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Creators: Ross, H. H.

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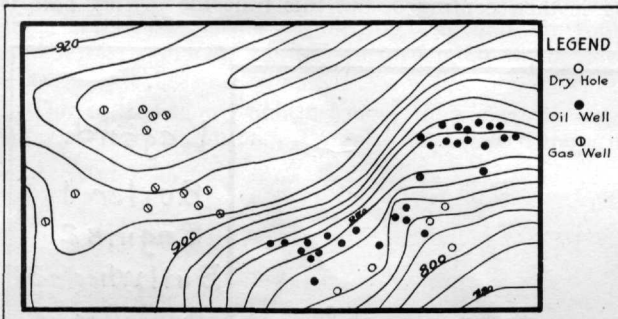
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AN AUDIENCE WITH KING OIL

And How Well He Is Guarded From Casual Visitors

By H. H. Ross, *Mining Engineering, '26*

WHEN Mr. Drake took the first petroleum from Mother Earth in 1849, he unconsciously brought forth for the earth one of its greatest industries. The birth and also the growth of the industry are common knowledge, and the present branches of it, beside being extremely interesting, afford a means of keeping some of our largest corporations very busy indeed. Two of these are the Standard Oil and the Royal Dutch Shell, both being internationally famous, thoroughly competent and disconcertingly prosperous.



We are probably most interested in the Standard, which has all been planned and effected within the lifetime of one of our more obscure citizens, John D. Rockefeller. Previous to the time when Mr. Rockefeller was seized with the urge to be up and doing and amount to something, each oil producer had a small refinery of his own and distilled his own oil. Rockefeller thought it would be cheaper to build a large refinery and transport the oil to it, rather than have so many small ones operating under high overhead and competing with one another. With this idea in mind he organized a company which purchased the interests of a group of small companies and gave stock in the new company as payment. The company prospered and branched out until today it is represented in almost all the phases of the production of oil and gas.

The essential operation is, of course, the production of the crude oil and gas. This article will convey to you, we hope an idea of the way these raw materials are secured and handled.

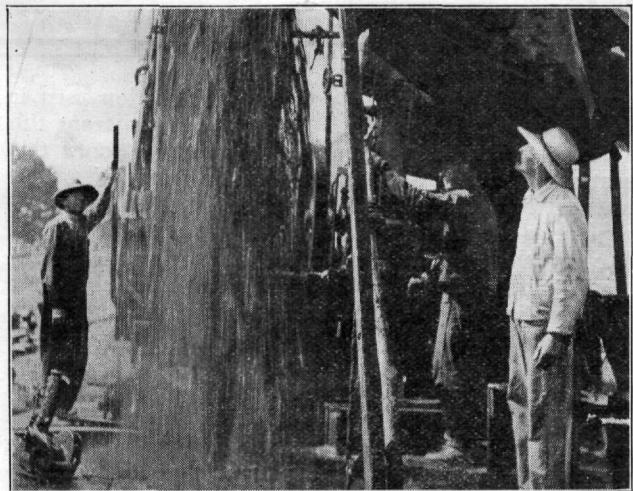
The first thing necessary to the drilling of a well is the permission of the landowner. There is generally little difficulty about securing this. The general terms of a lease in this country are: one-eighth of the oil, if any, or for a gas well, \$200 a year. This is paid the landowner and the operating company takes all the risks and profits. Sometimes a landowner is paid a fabulous price for his holdings if the indications are very strong for large production, and he knows the value of his land. The large companies have almost eliminated this by leasing large tracts before any work is started.

After the lease is secured the geologist investigates the territory it covers. At first he makes a preliminary survey of the land and reports whether it is worth any further investigation. If it is, he is advised to repeat his work with much more accuracy and greater detail. He does this, and from his observations makes a structure map. A structure map shows the geological structure of the region as a topographic map shows the topography. The data for this is obtained either from the

logs of previously drilled wells, test holes, or from outcropping "markers." It has long been known that there is a regularity in geological formations, and by observation it has been found that the interval between certain formations is approximately constant, or that they bear some definite relation to each other. By determining the structure of some outcrop on the surface, or marker, we may determine the structure of the producing sand. We have learned that any irregularity in the structure of the formations, that is, the ones under the surface, offer an opportunity for the accumulation of oil, just as water collects in depressions on the earth after a rain.

