128B/81-86 OIL SHALES.

INTRODUCTION -

Petroleum has become an indispensable commodity of civilisation. Australia, at present, is wholly dependent on other countries for supplies of natural petroleum. The necessity for the provision of adequate supplies, from within our own boundaries, both for war and industrial purposes, has long been realised. In recognition of this fact, and in an endeavour to encourage oil exploration, the Commonwealth Government offered a large reward for the discovery of a commercially important reservoir, and a substantial bounty for oil distilled from shale. The principle of a reward was not considered the best means of assisting in the search for oil, and assistance in drilling is granted instead. Several companies have been formed during recent years for the purpose of exploring our resources of natural petroleum, but their operations have not been productive of important results. However, immediate requirements may be supplied in part from extensive deposits of Oil Shale, some of which occur in Tasmania.

Local shales are of two kinds:

(1) The tasmanite shale of the northern and north-western districts, and

(2) The so called kerosene shale or torbanites of Preolenna and Barn Bluff.

GEOGRAPHICAL DISTRIBUTION -

(1) Tasmanite shale has been found in the northern portion only of the Island, and is confined within an area fronting the coast thirty miles wide and extending from Tamar River to Stanley. The arbitrary boundaries enclose not only the several known isolated occurrences, but also all other areas that are considered likely to contain important deposits. The known deposits encompass comparatively small areas, and have been definitely delimited. They are situated in two widely separated fields associated with basins of kerogenite and humic-kerogenite coals.

(2) Kerosene shales or torbanites are distributed over two areas widely separated. Those at Preolenna are contained within a coalfield lying thirteen miles south of Wynyard, on the North-west coast. The second area lies some 35 miles to the south-east, and is situated on the extreme north-western end of the Central Plateau of Tasmania.

GEOLOGY OF THE SHALE BEDS -

(1) The tasmanite beds are contained within the Permo-Carboniferous formation, the strata of which were laid down in regional synclinoria developed in older rock formations. The formation generally consist of basal conglomerate and sandstone, limestone, Upper and Lower Marine mudstones with intercalated coal measure sandstones, shales, and grits. Apparently the bed of shale corresponds in position to the coal measure series between the Lower and Upper Marine members of the formation. The coal measures are correlated with the Greta of New South Wales, and are replete with similar flora.

Tasmanite occurs in a three to 6 foot seam at or about the horizon of the coal bed in contiguous area. Only one seam of tasmanite and only one seam of workable coal is known in the district. In some places the coal ends abruptly where the shale begins, but as there is no evidence of mergence one into the other their geographical relation may be due to faulting. However in one place the coal seam recurs on the other side of the narrow shale belt, indicating a close correspondence in time of formation. There is no evidence to show that tasmanite and coal occur mutually superimposed in any part of the district; on the contrary, it is found that where coal occurs, it is futile to search for tasmanite, and where tasmanite occurs, for coal. This knowledge facilitates exploration considerably by the elimination of all coal areas from examination. It has been established that tasmanite fringes the shore-lines of Permo-Carboniferous seams, from which it follows that where the upper mudstones abut early Palaeozoic or Proterozoic rocks (conglomerates, slates, schists &c.) the presence of tasmanite may be anticipated. A striking feature is that there is no appreciable thinning of the seam as the shore line is approached. Probably this is due to the steepness of the Permo-Carboniferous shore-line.

(2) The coal seams, in which the oil shales of the Preolenna are confined, were laid down in the Permo-Carboniferous Period. Of this system there are visible in the coalfield itself the following series in descending order:-

The Tomago coal measures
The Upper Marine mudstone
The Greta coal measures
The Lower Marine mudstones

This shows that the coal occurs at two horizons, namely, the Greta coal measures and the Tomago horizon. The seams in the Greta measures number four. The number in the Tomago has not been ascertained. A number of outcrops occur, but these could quite possibly be the one seam faulted into various positions.

The coal seams vary in thickness from 9 inches to 24 inches, and are characterised by the fact that without exception they belong to the kerogenites or humic kerogenites. Several of the coal seams show at various places the occurrence of high-grade kerosene shale, and it is specially noteworthy that this shale is not confined to any one seam, but makes and disappears in the various seams in a manner totally characteristic of this class of coal.

(3) There is only one coal seam in the Barn Bluff area. This occurs in the Greta coal measures of the Permo-Carboniferous Period. This coal seam is of the humic-kerogenite type, and, as quite characteristic of this type of coal, may consist of the variety pelionite in one part, and of a totally different type of cannel coal is another.

