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"OIL" ON FLINDERS ISLAND–BASS STRAIT

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(With one text figure.)

ABSTRACT

A survey has been made of the alleged occurrence of petroleum on Flinders Island, Bass Strait. An investigation of the material purporting to be petroliferous, has shown it to be a curious comminuted organic mass of plant detritus, apparently formed under unusual conditions.

The paludine "oil", and that produced by pyrolysis of the semipeat, is not related to mineral oil in any way. It is, on the contrary, a resinous, viscid decomposition product, composed of phenols, waxy esters, resins and an indefinite variety of organic residuals, to which the name plant adipocere might well be applied.

INTRODUCTION

Oily seeps, whether derived from petroleum or not, have often led sanguine prospectors to envisage potential oil finds, and, on many such occasions, quasi-fatty oils derived from elateritic or similar deposits have been confused with mineral oil. A case in point is that of Coorongite in South Australia, which has, in the past, given rise to a strong belief in the existence of petroleum in the area. Coorongite is, in fact, a partially decomposed fatty mass derived from the alga Botryococcus braunii (Conacher 1938).

Recently, the attention of the writer was drawn to a long-current belief on Flinders Island (Furneaux Group, Bass Strait) that there was a petroleum seepage there. The alleged petroleum was said to be associated with an elateritic deposit in a lagoon to the north-west of Adelaide Bay, at the south of the island. In the hope of finding Coorongite (it was thought unlikely that petroleum itself was present) a visit was made to Flinders Island, in February, 1965.

In view of the present interest in the search for petroleum in Bass Strait, it seems pertinent to place on record the exact nature of this "petroliferous" material and of the "oil" derived from it.

Discussion with local inhabitants confirmed that rumours of the occurrence of petroleum on the island had persisted for more than fifty years; in fact, in 1936, so strong was the belief in an impending oil boom, that the Austral Oil Drilling Syndicate was formed, with leases over 30,000 acres in the locality mentioned above. The occurrence of oily films on paludial waters in this area, and of two smoky fires in a nearby dry lagoon, one in 1913 which "burnt for years" and another about thirty years ago, no doubt gave rise to the persistent belief in the presence of petroleum. At one time, the Tasmanian Mines Department was persuaded to look into the matter and an interim report was made (Carey, 1945); somewhat earlier (Mines, 1932) the area was believed to be associated with oil shales.

A survey was made and, with the help of information from local farmers, the "oil field" was located, and samples obtained.

