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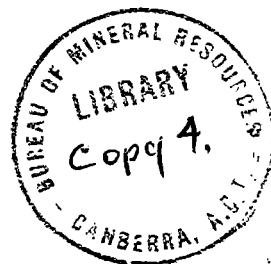
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DEPARTMENT OF NATIONAL DEVELOPMENT.  
BUREAU OF MINERAL RESOURCES  
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Record No. 1964/2

Some Geological Observations on the  
Oil Occurrence at Barrack Swamp, near  
Shellharbour, New South Wales.

by

J. M. Drummond

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SOME GEOLOGICAL OBSERVATIONS ON THE  
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## SUMMARY

At Barrack Swamp, New South Wales, considerable amounts of heavy oil are associated with a thin layer of vegetable matter lying above peaty soil and below a layer of recent sand. All of these deposits are saturated with brackish waters. The origin of the oil is uncertain. More data is needed to prove that it originated by seepage from beneath the swamp. Present evidence favours the possibility that the oil was washed in from the sea.

## INTRODUCTION

Barrack Swamp, near Shellharbour, about 55 miles south of Sydney, has been known to be the location of an oil occurrence for some years, and is included in Petroleum Prospecting Licence No. 7 (New South Wales), presently held by Consolidated Oil Limited. Mr. I.R. Lightner, geological consultant for Consolidated, carried out detailed work at the swamp during 1963, and a visit was paid there towards the end of his investigation, on 17th October, to examine the area and collect samples of the oil. Mr. M. Rose (petroleum geologist), Mr. W. Lawson (petroleum engineer) and Mr. J. Thomas (chemist) visited the area as representatives of the Department of Mines, New South Wales, while the writer represented the Bureau of Mineral Resources.

Considerable amounts of oil occur at Barrack Swamp, but it is uncertain whether the oil is due to a natural seepage in the immediate area or is derived from other areas. In the second case the oil might be seepage oil, or may be either crude or processed oil from ships. Available analyses do not prove whether or not the oil has been processed, and owing to its conditions of preservation, discussed below, this may not be determinable. The nature of its origin is therefore largely a geological problem.

Mr. Lightner showed during 1963 that the amount of oil in the swamp is much greater than was believed earlier. A brief visit did not allow approximation of the amount, which could range from a few barrels to several hundreds. One or two hundred barrels are probably present. The final report by Mr. Lightner may provide an approximation.

## OCCURRENCE OF OIL

Figure 1 indicates the main surface features at Barrack Swamp. The locality is reached by the road north past the front of the Shellharbour Hotel. The swamp lies between the Port Kombla

Highway on the west and beach dunes on the east. The dunes are 2-10' high, and appear to pass west underneath the swamp (Cross-section) where sand was recovered in augered holes. Wind-blown sand also overlies the eastern side of the swamp to a thickness of several feet, and the swamp material lenses out to the east. The main swamp material consists of soft black porous clay which appears to be rich in fine grade vegetable matter and is termed "peat" by Mr. Lightner. It is shown as peaty soil in Figure 1. A layer a few inches thick composed of vegetable matter, above the peaty soil and below the upper sand, is important because most of the oil appears to be associated with this layer (Cross-section). The sands, peaty soil and vegetable matter are all porous, and at the time of the visit were impregnated with brackish water to within a few inches of the surface. This is only a few feet above high tide mark, so the water level in the swamp will probably remain within a foot or so of the surface.

Mr. Lightner said that during rainy periods the swamp becomes inundated and that the water in the sands below the peaty soil is relatively fresh. Apart from the oil associated with the layer of vegetable matter, the only other important reported oil indication at Barrack Swamp consists of iridescent flecks which rise to the surface of the water when the peaty soil is augered. The significance of these flecks is uncertain and is discussed later. The term "oil", as used here, refers to the oil associated with the layer of vegetable matter.

The Barrack Swamp oil is viscous, and resembles an inspissated heavy natural crude in appearance and aroma. However, it could be a partly weathered processed oil. Abundant oil was noted in trenches and auger holes cut by Mr. Lightner. Three fresh exposures were made during the visit, at localities 1, 2 and 3. At locality 1, very heavy oil occurred in aggregates associated with woody heather-like vegetable matter, and dessicated oil patchily impregnated the sand, which was dry. Elsewhere, wet sand appeared to be unimpregnated, and this may be significant. At locality 2, the oil was associated with the layer of vegetable matter. This consisted of semi-decayed plants resembling rushes and coarse grasses. Some of those plants were green in their inner parts (probably a copper porphyrin after chlorophyll), while the outer leaves, although brown, were only partly decayed. The relative lack of decay is probably due to impregnation in a salty solution, and to the presence of oil. In spite of these factors, it seems unlikely that the vegetable matter is very old. Water levels in the swamp must vary, and the vegetable matter is only one or two feet below the top of the sand, so its preservation for any

great length of time seems improbable. At locality 2 Mr. Lightner demonstrated iridescent flecks rising from within the water-logged peaty soil. At locality 3, where the peaty soil is at surface, there are no visible indications of oil.

