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PETROLEUM AND OTHER MINERALS IN EASTERN WAIRARAPA DISTRICT

(REPORT ON PROBABLE OCCURRENCE OF).

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REPORT ON THE PROBABLE OCCURRENCE OF PETROLEUM AND OTHER MINERALS IN THE EASTERN WAIRARAPA DISTRICT, WELLINGTON.

By P. G. Morgan, M.A., General Geologist.

Narrative.

Acting on instructions received, the writer left Wellington for Masterton on the afternoon of Tuesday, the 12th July. Next day he proceeded by coach *via* Taueru to Awatoitoi Station, near Carswell's, a post-office sixteen or seventeen miles east of Masterton. On Thursday, the 14th July, the gas-spring between Awatoitoi and Blairlogie homesteads was visited, but owing to the wet weather very little other work could be done on this day. On Friday, the 15th, the writer rode *via* Tenui to Whakataki, a small settlement on the east coast at the mouth of the Whakataki Stream. Next day he rode up the coast to Aohanga, and on the following day returned to Whakataki, whence on the same day he proceeded *via* Castlepoint to Otahome Station, the property of Mr. W. Andrew. On the 18th the writer rode across country to Mr. Campbell's residence, near Ica, and from there returned to Awatoitoi by the road. *En route*, Cameron's gas-spring was visited. On the 19th a mineral spring and other points of interest on Awatoitoi Station were inspected. The writer then returned to Masterton, and on the 20th reached Wellington.

Throughout the trip Mr. D. Laing, of New Plymouth, accompanied the writer, and acted as guide.

Character of Country examined.

The Town of Masterton is situated in the broad Wairarapa Valley, drained by the Ruamahanga River and its tributaries. Westward are the ranges known as the Rimutakas and the Tararuas, while to the eastward is the country specially examined, a region of rolling hills varying in height from a few hundred feet to possibly 2,000 ft. There are no well-marked ranges more than a few miles in length. The various elevations that, owing to their rugged appearance, are designated "taipos" occur at intervals along a more or less irregular N.N.E.-and-S.S.W. line passing through Tenui. The "taipos" are masses of hard sandstone that, on account of their resistance to denuding agencies, stand out above the surrounding country, and form prominent hills with precipitous slopes. The Trooper Range is a ridge, averaging perhaps 1,000 ft. in height, that runs roughly parallel to the coast from Whakataki southward to the mouth of the Whareama River. Mount Percy (1,557 ft.) is a prominent hill near the coast-line north of Whakataki and south of the Mataikona River.

The chief streams of the area are the Taueru, a tributary of the Ruamahanga; the Whareama River, with its chief tributary the Tenui; Otahome Stream, Ngakauau Stream, Whakataki Stream, Mataikona River, and the Aohanga River. Except the Taueru, all these streams flow to the east coast. In general the drainage of the area may be described as somewhat irregular or disorderly. The larger river-valleys, especially that of the Whareama, exhibit some alluvial flats. The smaller streams are often in deep valleys, cut in rolling table-lands. Rock-bound gorges are rare. Whilst the last movement of the land may have been one of slight depression, as indicated by alluvial flats at the mouths of some of the streams, the land-forms suggest three distinct periods of elevation in fairly recent geological times.

The area traversed is nearly all open country, with here and there a little bush. Considerable areas of scrub still remain, but are fast becoming cleared. The chief industry of the district is sheep-farming, for which the greater part of the country is excellently adapted.

Previous Geological Observers.

So far back as 1875 Mr. Alex. McKay travelled over the greater part of the area lately examined by the writer. His observations will be found in a "Report on Country between Cape Kidnappers and Cape Turnagain" (G.S. Reports during 1874–76, Vol. ix, pages 50–53). McKay made considerable collections of fossils from the district, but only a small number of the fossils were identified. In several later reports McKay again refers to the geology of the district (G.S. Reports, 1876–77, pages 73, 89, 90; 1877–78, page 24; 1878–79, pages 82, 83; and 1883–84, page 72).