Oil and gas generally occur in what are called sands. By sands are meant layers of sandstones below the surface of the earth, and which run approximately horizontal. Between the layers is shale, which is impervious and confines the oil and gas to the sand. The principal oil and gas producing sands of Ohio are the Clinton, Berea, Cow Run, Maxon, Injin, Salt and Keener. There are, however, some other sands that occur in certain localities. Around Lima, oil and gas are found in limestone.

A definite case of structure is shown in Fig. 1. This is the Berea sand in a portion of eastern Ohio. The datum plane of this map is taken at 1,000 feet below sea level, and the figures on the contours show the height above this datum plane. The actual elevation of the sand at this point is sea level, or nearly so, and this means that it is about 1,200 feet below the surface, inasmuch as this is the elevation of the land directly above at this place. From the map it can be seen that the



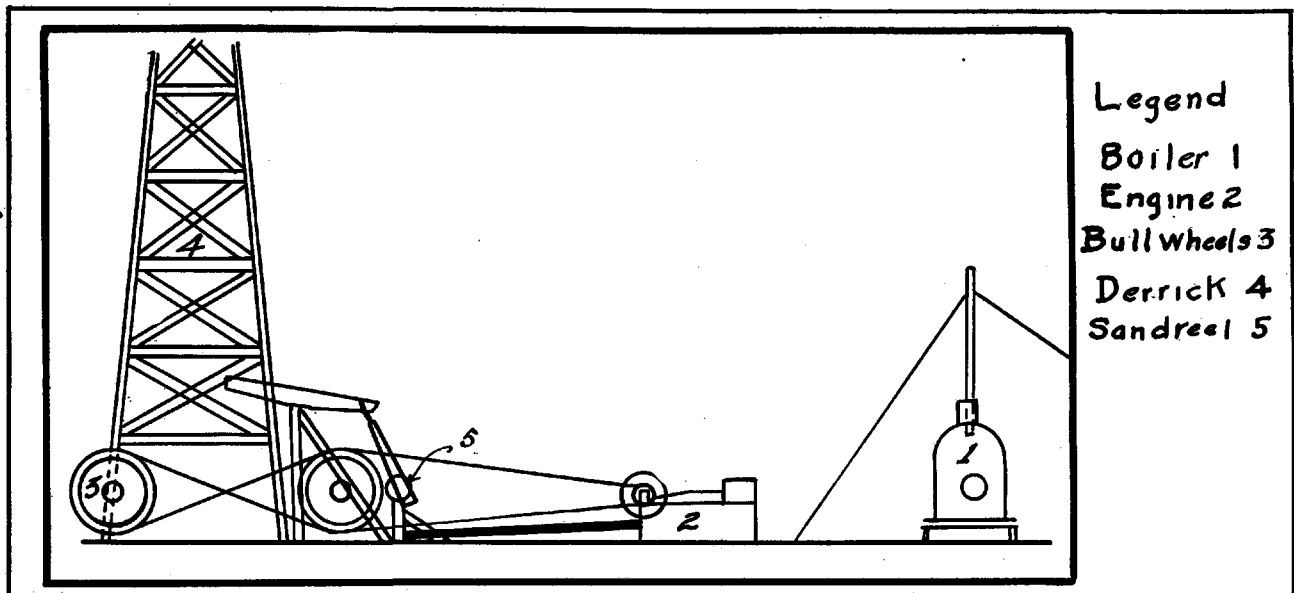
producing wells are located in regions where the contours show the formation of an amphitheater. This formation gives the maximum chance for accumulation of oil. On the lower levels and on the more regular structures there is no oil. But on the higher levels there is gas. The so called "dry holes" often produce water. This is simply in accordance with the different densities of the substances. The water, being heaviest, is found in the lower parts, the oil, somewhat lighter, coming next, and the gas, lightest of all, on the top.