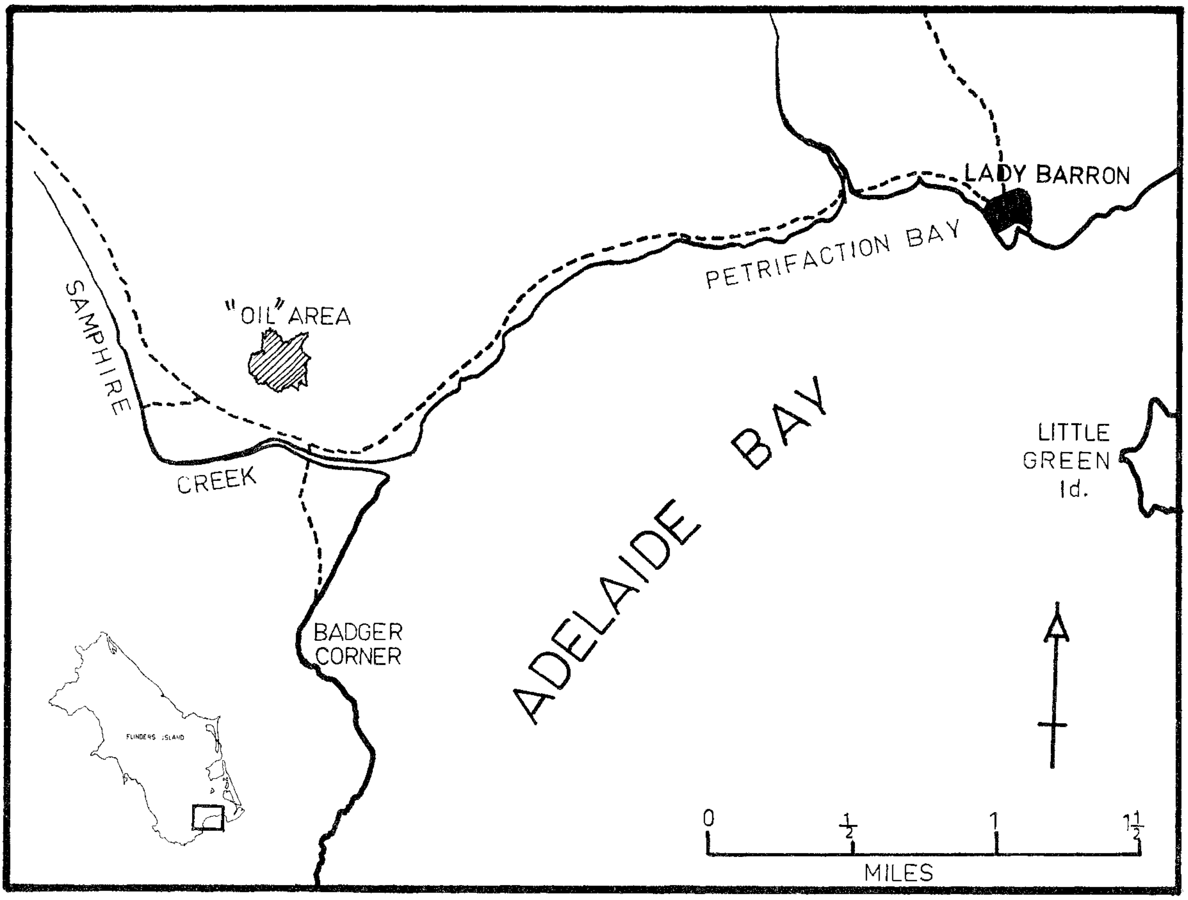
PHYSIOGRAPHY

The particular area is sparsely covered with vegetation and the alleged oil-yielding lagoon lies in a slight depression in the south coastal plain, about 700 yards north of the crossing of Samphire Creek by the road to Badger Corner—(the position is shown on the chart on the following page).

The vegetation, which has been described by Dimmock (1957) can be depicted as low open heath scrub on an acid humus podzol. Ground cover is provided by grasses, sedges, heaths and various reeds, while the dominant flora are teatree and banksia which occur together as dense scrub in patches in an otherwise fairly treeless area, there being no trees much higher than about fifteen feet. It is particularly interesting to note that, although the "petroliferous" material is a semipeat, composed almost entirely of what appears to be organic detritus substantially from Blackboy or Yacca (Xanthorrhaea australis), the lagoon and immediate surrounds are now devoid of this plant. This difference is almost certainly connected with a bygone change in level of the water table, Xanthorrhaea being particularly adverse to wet ground conditions. However, a mile away, on dry ground, stands of Xanthorrhaea are so thick as to allow little else to grow.

Although, at the time of the visit, the countryside was very dry, excavations at the lagoon itself showed brackish water only a few inches below ground level, small areas being quite marshy. It is alleged that, during the winter, the depression is thinly covered with "oily" water over an area of about 40 acres. The soil in the lowest areas showed salt encrustation.

Soil sections showed an upper layer of 1″-3″ of recent vegetal remains, followed by varying thicknesses (2″-8″) of a brown-black peaty soil, in which were embedded numerous small pieces of very porous charcoal. This char appeared to originate from frond-like vegetation and its presence supported the statements regarding the earlier fires. Below, was a layer of heavy black soil, followed by quartzitic gravel and then clay. By diligent



searching in the scrub, areas were found composed of small knolls (1-2 feet in diameter) of nearly pure organic matter; these had apparently escaped the fires.

Restricted sapropelic decomposition was occurring in the marshy portions of the area as certain spots had an odour of hydrogen sulphide. The writer was told that an inverted can would collect enough gas to burn with a flame as it issued from a small hole in the top. This gas is very probably methane arising from the bacterial decomposition of cellulose. Nevertheless, a combustible gas would certainly lead to further credence of the occurrence of mineral oil. The water was covered with a thin film of resinous organic matter ("oil"), possibly derived from the yacca gum of a past era.