### GEOLOGICAL FACTORS

The nearest outcrop of bed-rock is one thousand feet or so away from the main oil occurrence. The exposures consist of brownish or reddish sandy, silty, tuffs (~~Jamberoo~~ Tuff of the Gerringong Volcanics). Similar rocks, with occasional fossils, occur on the foreshore for some distance to the south and probably underlie the swamp at no great depth (Cross-section). The exposed rocks are dense and tight, and on the basis of their poor sorting are unlikely to develop effective intergranular porosity. All outcrops of the tuffs examined exhibit two well developed joint sets. Under suitable conditions, these joints could form permeable channels for a seepage. Minor faults could also do so.

The Stockyard Mountain Well No. 1, a hydrocarbon test five miles south-west of Barrack Swamp, penetrated approximately 3,300 feet of Permian strata above metamorphosed sediments. The section there consists of the lower part of the Gerringong Volcanics, and of the Shoalhaven Group (Berry Shales, Nowra Sandstone, Wandrawandian Siltstone, Conjola Beds, and Basal Conglomerate). Volcanic rocks, especially tuffs, are common in the Gerringong Volcanics and Conjola Beds, but the section is predominantly shales, siltstones and sandstones. Most of the strata are believed to have been deposited in a marine environment. Some permeability occurs in the Nowra Sandstone. The sequence beneath Barrack Swamp should include a thicker section of Gerringong Volcanics than at Stockyard Mountain Well No. 1, so the total section at the swamp probably also will be thicker. These data are compatible with the oil at Barrack Swamp being seepage oil, but do not imply that it is, because no oil has been shown to occur in the Permian section.

The structure of the area will not be discussed. If it could be shown that the oil in the swamp is seepage oil this would indicate the presence of a structural or ~~stratigraphic~~ trap. The opposite argument does not hold.

### ORIGIN OF OIL

There is at present no conclusive evidence that the Barrack Swamp oil is either local seepage oil or is derived from elsewhere. The main points which suggest that the oil is local seepage oil are as follows :

- (i) The volume of oil appears too great for it to have been washed in from the sea.
- (ii) The irridescent flecks in the augered peat indicate a possible seepage through the peaty soil of the swamp.
- (iii) Geological conditions are compatible with a seepage occurring in the area.

The following arguments can be made against the oil being due to local seepage :

- (i) Barrack Swamp is only a few feet above high water mark. During a storm, seas would sweep over the dunes, and on a high tide even moderate seas would run in the channel shown on Figure 1. Buoyant material like oil would tend to accumulate in the sheltered area of the swamp.
- (ii) Although oil could have been washed into the swamp on many occasions, the association between the oil and the layer of vegetable matter is probably significant. Mr. Lightner discovered that oil was washed into the swamp in 1942, when it soiled the udders of cows grazing there. At present there is not much vegetation on the surface of the swamp, and the layer with the oil is the only one indicative of abundant plant growth. Vegetation in 1942 must have been reasonably luxuriant and quite high. This suggests that the layer of vegetable matter formed the surface growth in 1942, and that the oil washed into the swamp then is the oil presently associated with the layer. Oil would tend to kill the vegetation, and standing plant growth covered with oil, when compressed, could form a thinner oil-rich layer. Wind-blown sand could cover and compress the vegetation, and brackish water would tend to preserve both the vegetation and the oil. The area of swamp not covered by sand would tend to lose both the oil and the layer of vegetation by oxidation.
- (iii) The sand, peaty soil and layer of vegetable matter are all highly permeable. If the oil originated by local seepage it should impregnate the peaty soil and sand as well as the layer of vegetation. It does not appear to do so, except where drying out has occurred near the edges of the swamp. In this case impregnation is to be expected.

- (iv) The volume of oil is consistent with its accumulation in vegetation which was later compressed.
- (v) Partial weathering and bacterial action may have given the oil the appearance and odour of natural crude, assuming that crude oil was not washed into the swamp. No traces of free gas were apparent in the oil in the swamp.
- (vi) The iridescent flecks which floated up from the augered holes in the peaty soil could have originated in the peaty soil, or more probably were due to contamination by the overlying oil horizon. The flecks appeared to be absent at locality 3, where oil also was absent. Whatever their origin, the flecks cannot be considered positive evidence of a seep.

#### CONCLUSIONS AND ACKNOWLEDGEMENTS

The simplest way to prove that the oil at Barrack Swamp originated by seepage from under the swamp is to obtain oil-stained cores of bedrock from beneath the swamp. If the oil comes from fracture porosity it could be difficult to locate the seepage fractures. On the other hand, a light rig could penetrate the soft material above bed-rock very quickly, and a large number of cores of bed-rock could probably be cut in a short time. A rig capable of drilling to one hundred feet could probably prove or disprove the reality of the seepage, to indicate whether or not a deeper test was merited.

The fact that the arguments presented here favour the possibility that the oil was washed in from the sea is not intended as a criticism of Mr. Lightner, who argues in favour of a local seepage. As already noted the origin of the oil remains uncertain. Mr. Lightner was most helpful in demonstrating the oil occurrence, and provided much of the data used in this report. Appreciation is also extended to Mr. M. Rose, of the Department of Mines, New South Wales, for advice on the geology.

#### REFERENCE

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