## 7. PETROLEUM AT WAIOTAPU, ROTORUA DISTRICT.

(By P. G. Morgan.)

On the 25th January, 1922, I visited the oil-seepages occurring on the east or left bank of Waiotapu Stream, in Section 4, Block 3, Paeroa Survey District. The ford on the cross-road between the Galatea and Taupo roads is just up-stream, so that the locality is easily reached.

The oil-seepages occur on a small sinter terrace, perhaps 25 or 30 yards long and 10 or 12 yards wide, which is only a foot or two above the level of the stream. Here are numerous roughly circular holes, of an average diameter of 12 in., filled with hot water, through which rise bubbles of non-inflammable gas. The water in the holes is covered with irridescent oil films, and, as it is sufficiently hot to cause fairly rapid evaporation of the volatile and semi-volatile fractions of the oil, the supply of oil must be continually renewed. Round each of the holes is a thin ring or coating of dark material, representing the solid constituents of the oil. This is dark-brown to black in colour; the darker portions resemble pitch, and melt and ignite readily. In the stream-bed at the ford a few yards away large bubbles of non-inflammable gas rise to the surface. Each of these bubbles carries with it a little oil, which floats down-stream as an irridescent film. If the lumps of siliceous sinter and other debris on the edge of the stream are disturbed, globules of amber-coloured oil rise and float away.

Presumably the gas contains some inflammable ingredients; but many trials with lighted matches failed to give any sign of ignition, and therefore the gas must consist chiefly of non-inflammable constituents, such as carbon dioxide or nitrogen. Other gas emanations are reported to occur in the bed of Waiotapu Stream, especially toward Lake Ngahewa, to the north-west of the point examined, but I could not learn that any of these consisted of inflammable gas.

The surface rock at Waiotapu is a poorly consolidated rhyolitic tuff, which, as in many similar occurrences elsewhere in the Taupo-Rotorua district, was observed to contain numerous fragments of carbonized wood. This carbonized wood has, roughly, the composition of brown coal, and, like brown coal, on being distilled at moderate temperatures would yield more or less oil and gas. The origin of the petroleum is therefore very easily explained. The water of Waiotapu Stream is warm (temperature probably well over 90° F. on the day of my visit), and a large percentage must be supplied by hot springs, which derive their heat from the rocks they traverse. Vast masses of heated rhyolitic tuff must underlie the whole or part of the basin of Waiotapu Stream. Not far below the surface the thermal waters are well above normal boiling-point. The adjoining rocks are probably as hot, and the contained wood and other vegetal matter, subjected to this heat, give off the oil that reaches the surface. Dr. J. M. Bell, formerly Director of the Geological Survey, in a memorandum dated 21st November, 1910, suggested a similar explanation for the oil occurring in the Waiotapu district.

It follows from this explanation that the possibility of oil occurring in the immediate vicinity of Waiotapu in commercial quantities is very small.

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## 8. NATURAL GAS IN HAURAKI PLAINS.

(By J. Henderson.)

The whole of New Zealand within a geologically late period was at a decidedly higher elevation in respect to sea-level than at present. Then, as now, the low-lying areas were smothered in swamps. These, as the land sank, were covered by layers of sand and mud, and now form the peaty and carbonaceous bands passed through by the numerous bores drilled for water on the Hauraki Plains. Surface swamps and muds containing plant-fragments give rise to marsh-gas, and this inflammable gas continues to be produced after a swamp is covered. The "firedamp" of coal-seams shows how long it may remain imprisoned underground. Undoubtedly the inflammable gas issuing from the bores on the Hauraki Plains consists in great part of marsh-gas.

The officer in charge of the drainage-works on the Hauraki Plains, in his report for the year ended 31st March, 1910, gave the logs of two bores drilled for water, one at Pipiroa, near the mouth of the Piako, the other at Orchard, half-way between that township and Kerepehi. The first passed through 391 ft. of pumiceous sands and muds containing one 4 ft. layer of "peaty swamp," 200 ft. from the surface; the other, 435 ft. deep, penetrated similar strata containing five bands of "peaty mud."* Inflammable gas, however, is not mentioned in this report.

Similar occurrences of "natural" gas in New Zealand may be briefly described. At Horotiu, between Hamilton and Ngaruawahia, several bores were sunk about the year 1914 in the hope of reaching coal. No coal was found. The deepest bore penetrated 740 ft. of pumiceous sands and silts similar to, though more compact and probably somewhat older than, the beds underlying the Hauraki Plains. It passed through six carbonaceous layers.† Gas escaped in considerable quantity, and when lighted is stated to have continued burning for hours. When the bore was visited in 1918 inflammable gas was issuing from the pipe at the rate of perhaps 5 cubic feet per hour. It was not escaping continuously, and would not remain alight for any length of time.

In the Gisborne district inflammable gas occurs in many bores sunk for water in the Poverty Bay flats. At Makaraka, three miles from Gisborne, a dwellinghouse was lighted by natural gas for several years until the upper part of the pipe rusted away.‡ The gas in the strata underlying

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* J. B. Thompson: "Drainage Operations in Hauraki Plains." C.–8, pp. 1–6, 1910.

† J. R. Hetherington: "Record of Borings at Horotiu, near Ngaruawahia." Trans. N.Z. Inst., vol. 47, pp. 613–14, 1915.

‡ N.Z. Geol. Surv. Bull. No. 21, p. 62, 1920.