The writer was informed that Sir James Hector many years ago visited the east coast, and expressed a favourable opinion regarding prospects of oil near Aohanga; but the writer has not been able to find any published reference to this statement.

In 1888 Professor James Park reported on an area extending from the Kaiwhata River northward to the Akitio River, and having an average width of about fifteen miles.* Park's opinion as to the probable occurrence of payable oil is not favourable. He gives as his reasons the shattered nature of the rocks, and the absence of shales containing such a proportion of hydrocarbons as to be capable of yielding mineral oil.

In 1906 Mr. H. Hill, of Napier, wrote a paper,† portions of which bear on the district lately examined by the writer.

General Geology.

From the eastern side of the Wairarapa Plain to east of Carswell's the prevailing rocks are bluish mudstones, containing in places recognizable fossils (shells). They resemble the Blue Bottom of Westland, but may be somewhat younger in age. Near Taueru a thick band of yellowish limestone is observable on the north side of the road. This limestone is correlated by McKay with the Napier limestone. It overlies the blue mudstones seen at the east of Taueru, but its relation to those west of Taueru was not observable. When observed the dip of the mudstones is generally at moderate angles to the west, and hard calcareous bands and concretions are often seen in them. Eastward of Carswell's bands of shelly conglomerate are seen in the mudstones, and finally a thick bed of shelly conglomerate or limestone appears at the base of the mudstones. The strike is N.N.E. to S.S.W., and the dip about 45° to the west. The shelly conglomerates are best seen on Awatoitoi Station (owned by Mr. Hugh Morrison), towards the head of Middle Division Creek. Here more than half the conglomerate consists of shells. The pebbles are nearly all small and well rounded. A more typical example of an ancient sea-beach could not be easily found. Southward of Cameron's Lookout the shelly conglomerate seems to die out, but northward large boulders of shell limestone are seen on Kerosene Ridge, and again north of the Mangapakia Stream. Here shelly rock appears towards the head of a small stream opposite Mr. Cameron's house.

The following fossils were identified by the writer as occurring in the shelly conglomerates and limestones:—

Dentalium giganteum.
Turritella gigantea.
Turritella sp. n. D.: very abundant in places.
Turritella sp. n. Dd.: very abundant in places.
Struthiolaria nodulosa (?): extremely abundant.
Glycimeris, sp. n. D.
Cucullæa alta (var. B of Hutton).
Cucullæa sp. n. D.

The fossils may be considered to indicate a Miocene age. East and north-east of Kerosene Ridge a brownish claystone is seen over an area of 500 or 600 acres. Park mentions other rocks which from his description appear to lie unconformably immediately below the Miocene shell rock. These are exposed in an old quarry on the eastern side of Kerosene Ridge. The brown claystones north and south of the area indicated do not seem to have any great development.

The next distinguishable rock to the eastward, and still in downward sequence, is a very thick, hard, and altered sandstone, seen south-south-east of Kerosene Ridge. This rock forms the gorge of the upper part of Kaumingi Stream, and also the various "taipos" near Langdale and near Tenui known as Elder's Taipos, Morrison's Taipos, and Maunsell's Taipos. The latter, or Tenui Taipos, show a strong westerly dip of about 50°. Here, according to McKay, the sandstone contains a few fossils, which, as judged by his list, have a Miocene facies. The sandstone, however, has a most ancient appearance, and is probably pre-Miocene in age.

Eastward of the "taipos" to the coast-line the rocks seen are, for the most part, much-faulted mudstones and sandstones. In general the dip is westerly at considerable angles. There is not probably an unconformity between the Taipo Sandstone and these rocks, but of this no certain evidence was obtained. Between Tenui and Whakataki Saddle the rocks seen in the road-cuttings are greatly crushed mudstones of various colours. About a mile and a half from Whakataki a

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* "On the Probable Discovery of Oil and Coal in Wairarapa North County": G.S. Reports during 1887–88, Vol. xix, 1888, pp. 20–24.

