Theories of Oil Origin with Application to New Zealand.

The many theories accounting for the oil found in rocks, may, in a general way, be divided into two groups, one group assuming the oil to be derived from the remains of animals and plants and the other ascribing it to chemical reactions in the interior of the earth. Naturally, one cannot reproduce geological conditions in the laboratory, and no theory can be proved beyond the shadow of doubt. Nevertheless, the facts of distribution of petroleum combined with those derived from controlled experiments make it most probable that the oil of commerce is organically produced, from fish, molluscs, sea-weeds, or land plants, as well as from the tiny hard-shelled animals (foraminifera) and plants (diatoms) that live in the sea in countless myriads.

The mud, sand, and limestone constantly being laid down on the sea-floor contain all these organisms; the amount in the aggregate is vast. From the weight of the later overburden, from earth stresses, from heat rising from below, and from cementation by infiltering solutions, these deposits are consolidated into the sedimentary rocks which form a large proportion of the present land. Petroleum in one or other of its many forms is in all rocks of this kind, but its occurrence in amounts that allow of its profitable extraction by man is comparatively rare. Heat and pressure have affected large areas of sedimentary rocks so intensely that the oil they originally contained is now destroyed or driven out. Such are the schists of Otago and Marlborough and the shattered sandstones and slates of the Southern Alps, the Kaikouras, and the main ranges of the North Island. In these rocks it is as hopeless to expect oil in commercial amount as to look for it in the lavas of Hauraki and Tongariro or in the granites of Nelson and Fiordland. The rocks that may yield oil in payable quantity, though they may be compact and strong, still have pore space between the component grains of the bands of sandstone and are covered by strata impervious enough to prevent the ready escape of oil. Though the physical condition of the rocks is much more important than their age, sediments favourable for the occurrence of petroleum are most common in the younger part of the geological rock column, and are most abundant in what are known as the Tertiary and Cretaceous periods of the geological time scale. These rocks have not been so deeply buried or subjected to so many earth stresses as those of greater age. Roughly, the Tertiary rocks were laid down between two and sixty million years ago and the Cretaceous from sixty to a hundred million years ago. Marine sediments of these ages or areas covered with gravel moraine or volcanic ash beneath which such formations do, or may, occur occupy about two-fifths of New Zealand's land-surface.

In general, the sediments as they are deposited, even those richest in organic remains, contain but a small proportion of oil or of substances that yield oil, and where petroleum occurs in commercial amount, it has segregated from a considerable body of rock. Owing to the compaction of the beds under the gradually increasing overburden, to the filling-up of the voids, to the increase of temperature with depth, and to a number of other causes the oil tends to leave the mud and to enter the sand-beds. Along these it migrates from areas of high to areas of low pressure, always seeking to escape to the surface. But if, as very commonly happens, earth stresses have faulted, folded, or otherwise disturbed the original horizontal layers of sediments, "trap" structure are formed in which the oil accumulates and from which it cannot escape. In such places, masses of porous rock become saturated with oil and form what are popularly called "oil-pools." The petroleum such reservoirs contain exudes from the pores and enters any bore that may be drilled and which penetrates them.

There are many oil-seepages and gas-emanations widely scattered over New Zealand, but in some of the districts containing such indications conditions are present which geologists, from a close study of producing oil-fields, know to be definitely unfavourable. The conditions are promising, however, where relatively soft marine strata cover wide areas and contain porous sandstones lying between shales twice or more times as thick again. In the five districts in which the indications of oil are unusually strong these favourable geological conditions are also present. These districts are Taranaki, the East Cape, Gisborne region, the Murchison basin, and North Westland.

The Maoris knew of the strong oil escapes from the shallow sea floor near New Plymouth long before the coming of Europeans. Since 1866 numerous wells have been sunk in the neighbourhood, several have yielded considerable amounts of oil, one, still flowing vigorously, has given about half a million gallons, and the small area between New Plymouth and the Breakwater has yielded altogether over two million gallons. There are at least three oil-horizons, the most productive being a little over 2,000 ft. below the surface. East, south, and west thick volcanic debris covers the whole district, for many miles and obscures the structure of the oil-yielding strata. These rocks, however, are exposed in eastern and northern Taranaki, and consist of Tertiary sandstone and mudstone many thousands of feet in thickness, and these, though strong faults occur, are in general, folded only gently. The three or four bores drilled in eastern Taranaki, though they yielded shows of oil, were unsuccessful but were quite inadequate to test the many square miles of possible country, or even the known structures. At New Plymouth, from what can be made of the bore logs and from general considerations, the beds have gently dipped. Close to the west, volcanic rock rises through the Tertiary sediments and forms the steep-sided hill of Paritutu and the neighbouring Sugarloaves, and these may be connected in some way with the accumulation of the oil.

Indications of oil and gas are widespread in the East Cape – Gisborne district, where the rocks are of younger Cretaceous and Tertiary age, both sets containing great thickness of favourable rocks. The oil, however, is chiefly derived from the Cretaceous beds among which are massive layers of black shale which most geologists consider a likely source of petroleum. The structure of the beds is decidedly complex. The Cretaceous strata were strongly folded and partly destroyed by erosion before the Tertiary sediments were laid down. During and after the deposition of the latter the whole region was deformed on several occasions. A considerable amount of boring has been done, but only a few barrels of oil have been obtained; most of the numerous trap structures or anticlines, however, are not drilled and several of those that have been bored are not properly tested. There are great