After the geologist has made his final favorable report, the location he indicated becomes a scene of activity.

The first operation is the building of a derrick, which the oil man refers to as a "standard rig." As almost any one in Ohio knows, the derrick, or rig, is a tall wood structure. The standard dimensions are: 84 feet high, 20 feet square at the bottom and 4 feet square at the top. In this rig there is constructed a spool like affair of two wheels on an axle, free to turn, and collectively referred to as the "bull wheel." On the bull wheel are wound the lines used in drilling and handling the well casing. One of these wheels has a braking device used when casing or drilling tools are being lowered into the hole. The driving power for these wheels is furnished by two ropes which function as a belt between the main band wheel and the bull wheel. These ropes may be thrown off at the will of the operators. The prime mover of the whole outfit is a horizontal, non-condensing steam engine, usually a 12 by 12. The engine is connected to the band wheel by an ordinary belt. The band wheel is supported on the main shaft. On the other end of the main shaft is a

way that material can be removed from the hole is by mixing it with water and bailing it out, the bit must also act as a mixer.

The task of the driller would be a great deal easier if all he had to do was to run his machine until his tools had crashed through to the necessary depth. But as soon as he strikes the first vein of water, or a vein of shale that caves in, he must drill through to the next solid material below this point and proceed to "case" the hole. He does this to prevent any further caving and to keep the water out. The casing used is much like ordinary gas pipe, only larger, and the size depends on the diameter of the hole in which it will be placed. All this casing must rest on some solid impervious material and this is why the driller goes through to such material before he installs any casing. If the hole as drilled is 10 inches across, the casing will be $8\frac{1}{4}$ inches across. It is in sections; the sections are lowered one at a time and by their own weight keep tight at the joints. Drilling is then continued, but this time the drilled hole is



large crank that gives the reciprocating motion used in running the drilling tools. A pitman runs from this crank to the walking beam, which carries a screw that is attached to the drilling line. The screw is a long threaded bar that may be turned to lengthen the drilling line as the tools go deeper. There must be a drum to carry the line used to raise and lower the bailer. This drum is placed behind the main shaft so that a pulley on its shaft may be made to friction on the band wheel when needed.

Figure 2 is not intended to be a working drawing at all, but is merely to give an idea of the standard rig. Its details are limited, but the main parts are all shown.

After the rig has been erected comes the drilling proper. The whole principle of drilling is that of raising and letting fall a long heavy tool which is more or less pointed at the drilling end. Due to its great weight, it acquires sufficient momentum in falling over a short distance that it is able to work its way downward through almost anything it may encounter in its path. The weight of the whole moving element ranges from a ton to a ton and a half. The ordinary drilling tools consist of the rope socket, the stem and the bit. In an installation of this kind, it is important that the connection between the line and the tools be very strong. The rope socket makes this possible. The function of the stem is to add weight to the unit. The actual cutting away of material is done by the bit. Inasmuch as the only

$8\frac{1}{4}$ inches across. As soon as similar conditions are again encountered, the same procedure is followed. This time the casing is $6\frac{3}{8}$ inches across, and the hole drilled beyond will also be that size. The next size is $5\frac{3}{8}$ inches. It is seldom necessary to case with anything smaller than this. It is very easy for one familiar with the region to tell what size hole must be started in order to reach a certain sand.

When drilling, water is poured into the hole and the tools mix the water with the material chipped off during their progress. When this mixture becomes thick it is removed from the hole by means of the bailer, which is simply a bucket device lowered into the hole and pulled out when it has filled.

It cannot always be told definitely whether oil or gas will be found. If gas, it will occur in the upper part of the sand, and if a heavy flow is encountered, it may be better to play safe and take gas instead of oil. If this is the case, drilling is stopped and the well is shut in. To do this, a packer is lowered into the well on a length of two inch pipe. A packer is a large piece of rubber that can be expanded to fit the wall of the hole after it has been lowered into place. When this packer is set, the gas is confined, and it flows through the pipe into the lines which convey it to the gas mains.

