

stitute" Professor Hutton sought to show that the Waihao Forks greensands do not underlie the limestones of the Oamaru system at that place; and Mr. McKay, in reply, endeavoured to prove that they do. In vol. xx., "Trans. N.Z. Inst.," Professor Hutton admits there is a greensand under the limestone, but contends that it is not the greensand equivalent to that at the Waihao Forks, which, as appears, he still regards as younger than the Waihao limestone. Mr. McKay also admits the occurrence of two distinct deposits or bands of greensand, but he maintains that both have a position inferior to the Waihao limestone.

Mr. Park said there was really no geology in this paper; it was merely an explanation of some personal differences between the author and Professor Hutton. He deplored the fact that personalities should find their way into scientific discussions, and thought it would be wise to exclude such papers from publication.

5. Mr. James Wallace gave an interesting account of the recent discovery of manganese upon property near the Wellington-Manawatu Railway Company's line. He stated that a quantity had been sent home for a professional opinion as to its real value. He stated that upon analysis in the Colonial Laboratory the ores yielded, in the case of the oxide, 75 per cent., and of the carbonate, 84 per cent. of manganese.

Mr. McKay considered this an important discovery: it occurred in very large blocks, and would no doubt prove of commercial value.

Mr. Hughes, who had also visited the locality and seen the deposit, spoke highly of it. He had sent samples to England for expert opinion.

FOURTH MEETING: 22nd August, 1888.

W. M. MASKELL, F.R.M.S., President, in the chair.

New Member.—A. B. Keyworth.

Papers.—1. "On the Oil-bearing Strata of the North Island," by J. Park, F.G.S.

ABSTRACT.

Mr. Park said that the oil-strata of this island belonged to two formations—one of pleistocene and the other of cretaceous age. The former included the petroleum springs at Taranaki, and the latter the oil-rocks at the east coast of Wellington and Poverty Bay. The geological conditions and the surface-evidences of oil at these places were discussed at considerable length. On the east coast of Wellington the strongest gas-spring was that at Blairlogie, the flow of gas being about equal to the discharge of an inch pipe. The oil-strata, consisting of slaty shales and crumbling marly clays, were everywhere much shattered and contorted. The gas-spring at Langdale was unlike any other in the district. The gas was sulphuretted hydrogen, and the water accompanying the gas belonged to the sulphurous or hepatic class of mineral waters, which possess valuable medicinal properties. The gas-springs at Ika, Aohanga, and Akitio were feeble compared with that at Blairlogie. Passing on to Poverty Bay, Mr. Park said that the first report on the district was made by Sir James Hector in 1873. Gas-springs were numerous throughout the whole district, and at places oil oozed from the rocks and collected on the surface of lagoons and pools. The author quoted from the reports of Sir James Hector and Mr. McKay to show the character of the oil-strata, which consist of grey contorted sandstones and dark-grey shaly marls. The strata are everywhere much disturbed and broken. At Taranaki the oil-strata consist of volcanic agglomerates and tuffaceous sandstones,

containing beds of lignite. The true source of the oil is still undetermined, but is probably, as suggested by Sir James Hector in 1866, the coal-seams which are supposed to underlie Mount Egmont. Before proceeding to discuss the prospects of oil at the places just reviewed, Mr. Park briefly described the geological conditions usually attending the production of oil in other parts of the globe. Mineral oil, he said, was obtained from two sources—namely, from bituminous shales by distillation, and as a natural product from certain oil-strata. Reference was then made to the oil industry in Scotland, which continued to hold its own against the natural oils of America and Baku. Petroleum was found associated with shales (or coals) and sandstones. The former yield the oil, while the latter serve as reservoirs to collect the oil. The author then went on to consider the prospects of payable oil in the three districts already described.

Prospects on East Coast of Wellington.—He did not think the indications sufficient to warrant the assumption that payable oil would be found in this district, his reasons for this belief being as follows: (1.) That the shales contained too small a proportion of carbonaceous matter to yield oil by distillation. (2.) That the strata are too much shattered to afford the pressure necessary to condense the volatile gases.