THE "OIL" YIELDING MATERIAL

Laboratory examination of the dried semipeat, and of earlier samples taken in 1934, showed the major portion to consist of a curious dun-coloured matrix of friable corky nature, in which were embedded many charcoal particles and small fibrous remains of other plants. When dry, the substance was extremely hydrophobic and had a specific gravity of only 0.31. The dry material ignited readily and burnt with a smoky flame, the fumes having a strong smell of burnt cork. When the flame was extinguished, the material smouldered away until all the carbon was consumed, leaving a white ash amounting to 7.8% on a dry basis. The slow smouldering of the substance permitted a certain amount of dry distillation to occur ahead of the actual burning area, producing a soft yellow, waxy material. The volatiles had a resinous smell, and in no way resembled those from crude petroleum or from oil shale. The ultimate analysis of the raw organic matter showed (on a d.a.f. basis):

Carbon	64.85%	
Hydrogen	7.58%	
Nitrogen	0.83%	
Sulphur	1.35%	
Oxygen	25.39%	(diff.)

A study of the well-known diagram of Ralston (1915) showed that this material is outside the conventional limits of elaterites, kerogens, peats, lignites and other such material, but is within an area occupied by plant cuticles, resins, exines and certain sapropels (Bajars, 1958).

Microscopic examination of the dissected material revealed an entirely disorganised mass of plant debris devoid of any bedding plane. The substance was made up of highly suberised tissue and cutanised vascular remains, flakes of cuticle, specks and fragments of resins and pollens, bacterial residues and charcoal particles, together with large plant remnants and cells. The whole was in such a fine state of subdivision that, to the naked eye, the material was reasonably homogeneous. True cellulosic remains were not very evident and, presumably, had been removed by bacterial action. With the assistance of the Botany Department of this University, some larger plant fragments were identified as basal portions of the fronds of Xanthorrhaea australis. It is apparent that the plant tissue must have suffered extensive cutinisation which, together with the resins and waxes provided the bacterial-resistant portion of the debris; cuticles are very resistant to such conditions, even over geological periods. Suberisation had occurred to an extent such as to give the whole a friable corky nature, which accounted for the smell of the burning material.

When heated in a modified form of the Gray-King apparatus (Fuel Board, 1940) the dried substance yielded an orange resinous viscous " oil ". The assay figures were (% w/w):

	" Oil "	*Liquor*	*Char*	*Gas (diff.)*
Sample 2B4 (1934)	47.2	12.2	35.6	5.0
Sample 3B6 (1965)	39.3	11.6	44.0	5.1

The aqueous liquor was acid, strongly reducing in character and, when made alkaline, evolved an ammoniacal smell. Some of the " oil " no doubt exists as resins (yacca gum) in the raw material as a Soxhlet extraction with isopropanol/hexane showed 11.2% solubles. Ultimate analysis placed the extract in the centre of the resin area of the Ralston diagram and the infra-red spectrum supported this classification.

The pyrolystate " oil " was surprisingly high in tar acids (13%) which were substantially phenolic. Tar bases appeared to be absent.

The distilled acid-and-base-free pyrolysate (neutral portion) was a yellow liquid which darkened on exposure to air. Although somewhat waxy, the high refractive index ($n_D^{25} = 1.5098$) and the infra-red spectrum, showed that long chain carboxylic acids or hydrocarbons were not predominant. The spectrum was characterised by several strong peaks corresponding to carbonyl groups in a carboxylic environment. CH_2 stretch frequencies were present and other notable features were absorption at 748 cm^{-1} (benzene ring deformation and substitution) and peaks at 1270-1230 cm^{-1} corresponding to phenolic esters. There was no reasonable correlation between the spectra of montan wax, ozokerite or crude petroleum and that of the present " waxy oil ".

The above data, then, definitely excludes any notion of the deposit, or the " oil ", being derived from, or associated with, mineral hydrocarbons or oil shale. On the other hand, the chemical evidence supports the hypothesis that this material represents a curious plant degradation product formed under abnormal conditions; this hypothesis is borne out by the macroscopic and microscopic examinations. The " oil " associated with the maceral is of a resinous nature and is partially derived from natural resins and gums and partially from pyrolytic decomposition of the plant debris. The major chemical components of the semi-solid pyrolysate appear to be substituted phenolic esters, phenols, hydrocarbons of varying chain length, together with a considerable portion of complex chemicals of indeterminate nature. The conditions giving rise to the deposit can be envisaged as an extended period (or periods) of lush growth of characteristic plants, possibly nearly exclusively Xanthorrhaea and grasses, followed by the total death of the stand by a change in environment, probably an alteration in the water table. If Xanthorrhaea were the main contributor to the deposit, there is no doubt that the phenolic constituents of the yacca gum could indeed affect the whole nature of the subsequent microbiological decomposition process.

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