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OIL AND GAS STUDIES BY THE DIVISION OF GEOLOGY

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(Paper read before the Washington Natural Resources Association meeting at Everett, October 23, 1936.)

A discussion of oil and gas in Washington and of the studies pertaining to them carried on by the Division seems particularly appropriate at this meeting. It was here in Snohomish County that the first test of which we have record was made for oil. This was in 1892 when John E. McManus drilled to a depth of about 900 feet in the vicinity of Stanwood. Since the time of that early work, about two hundred wells have been drilled in this State for gas or oil. Some few, probably, have been out-and-out stock-selling swindles, but most of them have been bona fide efforts to prove the existence of a potential resource. Some have been ill-advised as to location, were based upon inadequate geology, or the promoters have been influenced by the claims of pseudo-geophysical operators whose instruments are generally known as "doodle bugs." Many of the wells, however, particularly in later years, have had the benefit of more competent and complete geologic study, have had skillful management, and so fall in the category of ventures that deserve the support of the general public.

The Division of Geology has made a serious effort to collect all the data possible on these oil explorations. Unless such information is obtained while the drilling is in progress, it is most difficult to secure authentic data on what

actually takes place. The all-important details of what rocks were penetrated, the horizons at which water occurred, the showings that were obtained of either gas or oil, and the mechanical difficulties encountered become either completely lost or badly garbled shortly after drilling ceases. During the last few years the Division has been closely in touch with most of the organizations carrying on exploration work. Excellent cooperation with the drillers has been had, logs have been supplied, and samples of the rocks penetrated have been sent in for study and classification. A file of older drillings is also maintained by the Division, and as information comes to light, the records for the various wells are gradually made more complete.

It is hoped that complete details will be available, eventually, on the history of the search for gas and oil within the State. Then, those that are interested in such work may be supplied with valuable data, if not on the results obtained in an individual well--because much of that work is of a confidential nature--at least with information on what may be expected in a given locality or in a certain formation.

Since the early days of geologic work in Washington, structural and stratigraphic data have been collected which bear on the problem of the occurrence of oil or gas. This work is the basis for many reports that are now available to the oil fraternity. Most of these were not intended primarily for that use, but information may be obtained from them which may mean a great saving of time to those investigating any given

locality for its oil possibilities. I have particular reference to such reports as the surveys of the coal fields in King, Pierce, Lewis, Skagit, Whatcom, and Kittitas counties. These reports deal with coal, yet they are filled with information on the stratigraphy of possible oil or at least gas-bearing formations and contain a large amount of structural data. In 1915 the Survey published a report by Dr. Weaver on "Tertiary Formations of Western Washington." This contains a wealth of information on both stratigraphy and structure, and although of a preliminary nature, is one of the most valuable reports we have applicable to oil and gas. In 1935, an investigation was made of the possibilities of oil and gas in western Whatcom County. This resulted in the first report to be published by the Division solely on the subject of these hydrocarbons. It was followed by similar work in Skagit County, the results of which, now in manuscript form, are awaiting the availability of funds for publication. Work has been initiated in other counties of the State and it is the intention of the Division to publish as rapidly as possible, reports on the oil and gas possibilities of the various other counties, these reports later to be incorporated in a complete report on the possibilities of the State as a whole.

Probably no other one mineral exploration so interests the general public as the search for oil and gas. They hear of quick profits accruing from small investments in oil fields; they are constantly being importuned to aid in the financing of Washington ventures; and they show a most commendable desire--which has been particularly apparent in late years--to

inform themselves as to the geologic merit of the tests under way. This has resulted in the Division of Geology receiving a vast number of inquiries, both oral and written, on the subject of oil and gas exploration in general and on specific tests. The inquiries follow a general theme, or pattern, and it has been possible to discover from them points of most usual interest. Based on this study of the inquiries, a report of investigations has been prepared recently to serve as a general answer to all such queries. This is now in the hands of the printer and should be ready for distribution very shortly.

It may be of interest here to make some remarks based on this forthcoming report.

First, it will be necessary to touch on the basic theories which explain the occurrence of gas or oil. Many of you already have this well in mind; others may not have had it brought to their attention. Very briefly, oil and gas originate from the slow natural distillation of organic matter trapped in the muds which were laid down in ancient seas and estuaries. Gas may originate from similar material laid down in bodies of fresh water, where, also, it is theoretically possible for oil to occur.