† "Oil-wells and Oil-prospects along the East Coast": Trans. N.Z. Inst., Vol. xxxix, 1906, pp. 509–20.

hard bluish rock, probably dipping to the east, is seen in a road-cutting. Mudstones seem to overlie.

The country to the southward of the Tenui–Whakataki Road between Castlepoint and Ica Homestead consists mainly of sandstones, with minor bands of claystone and fine conglomerate. These rocks, though most commonly dipping to the west, often dip in other directions. Loose boulders seen in a tributary of Otahome Stream are calcareous, and some show the remains of a rather problematical organism with a fibrous or prismatic structure.

The rugged prominent bluff known as Castle Rock, and the island that forms the seaward side of Castlepoint Basin, are, according to McKay, of fossiliferous rocks corresponding in age to those at Napier. Park maps them as Miocene.

In 1875 McKay found in a stream that he calls Station Creek (perhaps the Ngakauau of the present maps) a boulder of an igneous rock containing leucite.* The source of this rock has never been determined.

Northward of Whakataki only the rocks exposed along and near the coast were seen. Near the mouth of the Whakataki Stream, and northward for some miles, the rocks are well-bedded sandstones, with minor mudstone layers. These in general strike parallel to the trend of the coast, and dip 20° to 45° or more to the west. In places, however, the strike is seen to curve round in a very short distance, owing to what may be called very pronounced "rolls." Occasionally the dip may approach 90°. At Reef Point, about four miles south of the Mataikona River, the rocks exposed are much altered, and are jointed and shattered very irregularly. These rocks, which might be called grauwackes, are decidedly old-looking, and quite possibly are pre-Cretaceous in age. The dip seems to be at a high angle to the south-west. On the south side of the Mataikona River, near Mr. Barton's homestead, the rocks are of somewhat similar character, but are finer-grained, and contain dark mudstone or shale bands, with some carbonaceous material. The dip of these rocks may be at a high angle to the east. In Pakowai Creek, a tributary of the Mataikona, the chief rocks exposed are said to be sandstones with a westerly dip. Towards the head of the Mataikona River rocks corresponding to those of the Rimutaka Range are reported. Pebbles seen in the bed of the river support this statement. At the mouth of the Mataikona and northward bands of medium-grained conglomerate are seen along the beach, interstratified with sandstones and mudstones. Farther north the conglomerates are no longer seen, but well-stratified alternating sandstones and mudstones are still exposed along the beach. The strike, while in general parallel to the coast-line, varies greatly. The dip is as a rule westerly at angles of 45° or more. In some places it flattens, in others it may approach 90°.

On the road from Aohanga Landing over the ridge to Aohanga Settlement two or three outcrops of shattered mudstones or shale are seen. Near the top of the ridge, about 300 ft. above sea-level, a bold mass of glauconitic sandstone, that has been quarried to some extent for road-metal, appears on the east side of the road. The outcrop is about a chain long from east to west, and about half a chain wide. It weathers to a green colour, and is much jointed and altered. No strike or dip could be obtained. The solid sandstone when broken, and the loose pieces of stone in the quarry, possess the remarkable property of smelling strongly of kerosene.† The hard rocks that outcrop on the north and south banks of the Aohanga River near its mouth are said to consist of the same sandstone, but they have not as yet been found to contain petroleum.

A short distance up the Aohanga River from the hotel altered sandstones with shaly bands may be seen on both sides of the river. These rocks dip inland, and are followed in that direction by what appears from a distance to be a bluish mudstone. Some six miles up the river a fossiliferous limestone appears. This may possibly be of Miocene age.

As regards the age of the rocks along the coast-line from Whakataki to Aohanga the writer agrees with McKay and Park in considering them pre-Tertiary. In the absence of recognizable fossils their exact age must remain uncertain until a detailed survey of the region has been made.