Prospects at Poverty Bay.—The author said that, after a careful consideration of the surface-evidences, he was of the opinion that payable oil would not be found at the places where boring was at present being conducted, his reasons being the same as in the case of the east coast of Wellington. He said the Awanui shale could not be regarded as the source of the oil, as it was always at or near the surface. The dark-grey shales were no doubt the true source, but they contained only 1 or 2 per cent. of carbon, while the oil-shales of Pennsylvania contained from 10 to 20 per cent. As regards his second objection, he said the strata were too much shattered and tilted to afford the pressure to condense the volatile hydrocarbons, and to prevent leakage on the surface. Ample surface-manifestations were not considered a good indication of payable oil. He thought further explorations might discover places in the oil-belt where the geological conditions were more favourable for the accumulation of oil.

Prospects of Payable Oil in Taranaki.—With regard to the prospects here, Mr. Park said it was difficult to form an opinion, as there was some doubt as to the true source of the oil. It was probably the coal-seams underlying Mount Egmont; and this hypothesis was supported by the occurrence of fragments of the purest graphite among the *débris* on the flanks of Mount Egmont. This graphite was no doubt a coal or lignite altered by volcanic agencies. The bores put down at Taranaki were too shallow; and the question of payable oil could only be determined by further explorations.

Distillation of Oil-shale.—This was an important industry in Scotland, and he did not see why it should not become the same here. Professor Black had shown that the Orepuki shale is superior to the celebrated torbanite, as it yields forty-two gallons of crude oil and other valuable products to the ton of shale, against forty gallons returned by the latter. To insure the success of this industry it would be necessary to manufacture our own sulphuric acid and alkalis. In the so-called refractory sulphides on our goldfields, and the native-sulphur deposit at White Island, we had an abundance of the raw material. The production of the alkalis would follow as a natural consequence. Mr. Park said our bituminous shales were a valuable asset, which would no doubt yield large returns when the proper time came for their development.

Mr. McKay asked the writer of this paper whether he had noticed the presence of petroleum in the east coast district of Wellington: he said that, so far as described, *gas-springs only seemed to occur*. Mr. McKay

referred to the existence of a mineral spring on Sutherland's station on the Pahoa River, which yielded inflammable gas, freely escaping from the older rocks of the district, and which had not been included by Mr. Park as gas-bearing. He thought that possibly the Blarlogie gas-spring might have its source in the same rocks. He thought the author had under-estimated the so-called oil-bearing belt at Poverty Bay at four to five miles, his idea being that in some places it was not far short of twenty-five miles in breadth.

Mr. Higginson pointed out that the distillation of oil from shale had been abandoned in Scotland, owing to the flooding of the market with oil from the Black Sea ports. He did not think it would pay to distil the oil in New Zealand. From what he observed he thought the prospects at Poverty Bay appeared good. Of course, it was now a question of quantity. The raw material was now in great favour for use in all kinds of steam-engines, and very startling results had been published. It would revolutionise the manufacture of small engines.

Mr. T. W. Kirk did not think there was much chance of the hopeful anticipations regarding oil-production in New Zealand indulged in by the author ever being realised—at any rate, for a great many years. In 1886 the export from Baku alone was over 370,000,000 gallons; America added 28,000,000 barrels of forty-two gallons each; and the supply from these places was still increasing: so that our being able to compete with the foreign article was unlikely.

Count Jouffroy d'Abbans hoped that when the Government sent the New Zealand minerals they had promised to the Paris Exhibition they would include specimens of the New Zealand petroleum and shales, so that they might be tested by the experts who would no doubt be present to report on such products.