Through the action of various forces, which I need not go into at this time, the hydrocarbons migrate to adjacent porous reservoir rocks which may consist of sandstones, cellular limestones, or conglomerates. In some places, these sediments may be flat lying and so afford but little opportunity for the hydrocarbons to accumulate in commercial quantities. In other places, through the action of various forces,

the strata are bent, arched, or folded so that they assume various attitudes known as structural forms. For various reasons, oil tends to accumulate in the higher portions of such structures. A simple example would be a mixture of oil and water in a closed pipe. If the pipe were up-ended, the oil would separate from the water and accumulate in the top of the pipe. In a general way, this is what happens in the folded rock strata. There are many complicating factors, however, but some structural form which will bring about a concentration of the oil or gas is essential if a commercial body of the hydrocarbons is to occur.

It will facilitate the study of possible oil ground in the State to make two broad divisions of the rocks which occur. The first, that in which oil or gas would not be expected, includes all igneous rocks--materials which were at one time molten--and all metamorphic rocks. These latter are rocks which may originally have been either igneous or sedimentary, but which through the long application of various geologic processes have lost their original character and have become recrystallized. Because of this, the properties which they originally had, and which may have been favorable at one time for the occurrence of oil, have been destroyed. It might be well to give a simple example of what is meant by the unfavorable character of metamorphic rocks. Assume that a brick was made from a mixture of sand and clay and allowed to harden in the air. One could immerse that brick in oil until it had become saturated. The oil, filling the pores of the brick, could then be recovered by pressure or by the

application of solvents. However, if that brick is placed in a kiln and fired, the oil which it once contained would be dissipated entirely or changed to a product no longer oil. This is what happens, in effect, to sediments when they become metamorphic rocks. In some of the old argillites and schists we find graphite, which at some time may have been oil, but never in argillites, slates, quartzites, marbles, or schists do we find commercial quantities of oil. So we are able to eliminate from the field of possibility areas where igneous or metamorphic rocks predominate.

This eliminates the Okanogan Highlands (Pend Oreille, Stevens, Ferry, and Okanogan counties), the eastern border of the State (Spokane, Whitman, Asotin, and most of Garfield counties), the region of the Cascade Mountains from the north to the south, much of the counties adjacent to the Cascades on the east and west, and the whole central area of the Olympic Peninsula.

A peculiar situation exists in the Columbia basalt plateau which makes necessary the separate consideration of that area.

Generally, throughout the rest of the State rocks are found that are favorable for the occurrence of gas or oil. They are exposed in Chelan County in the general vicinity of Wenatchee, in the western portion of Whatcom, Skagit, Snohomish, and King counties, in the western and northern part of the Olympic Peninsula, and in most of southwestern Washington.

In the Columbia basalt plateau the surface rocks are unfavorable for the occurrence of gas or oil, but in some

places under the basalt, at an unknown depth, it is reasonable to presume that rocks exist which are a source of gas. The commercial gas field in the Rattlesnake Hills of Benton County and the gas struck in many water wells in that region prove that such source beds underlie part, at least, of the basalt area. So, where structural conditions are suitable, it is warranted to sink test wells in the hope and expectation that gas and possibly oil will be encountered.

In western Washington and in the Chelan area mentioned previously there are Eocene, Oligocene, or Miocene sediments which in some places are favorable for the occurrence of the hydrocarbons. Some are of fresh-water origin, and so have greater possibilities for gas than for oil. Others are of marine or estuarine origin and contain abundant remains of the life of the times in which they were deposited. They consist of interbedded sandstones and shales, which make ideal reservoir rocks and capping for such reservoirs. In places, they have been folded into structural forms which could concentrate any oil they might contain. On the whole, they are entirely suitable formations in which to expect production.

It is certainly justifiable, then, that the drilling of favorable structures, when preceded by detailed geologic work, shall continue. As a further indication of the merit of such prospecting, we have the results from many of the more recent wells and from some of the earlier ones. Gas in almost commercial quantities has been discovered in Whatcom County. Gas in large amount has been discovered also in wells of Snohomish, King, Lewis, Pacific, and Grays Harbor counties and

on the Olympic Peninsula. In addition, shows of oil have been struck in many wells and a notable amount has been encountered in three of these. The two outstanding ones are located at the mouth of the Hoh River. The Sims No. 1, drilled there in 1931, produced oil in an amount indicated by bailing tests to run about 20 barrels a day. Nearby, in 1936, the Kipling No. 1 encountered similar oil. A pump was installed when this well was finished and actual production was obtained for a short time. These positive results, when considered with the favorable geologic conditions which prevail in so many places in the State are ample justification for a continued and thorough investigation of our oil and gas possibilities.