Structure.

Viewed broadly, the whole area from the east coast to the Wairarapa Valley appears to be monocline, with dip to the west. Thus the older rocks are to the east, the younger to the west (except at Castlepoint). Eastward of the "taipos" the strike and the dip of the rocks are often very irregular. An anticline is stated by Park to cross the Whareama River near Ica, and elsewhere there seems to be minor anticlines and synclines. More especially just east of Tenui there is some evidence of an anticline. On the eastern side of the various "taipos" the country is almost everywhere broken by faults. In the Whakataki Valley, at Castlepoint, at Reef Rock, at Mount Percy, and north of the Mataikona River faulting is very prominent.

Economic Geology.

Petroleum.—The main object of the writer's visit to the east Wairarapa district was to obtain evidence of the existence of petroleum. The most direct evidence bearing on the subject is the occurrence, as previously mentioned, of petroliferous glauconitic sandstone near Aohanga. This rock, according to a test made in the Dominion Laboratory of a sample supplied by Mr. D. Laing, contains 0·46 per cent. of petroleum. This result does not include any oil of the benzine class that may have been present. As evidence of the strong petroleum-like smell of the rock, it may be mentioned that according to reliable reports horses used to shy when passing over portions of the road freshly metalled with the rock.

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* Mines Report, 1889, C.–9, p. 36.

† Mr. H. Hill mentions this occurrence in the paper previously mentioned. (See Trans. N.Z. Inst., Vol. xxxix, 1906, pp. 512, 516.)

The gas-escapes on Messrs H. Morrison's and Cameron's properties, east of Carswell's, when visited by the writer, had the characteristic smell of kerosene; but no oil was seen. Several reported occurrences of oil-films—for instance, one north of Akitio, on the inland side of the coastal range—may be considered as more probably due to iron-oxide or to oily material formed by the decay of surface vegetation than to petroleum. Reported oil-films in a small creek east of Mr. Morrison's gas-spring could not be seen by the writer, owing to the flooded state of the stream.

At Mr. Maunsell's house, near Tenui, it is said that, after a flood caused not long ago by the damming and subsequent breaking-away of a neighbouring small stream, a smell of petroleum was perceived for weeks.

Gas.—A number of gas-springs are found in the eastern Wairarapa district. One of the best-known of these is on the property of Mr. H. Morrison, between Carswell's and Blairlogie. The spring itself is on the east side of Kerosene Ridge, at a barometric height of 910 ft. above sea-level. In fine weather the gas is reported to burn steadily with a flame from 6 in. to 15 in. high. At the time of the writer's visit during heavy rain gas was bubbling vigorously through the water in a small hole about 6 in. in diameter, whilst over an area of several square yards there were numerous small escapes of gas. The main gas-escape ignited readily, and burnt with a bluish-yellow flame. The water in the hole tasted very perceptibly of kerosene.

A second gas-spring occurs about a mile and a half to the northward, on Mr. Cameron's land, and about a quarter of a mile south of the Whakataki Road. Here, over an area of two or three yards, the writer noted gas-springs escaping in numerous small jets. Some of these when lighted burnt continuously with a pale bluish flame. The discoverer, Mr. J. Cameron, who had guided the writer to the spot, said that when first found the gas was escaping from a single vent, and burnt with a flame of some size.

Near Ica, in Boundary Creek, a small eastern tributary of the Whareama River, Park describes a small escape of carburetted hydrogen. According to information supplied to the writer by Mr. Campbell, manager of Mrs. J. C. Andrew's property, what is probably the same occurrence does not afford on trial with a match any inflammable gas at the present time.

It is stated by Park that he was informed that during the formation of the road from Aohanga Landing to the homestead the grey shaly clays (mudstones) of the cuttings were found to give off a large amount of gas. This possibly was derived from the glauconitic sandstone already described as containing petroleum.