The high grade pelionite, which has been found in the glacial moraine at the eastern foot of Barn Bluff in slabs up to 8 inches in thickness, represents this seam varied to the extent of consisting of practically wholly of the substance to which the name of "pelionite" has been given, which is, in fact, a special variety of the kerogenites and humic keroginites. The part of the seam from which these fragments have come has not yet been disclosed.

NATURE OF OIL SHALES. -

(a) Tasmanite, like cannel coal and kerosene shale, is not so oil bearing, but an oil-producing substance, that requires heat for the generation of oil. The source of the oil is an organic substance called "kerogen" with which the shale is impregnated. This material, so adapted to the generation of artificial petroleum by distillation, consists of innumerable minute disc-like spore cases set in a fine-grained arenaceous sediment. The amber-coloured discs or sacs are about half a millimetre in diameter, and, where not deformed, are nearly circular in outline. The sacs have been preserved by a decay-resistant waxy or resinous substance forming the outer skin, but the spore cases have decayed, and their remains are generally almost indistinguishable. These waxy or resinous products of the plant are hydrogen-rich and oxygen-poor substances. They are strangely, almost unaffected by the ordinary solvents of waxes and resins.

(b) As compared with the Barn Bluff occurrence of cannel coal, the Preolenna kerosene shale is distinguished by the absence of the marked amorphous unlaminated character and well developed conchoidal fracture of the former. There is a notable difference in the lustre of the two minerals, also, the pelionite (Barn Bluff) having more the appearance of vulcanite, as contrasted with the pitch-like aspect of the kerosene shale. The streak of the former mineral is black, whereas the latter has a tendency towards a brown streak; pelionite also exhibits marked sectility. In the matter of chemical composition, also, there is a distinct difference, for whereas the rates of volatile constituents to fixed carbon is 2.7 in Preolenna kerosene shale, it is only 1.24 in pelionite.

SHALE FIELDS. -

I. The more important tasmanite shale field extends from Latrobe in a south-easterly direction to Quamby Brook. From Latrobe the seam has been traced without serious interruption, under the broad flood-plain and valley sides of Mersey River, to a point three miles south-east of Kimberly. Beyond that point through Dunerlan and Delorain the Permo-Carboniferous do not outcrop, but they reappear a mile south of Deloraine, and, in the valley of Quamby Brook tasmanite is exposed at intervals over two miles. Along this 27 mile belt the shale has been proved to extend thirteen miles, and in the section intervening Kimberly and Quamby Bluff exploration has lately revealed its occurrence. At Latrobe and Railton the seam outcrops, and in no part of those areas is it far below the surface. At Native Plain it is from 300 to 900 feet below river level. Outliers of the main body are known at Beulah and Nook on the west and at Paramatta on the east side. Far removed from these is the Cam River tasmanite field, situated near Oonah, 22 miles south of Wynyard. It consists of two areas - one near the point of confluence of the eastern branch with the main stream; the other and larger one four miles west of it. Aside from the known deposits it is considered likely that tasmanite will be found in the vicinity of Preolenna, near Newhaven, and on the Emu Bay block of the Van Dieman's land Company.

II. The Preolenna kerosene shale field is situated on the northern slopes of the Campbell range. The more important

outcrops occur on the western side of the deep precipitous gorge of Messie River, which drains part of the northern fall of the Campbell Range and flows into the Inglis River at a point about three miles distant from the present mine workings. The extent of the field has not been definitely determined, but there occur in the eastern portion of the shale-bearing areas approximately 1000 acres, which are shale-bearing. In the western portion of the area there is in the vicinity of 1000 acres, but the exact area has not been determined, as the western limit has not been delineated.

III. Barn Bluff shale bearing area lies beneath the approximately conical mass of Barn Bluff, and extends northward under the spur which connects that mountain with Cradle Mountain. The shale horizon outcrops on the eastern side of the steep-sided gorge of the Fury River, and on the eastern side at the heads of the valleys of the various branches of the Brown River.

The potential shale-bearing area is, approximately, seven square miles.

CHEMICAL COMPOSITION -

Oils cannot be extracted from Tasmanite by solvents nor by subjecting the mineral to high pressure, but oils can be formed from it by the application of heat under certain conditions. When the shale is placed in a retort and heated the organic component "kerogen" is progressively decomposed into permanent gases and oil vapours of various kinds, the latter of which can be easily condemsed into crude shale oil. The richness of the shale is in proportion to the amount of kerogen it contains. Information regarding the chemical composition of the kerogen of tasmanite is meagre. It is doubtful whether the kerogen can be expressed as a definite chemical compound. The nitrogen and sulphur constituents occur in combinations with the hydrocarbon and in fairly constant proportions. The composition and the properties of the oil distilled from tasmanite differ greatly from the oil of other shales.