Mr. A. S. Paterson (advocate, Edinburgh) regretted that, having just arrived in the colony, he was not a member of the Society, but hoped he might be allowed to answer some of the difficulties referred to in the discussion. Permission having been granted, Mr. Paterson stated that, having been lately in contact with the shale enterprise in Scotland, he was in a position to assure the Society that since the opening of the Baku wells, and, still earlier, the introduction into Scotland of American natural oils, the working of shale had enormously increased. This was due to the fact that shale was no longer distilled merely for the oil it contained, but was treated by a new process for ammonia and other products previously regarded as by-products of little or no value. At *Burntisland, Straiton*, and other places in the vicinity of the Firth of Forth, large works had sprung up, and gave large returns, in some instances 30 per cent. being earned. There had been difficulties with the workmen at *Dalmeny* and elsewhere, resulting in strikes of a disastrous character; but these were no indication of any loss of trade. It was a curious fact that for many years this valuable shale had been lying in strata exposed to public view in road and other cuttings in the vicinity of *Edinburgh* and elsewhere, but only within the last eight or ten years had its full value been discovered. He was not in a position to say that the New Zealand shale would give the same return when similarly treated; and, indeed, one specimen he had seen appeared to differ—at least, outwardly—from the best Scotch shale. He concluded by thanking those present for having heard him.

Mr. Gordon said that, with regard to Mr. Park's paper on the mineral oil in the Poverty Bay district, the author held out very little chance of success at the place where boring operations are now being carried on; but the reasons assigned did not appear sufficient to warrant this conclusion. Before we can tell definitely where petroleum is likely to be found we must understand its origin, and that is a subject on which scientists do not agree. We are pretty certain it is formed by the decomposition of

organic substances, but this need not be confined to the palæozoic rocks. A popular impression exists that the only rocks in our geological scale which contain carbonaceous remains are those of the carboniferous age; but Professor Peckham thinks it is very probable that carburetted-hydrogen gas and petroleum are derived from microscopic animals. When examining the oil-bearing strata in the Poverty Bay district lately, the question that occurred to him was whether the porous sands which contain the gas and oil were sufficiently thick to form reservoirs. There is no doubt as to the porosity of the seams on examining the strata in the gorge of the Waipaoa River: there are alternate bands of very porous sandstone, full of fissures and cracks, lying in almost a horizontal position among the calcareous marl. If thick porous beds of sandstone or limestone occur lying in the same manner where the oil is found they would form a large reservoir for the oil; therefore, before we can determine whether there is likely to be a good supply of oil obtained at the place where the present operations are carried on by the South Pacific Company, far more information is required to form data from which to give an opinion on the subject. He then read an extract from a paper read by Charles A. Asinburner before the American Institute of Mining Engineers: "In all geological ages prior to the carboniferous there did not exist sufficient land-vegetation to form extensive coal-beds; but the fossil remains of water-plants amply attest the fact that there was buried in the rocks below the carboniferous a great abundance of vegetable forms. Even in the Laurentian rocks of Canada, far below where I believe it is possible to find natural gas, there is a large accumulation of carbonaceous material in the form of graphite, which is now universally conceded to have been derived from the remains of vegetation. These plants belonged to the lower forms of vegetable life, as the animal remains of which many of our limestones are composed belonged to the lower forms of animal life. The latter are no doubt the source of the large amount of both oil and gas derived from the limestone beds. According to researches made by Professor Peckham in Southern California, the petroleum and gas there are very probably derived from microscopic animals."

In reply to Mr. McKay's questions, Mr. Park said that the gas-spring at Blairlogie occurred in the cretaceous rocks. As to the gas-spring at the Pahaoa River, the gas was sulphuretted hydrogen, which was inflammable, but no indication of oil. As to the average width of the oil-belt, he said that, although over twenty miles in some places, it was only a few chains at others. Five miles was a fair average. Mr. Park thanked Mr. Paterson for his valuable information regarding the shale industry in Scotland. He believed the shales of New Zealand would in time be turned to profitable account. In reply to Mr. Gordon, he said that petroleum occurred in rocks of all ages, from the silurian epoch up to the present time. The origin of the oil was not so important as the discovery of the strata which yielded it.

2. "On a Curious Feature in a Marsh Plant (*Glossostigma*)," by C. W. Lee. (*Transactions*, p. 108.)

3. "On the Production of Artificial Chromes for Ornamental Purposes," by W. Skey. (*Transactions*, p. 359.)

FIFTH MEETING: 12th September, 1888.

W. M. Maskell, F.R.M.S., President, in the chair.

Papers.—1. "The Late Earthquake (1st September, 1888), and its Bearing on the Architecture of Wellington," by W. M. Maskell, F.R.M.S.