In the neighbourhood of Aohanga and northward, in the Akitio district, are a number of inflammable-gas springs not visited by the writer. Those of which the writer has reliable information are as follows:—

(1.) At Spring Hill, about a mile north-west of Mr. Hume's Aohanga homestead, are two gas-springs within half a mile of each other.

(2.) At Glencoe Gorge, about six miles up the Aohanga River, there is a large gas-spring on Mr. Humphries's land. The rocks here are solid well-bedded sandstones, and a small anticline is said to be visible.

(3.) On Messrs. Toxward and Gray's property, some miles up the Akitio River and on the south side, are several fairly strong gas-escapes within a quarter of a mile of one another. The following analysis (No. 1) shows the composition of the gas from one of the springs. With it are given for comparison analyses of gases from No. 2 and No. 3 bores of the Taranaki Petroleum Company (Nos. 2 and 3).

	1.	2.	3.
Methane (CH_4)	35·3	24·4	22·7
Ethane (C_2H_6)	17·6	16·3	25·8
Oxygen	12·0	1·3	1·3
Nitrogen	35·1	8·8	6·5
Carbon-dioxide (CO_2)	Nil.	49·2	43·7
	100	100	100

Clefines (C_nH_{2n}) were not present in any of these samples. With regard to No. 1 (the Akitio gas), which is said to burn with a bright flame, Dr. Maclaurin remarks,—"The illuminating properties of the gas are due to the hydrocarbons (methane and ethane) present. The oxygen and nitrogen may be wholly or partly due to air having found its way into the bladders, rubber being slightly permeable to gases." The absence of carbon-dioxide from this sample is worthy of note.

(4.) On Mr. Frank Armstrong's property, at Esdale, on the south side of the Akitio River, eight or nine miles from its mouth, is a gas-spring.

(5.) Between Akitio and Weber, at Titree Point (north of the Waimata River, and eight or nine miles from Weber), are some fairly vigorous gas-springs. Again, near the Oparae Road, about five miles from Weber, is a strong gas-escape, said to have been discovered only a few months ago. The writer is informed that ever since the discovery the escaping gas has been burning over an area of several square yards, with a flame of at least a few feet high.

(6.) The mineral springs at Langdale give off bubbles of a slightly inflammable gas which from the smell may be identified as sulphuretted hydrogen (H_2S).

Mineral Springs.—The occurrence of mineral springs in several localities may be mentioned, since these are thought to be indicative of the presence of petroleum. One visited by the writer occurs on Mr. H. Morrison's property, and is on the north side of Middle Division Creek. The

water, which issues from blue claystones, smells strongly of sulphuretted hydrogen. It deposits at the point of exit a black evil-smelling mud, whilst just below there is a scanty white deposit containing some sulphur and probably a good deal of carbonate of lime. The water is quite cold.

At Langdale, on the eastern side of Morrison's and Elder's Taipos, are eight or ten similar springs, all on Mr. Frenche's property, and in an area of about half an acre. There is, however, according to information supplied to the writer, no white deposit from any of these springs.

An analysis of water from a spring at Langdale (probably one of those just mentioned), made at the Colonial (now Dominion) Laboratory, and quoted by Park in his 1888 report, is as follows:—

	Grains per Gallon.
Solid matter (principally chloride of addium)	316·36
Iodine	0·81
Sulphuretted hydrogen	1·76

At Whakataki Saddle is a small spring said to be a "magnesia-spring," owing to the water having the taste and smell popularly associated with magnesia. It deposits a white substance, probably carbonate of lime. The peculiar smell and taste of the water are perhaps mainly due to carbon-dioxide.

About three miles and a half up the Okau Stream, which enters the sea three miles north of Whakataki, there is a spring the waters of which smell of sulphuretted hydrogen.

