofing with large sections of glass which used to break from the vibration has been replaced by a concrete and vault light roofing. The whole project has been carried out without delay to a traffic of 225 trains daily or without inconvenience to the 1,500,000 passengers who use the station monthly.