If no gas is found, the well is pushed on to the bottom of the sand. If the geologist was right, there

(Continued on page 22)

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AN AUDIENCE WITH KING OIL

(Continued from page 6)

will be some oil here. If the flow of oil is heavy, all is well and the driller leaves with his work accomplished. If it is light, the well must be "shot." This is not a form of capital punishment inflicted on the well for its treachery at all; no revenge is intended. When a well is shot, a quantity of nitro-glycerine, varying from 10 to 200 quarts is lowered to the bottom and detonated in the oil bearing sand. This shock loosens the sand and increases the flow of oil.

In some localities the oil gushes out of the well so strongly that the problem is to confine it, but in Ohio such a thing is unknown and the valuable oil must be coaxed to the surface with pumps. These pumps deposit the oil in tanks, from which the pipe lines take their supply.

Now if everybody was wrong, and there was no gas, nor any oil within the reach of this well, it has to be plugged. This appears to be a simple matter at first, but it is hedged by many restrictions and specifications, for it may concern the welfare of other people and their property. In plugging great care must be taken in keeping fresh water that comes in the top of the hole from getting in the sand. If fresh water comes in contact with the crude oil, it forms an emulsion, and this spoils the oil. So even if you do not get any oil yourself, you must be careful not to spoil your neighbor's oil. Concrete is thrown down the hole until it is filled up above the sand. Then a lot of plugging material is driven down, and about fifty feet more of concrete is thrown in. A coal seam must be plugged up in the same way, except that concrete must be placed below as well as above the seam. In the past many have not been very considerate about plugging abandoned holes, and much trouble has resulted. The trouble served to aggravate our law makers to action, and now the law is very strict on these matters.

Many difficulties are encountered in drilling, and the chief of these is that of losing the tools in the hole. It may be due to the rope breaking, the tools sticking and getting caught in the hole, a cave in, or the casing may be collapsed by water pressure and the tools wedged fast. Some means must be found to remove the tools or the effort and money already expended are lost. Frequently six months or a year are spent in trying to get the lost tools out of the hole. It is a baffling, discouraging task, each instance presenting a different problem. The ingenuity with which drillers meet these situations is sometimes amazing, and the same might be said of their persistence.

Oil and gas must be marketed as well as produced. One of the things about handling of oil and gas is that the crude products are not transported in the same manner as most of our other commodities. In the case of the crude oil, it goes from the well to the receiving tanks. From these it is pumped to the pipe lines. These pipe lines are carriers just like a railroad. They are distributed all over the oil producing areas and take the oil from the producer to the refiner. The oil when pumped into the pipe line goes to a local receiving station, where it is pumped into the main lines. When the oil is taken into the line the producer is given a statement of the amount of his oil, and he may sell it at once, or speculate on a rise in price.

From the refinery the products go out as gasoline, kerosene, lubricating oils and greases and other products almost countless. In the case of gas, the gas from the well flows into the gathering lines of the lease, and is conducted to the lines of the purchasing company. Here it is measured by an orifice meter, and the producing company given a statement as before.

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If one has visited a drilling rig once or twice, he leaves with the impression that it is a crude, poorly constructed affair. This is quite a wrong conclusion. It is true that things are for the most part rough looking, awkward looking, but close observation reveals that they are really very clever. One should consider that the average man employed in this work has little education as far as books are concerned, but if he is getting along in the work, he is far from ignorant. He knows nothing of strength of materials, never heard of Boyd's Mechanics or the laws of flow from open pipes, but he can give a surprisingly close estimate of how much weight a rig will stand, or the amount of gas flowing from a well. Certainly they are all practical geologists. They deserve the title of engineers, for they are technicians in their own line. The life is far from easy; the driller works in the open, exposed to all sorts of weather. His works are great; his tools are few. Aside from the heavy machinery he has a saw, axe, sledge and hammer. With these he builds many beautiful devices, not beautiful in their external appearance at all, but in the functioning just as he designed and built them to function.