Possibilities of Petroleum.—From the foregoing paragraphs it will be noted that the indications of petroleum observed consist mainly of the petroliferous rocks near Aohanga, a number of hydrocarbon-gas springs, and mineral springs, the water of which generally carries sulphuretted hydrogen, with, at Langdale, sodium-chloride (common salt) and iodine. These indications are scattered over a wide extent of country. They are sufficient to justify the conclusion that petroleum exists within the area, but do not enable any inference as to the occurrence of it in quantity to be made. In certain parts of the area the shattered and faulted nature of the rocks, while not necessarily altogether unfavourable to the presence of oil, would lead one to expect more abundant surface indications than are actually seen. Elsewhere, however—for example, east of Carswell's—the surface rocks are a little disturbed, and are of a close-grained nature suitable as a cover for the oil-bearing rocks.

Since only a hasty examination of a comparatively small portion of the area was made, it is obviously impossible to offer more than tentative advice in the matter of prospecting. The district seems worthy of careful surface prospecting with a view to locating further indications. The portions that appear most promising are those in which hydrocarbon-gas springs occur—namely, east of Carswell's, and from Aohanga to Weber. In these districts a few bores of moderate depth might be put down. The petroliferous sandstone near Aohanga occurs in such a way as not to give a very favourable impression at first sight. The neighbourhood, however, ought to be carefully prospected for other outcrops of similar pertoliferous rock. The prospecting operations should be followed or accompanied by a geological survey.

Coal.—South of Castlepoint a seam of coal 7 ft. or 8 ft. thick is said to occur, and to have been used in a smith's forge. Mr. W. A. McKay, however, reports only thin streaks and small pockets of coaly matter in the neighbourhood.* A very poor lignite (probably a carbonaceous shale) is said to occur at Reef Point, and the writer was informed of the existence of a 1 in. seam of anthracitous coal on the northern border of Mount Percy, near Mr. Barton's homestead. Indications of coal at the head of Okau Creek are also reported. These various occurrences are probably due to very local accumulations of vegetable matter. It is hardly possible that any really workable deposits of coal will be found in the eastern part of the area examined—namely, from Otahome Station to the Aohanga River.

Limestone and Cement Rocks.—The yellowish limestone near Taueru, which is said to contain 90 per cent. of carbonate of lime, is doubtless pure enough to afford material suitable for lime-making. In conjunction with the underlying mudstones it would probably afford material adapted for cement-manufacture. The shell limestone on Awatoitoi Station is probably not pure enough for lime or cement. Near Ica calcareous rock suitable for cement-manufacture has been reported by Park, who quotes an analysis made by the Colonial Laboratory as follows:—

Carbonate of lime	76·41
Carbonate of magnesia	2·84
Alumina and iron soluble in acid	0·61
Alumina as part of clay	4·19
Silica as part of clay and sand	14·21
Water	1·74
	100·00

Phosphate.—It was reported to the writer that samples of limestone from Awatoitoi Station (Mr. Morrison's) tested in the Dominion Laboratory contained several per cent. of phosphate. On inquiry at the Dominion Laboratory it was found that the sample tested contained a very small amount of calcium-phosphate, probably less than 0·2 per cent. The writer saw nothing to justify any detailed search for phosphate rock in this neighbourhood.

* "Report on the Geology of the Trooper Range, Castlepoint District, Wellington": Mines Report, 1899, C.-9, pp. 34, 35.

Barite.—In 1894 Sir James Hector noted the occurrence of barite in glauconitic marls inland of Akitio.*

Gold.—At the head of the Mataikona River good colours of gold have been obtained. As previously stated, the rocks here are of the same character and probably of the same age as those forming the Rimutaka and Tararua Ranges.

Copper.—Samples of supposed copper-ore have been obtained by settlers in the Akitio district. So far as the writer could ascertain, these were loose boulders, and not from any kind of lode formation.

Ironsand.—Along the sea-beaches, especially north of the Mataikona River, a little black ironsand was observed here and there. It is probably not auriferous.

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* "On Baryte: a Rare Form": Trans. N.Z. Inst., Vol. xxvii, 1894, p. 664.

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