

disposed gravels, sands, and clays, with peaty lignite beds. The lowest beds of the horizontal series are formed by coarse conglomerates containing many norite and gabbro boulders. These conglomerates may be glacial in origin.

The oil-shales so far worked exist in a small basin surrounded by granite, which seemingly is a small embayment in the larger basin of coal-bearing rocks stretching inland from the bay on which Orepuki is situated. In this smaller basin there are now visible several outcrops of the oil-shales, which dip at gentle angles away from the surrounding granites, and another outcrop appears about three miles to the westward in the larger basin.

Boreholes have proved the continuity of the oil-shales within the smaller basin, and for a short distance from the entrance of that basin in the larger one; but it is not definitely known whether or not they exist beneath the widespread superincumbent later rocks of the larger basin, though this is thought to be the case.*

The oil-shale bed, which is generally about 4 ft. 6 in. in thickness, but is in places as much as 5 ft., occurs associated with beds of lignites, generally impure, which may overlie or underlie the shale.

The shale is high in paraffin, and contains a relatively low percentage of lubricating-oil, kerosene, and the more volatile oils. According to analyses made by Dr. J. G. Black, of Otago University, in 1873, Orepuki shale yielded 42 gallons of crude oil per ton, with a specific gravity of 0.897, equal to 16.8 per cent. of oil. An analysis made in the Colonial Laboratory in 1892 is as follows:—

Fixed carbon	..	..	..	..	..	..	13.82
Hydrocarbons	..	..	..	..	..	..	59.57
Water	..	..	..	..	..	..	6.20
Ash	..	..	..	..	..	..	20.41
							100.00

In 1906 extended tests of the shale were made at the Pumpherston Oil Company's works in Scotland.† Over 50 tons of material was treated, and the results show that the Orepuki shale yielded 38.41 gallons of crude oil per ton, whilst 19.12 lb. per ton of sulphate of ammonia was obtained. In addition, more than sufficient gas was produced for firing the retort. The crude oil, which had a specific gravity of 0.890, yielded 70.7 per cent. of finished commercial products, as follows:—

	Specific Gravity.	Yield per Cent. of Crude Oil.
Burning-oil	0.835	25.92
Gas-oil	0.849	3.07
Medium oil	0.868	4.05
Lubricating-oil	0.916	17.55
Hard paraffin, with melting-point of 119.5° Fahr., and containing 4 per cent. of oil	..	19.03
Soft paraffin, with melting-point of 86.5° Fahr.	..	1.08

About eight years ago a magnificent plant, costing £120,000, for the retorting and refining of the various hydrocarbon products of the oil-shales was completed. This, after about a year's operations, closed down, and has not since been reopened. Much of the plant is still in good repair, though in some parts crumbling brick walls, rusting ironwork, &c., testify to its decay. The plant is said to have been closed down for various reasons, the chief being,—

- (1.) Because of the removal by the Government of the duty on kerosene, paraffin, &c.
- (2.) Because of the expense of mining the shale. Before commencing the works it had been estimated that the shale would cost 3s. 6d. per ton to mine; but, instead, it is said to have cost no less than 18s. per ton. The very shattered nature of the shale and of the overlying rock rendered the drives, &c., difficult to keep open, and consequently greatly increased the cost of mining.
- (3.) Because the supply of shale was found to be so small that it would have been soon exhausted had the works been kept open.

I think the difficulty in regard to mining might have been overcome had there been pursued a longwall method, starting at the boundary and working backwards towards the incline shaft, and abandoning the ground behind.

The supply of shale, as already mentioned, in the small basin is undoubtedly limited. However, it seems probable, since there is an outcrop three miles distant from the entrance of the small basin, that the shale-bed is continuous beneath the larger basin as well. If this is the case, there is a goodly supply available, though it is another question as to whether it could be profitably mined and treated in view of the economic conditions at present existing in the Dominion.

Within the horizontally lying beds that overlie the tilted strata enclosing the oil-shales are lenses or leads rich in black sand, and containing in places payable quantities of fine pure gold. On the sea-beach is a thick deposit of black sand, accumulated by wave concentration of the debris derived from the denudation of the horizontally bedded sands, gravels, &c., forming the cliffs bordering the sea. In the cliffs is exposed a bed of peaty lignite, varying in thickness from 2 ft. to 7 ft.

The black sands formerly contained a great deal of free gold, but are now mainly exhausted. Away from the sea-beach the richer leads have, apparently, for the most part been worked out, but a few small claims are still being profitably operated.

* Recently, in a borehole put down by the Government drill 9 chains south-west of the shale-works, 4 ft. 9 in. of shale was located at a depth of 287 ft., underlying 3 ft. of coal (probably lignite). Some coal (thickness not stated) followed the shale.

† For some of the particulars see "New Zealand Mines Record," Vol. x, 1906-7, p. 268.