Ultimate Analysis of the Crude Oil - Nitrogen, 0.31; carbon 79.34; hydrogen, 10.41; oxygen, 4.93; sulphur, 4.93 The calorific power of the crude oil has been estimated at 21,625 B.T.U., and at 21,336 B.T.U.; the flash point is from 235° to 260° and the specific gravity is 0.931 to 0.956. Laboratory tests show varying results owing to different conditions of operation.

The following gives the proximate analysis of the tasmanite shale from several localities, as determined in the Government laboratories:-

Locality	Moisture	Volatile Matter	Fixed Carbon	Sulphur	Ash
Latrobe	0.80	30.84	5.86	2.56	62.50
Railton	1.00	30.00	6.20	1.92	62.80
Nook	1.90	16.28	8.50	1.26	73.32
Barnett Creek	1.30	22.86	5.84	1.65	70.00

The yield of oil from average samples of tasmanite is given in the subjoined table:-

Locality	Yield in Gallons
Latrobe	44.12
Barnett Creek (outcrop shale)	29.07
Great Bend	65
Railton	40.98

The analyses reveal the variation in the content of oil in shale occurring in the several areas. The crude oil is of an extremely dark colour and viseid character. Tests of the crude oil show that it consists of 64% lubricating oils, 25% lighting oil, and 11% benzine. The proportion of vaseline and mineral waxes is very small.

RESERVES

Tasmanite forms the greater part of the oil shale deposits and a recent estimate of the reserves of this shale is as follows:-

	Tons
Latrobe-Railton-Kimberley area	30,000,000
Beulah area	3,000,000
Quamby Bluff area	3,000,000
Nook area	800,000
Oonah area	6,000,000
TOTAL	42,800,000

The average yield of crude oil from these shales is estimated at 40 gallons per ton, and the oil reserve therefore amounts to 1,712,000,000 gallons.

No reserves have as yet been calculated for the oil shales of the Proclenna and Barn Bluff field, and in the present stage of their development, it can only be said that the reserves are small.

TREATMENT -

About 1910 the Tasmanian Shale and Oil Company constructed works for retorting tasmanite shale on the banks of the River Mersey at a point 2½ miles south of Latrobe. An endless steam-driven rope haulage conveyed the shale in trucks on a wooden tramway from the tunnel mouth to the top of the hill, a distance of half a mile. Thence the trucks ran down a self-acting incline to the rock-breaker, in which the stuff was broken into small pieces (2 or 3 inches size). From this the latter was carried by a conveyor to the top of the retorts.

Four of these retorts were built and each of them was supposed to treat daily four or five tons of shale, which was subjected to slow distillation, during which process the gas from the retorted shale passed into a cooler and through the condenser, and the crude oil finally flowed into the stock tanks. The lighter oil and spirit having been extracted by distillation, the remainder constituted residual, or fuel, oil. The spent shale was stacked for sale for manurial purposes. The operations of this company were suspended soon after starting owing to insufficiency of capital.

Of late years two companies have carried out experiments and have erected plants for the distillation of oil from tasmanite in the Latrobe district.

During last year one of these companies, the Australian Shale Oil Company, opened their mine and continued the erection of works, but ran out of capital. Two trials of their retors were made, with, it is claimed, satisfactory results, and about 60,000 gallons of oil were produced. The power kerosene obtained therefrom found a ready market in nearby centres. A local market is available for each of the products.

The other company, the Southern Cross Motor Fuels Ltd., continued their researches and experiments and as a result have designed a retort which they claim is superior to any other. Large scale trials gave credence to their statements.

CONCLUSION -

There is as yet no oil shale industry in Tasmania. Since the nineties a considerable amount of work has been performed on oil shale, and although it cannot be said that oil has been produced on a commercial scale, the pioneers of this industry have as a result of their works given us a great amount of valuable information relating to the peculiarities of these shales, and the nature of their products. It has been found that the problem is not merely the producing of oil; it is the producing of a uniformly good oil as a continuous operation. The establishment of the industry has been delayed because of a lack of appreciation of the problems confronting investigators a tendency to make light of difficulties, and not make provision for overcoming them, as a result we have two idle retorting plants. However, it now appears that as a result of recent researches and experiments the chief difficulties have been overcome. It has been found:-

1. That emulsification of crude oil and water can be prevented by preliminary drying of the shale,
2. That the drawing of dust into the condensers can be reduced to a minimum by the use of two or more outlets below the surface of the charge
3. That carbonisation of the walls of the retors can be prevented by the introduction of inert gases, such as carbon monoxide and carbon dioxide, into the retort
4. That greater efficiency is obtained by the use of a large number of small retorts instead of a few large retorts.

Those were the main causes of the early failures.

(signed)
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