ART. XLIX.—*On certain Rare Minerals associated with the Tin-ore of Stewart Island,*

By WILLIAM SKEY, Analyst to the Geological Survey of New Zealand.

With Notes on their Mode of Occurrence. By ALEXANDER MCKAY.

[*Read before the Wellington Philosophical Society, 10th July, 1889.*]

TOWARDS the end of last March a large and valuable collection was submitted to me for examination. It comprised numerous minerals and specimens of rock-masses which were collected by Mr. McKay, during his recent survey of Stewart Island, from the stanniferous deposits and other rock-formations of the island.

The results of my investigations I briefly communicated from time to time, as obtained, to the Director of the Geological Survey; but, as there are many interesting points in connection therewith which have not been treated of in those communications, and which should be made public, I have thought it proper to address myself to this Society in a paper which shall deal with the whole subject.

The following are the full particulars of the results of my investigations of Mr. McKay's collection to date. The precise localities of the minerals that I shall describe, and certain interesting particulars as to their mode of occurrence, will be given as a sequel to this paper by the collector of the specimens:—

Beryl (Silicate of Alumina and Glucina).—This mineral as exhibited to me is in broken crystals belonging to the hexagonal system. Their cleavage is obviously basal. The diameter of the largest crystal is 1½in., and the length of the fragment in the direction of the longest axis is 1¼in. Colour, pale-green; subtranslucent; hardness, 8.

Fluor-spar (Fluoride of Calcium).—Highly crystalline; crystals derived from the cube. Colour generally pale-green; some parts colourless. The coloured parts exhibited vivid phosphorescence when gently heated.

Analysis.

Fluorine	48·12
Calcium	51·19
Loss (impurities)	0·69
	100·00

Tourmaline (Silico-borate of Alumina).—This specimen was handed to me by the collector as tourmaline, and it proved to be the ferruginous variety. It is black in mass, light-brown in powder. Occurs as columnar aggregations in quartz.

Topaz (Silico-fluoride of Alumina).—This is generally of a remarkably pure white, distinct from the whiteness of the purest quartz, from which it is easily distinguished by this character when the eye has been educated to it. The mineral occurs in a crystallo-granular form, permeating quartz or forming irregular-shaped masses in it, and frequently enclosing cassiterite and wolfram. It is infusible in the blowpipe-flame.

Analysis.

Silica	33·06
Alumina	57·02
Manganese	Trace
Iron-protoxide	0·11
Fluorine	14·82
	105·01

The excess of 5·01 in the sum of my results is owing to a part of the silicon existing in the mineral as a fluoride being computed as silica. The fluorine in this mineral was not certainly recognized by the blowpipe test, using a flux of microcosmic salt, the well-known etching-power of phosphoric acid itself standing in the way of this. However, by fusing the mineral with four times its weight of carbonate of soda, and treating the fused mass with sulphuric acid, very good reactions of this element (fluorine) were obtained.

Zinc-blende (Sulphide of Zinc).—A few very small, almost microscopic crystals, reflecting from certain of their planes a deep-blue colour, were brought under my notice by Mr. McKay. They were considered by him as likely to be a form of some inferior oxide of tungsten, an opinion which coincided with my own until I tested them. This proved to be a remarkable form of zinc-blende. The sulphide of iron in these crystals is in such proportionately large quantity as to colour the powder intensely black. The property that certain of these planes have of reflecting blue colour in ordinary light is one that to my knowledge has not been hitherto observed in connection with zinc-blende. In this respect they compare with the planes of some of the specular iron-ores from Elba and Cumberland.

Gahnite (Zinc-spinel). — Occurs as small light-green-coloured crystals, interspersed through certain of the matrices of the tin-ore of this island. These crystals belong to the isometric system: many of them are perfect octahedrons. They are infusible in the blowpipe-flame, but blacken therein. Owing to the very intimate admixture of this mineral with topaz, cassiterite, and quartz, I have not been able to separate it quite clear of impurities; but, as the impure mineral afforded me 18·14 per cent. of zinc-oxide and but traces of magnesia, and 5·71 per cent. of silica, I have not hesitated to name it as I have done—that is, gahnite, or zinc-spinel.

The somewhat rare mineral wolfram (tungstate of iron) I do not here describe, as it has already been identified by Dr. Black.

These comprise all the rare, or comparatively rare, minerals now known to exist associated with the tin-ore of Stewart Island. It will be observed that they comprise all, or nearly all, those minerals that are generally associated with tin.

In none of the other deposits of tin-ore known to exist in these islands has there been anything near the same variety of minerals discovered—for the simple reason, I suppose, that the other deposits have not been explored as completely as that in Stewart Island.

I should remark here that this is the first time that what I may term "rock-topaz" has been identified as existing in the colony. Perhaps this is because in this form it is easily mistaken for quartz by miners.

Regarding the very interesting mineral fluor-spar, this is the first time that its occurrence in the colony as a native product has been certified to upon good authority. Just recently, however, I had the pleasure of identifying the same mineral in a collection, made by Mr. James Park, F.G.S., representing the rocks and minerals of the Baton River, in the Nelson District.

I will conclude my part of this paper by stating my results upon certain other minerals of this collection which have also been analysed.

No. 5218, a white, soft, light rock, resembling siliceous mud, given to Mr. McKay by Mr. Russa, of Invercargill, contains very distinct traces of silver. On the authority of Mr. Russa the specimen is referable to the Paterson's Inlet district of Stewart Island. The quantity of material was not sufficient to allow the quantitative determination of this metal.

No. 5249. *Limonite.*

Analysis.

Water	19·24
Iron-sesquioxide	78·55
Siliceous matter	2·21
	100·00

Percentage of iron, 54·88.

This is an excellent iron-ore.

No. 5250. *Wad* (manganese-oxides).

Analysis.

Iron-sesquioxide	7·42
Manganese-oxides	43·62
Alumina	Trace
Lime	Trace
Cobalt	0·46
Siliceous matter	2·29
Water and loss	46·21
	100·00

A very useful ore if in quantity and fairly accessible.

Notes by ALEXANDER MCKAY, F.G.S., Assistant Geologist.

THERE are three distinct formations of Palæozoic date in Stewart Island. Of Secondary or Older Tertiary rocks there is not a trace. Outside the northern entrance to Port Pegasus there is a small islet formed of coarse and rudely-stratified granitic material, which I am inclined to refer to the Pliocene period. All the other deposits that have as yet been observed are obviously of Pleistocene or Recent date. These latter are of considerable extent in the district between the head of Paterson's Inlet and the west coast, and along the valley of Freshwater River. Away from the coast-line little is known respecting the geology of the north and north-east parts of the island; and what we do know of the formations along the coast-line is mainly due to the researches of Sir James Hector, who touched at Stewart Island in 1863 while engaged in exploring the south-west and west portion of the Province of Otago. More recently I have added something to a knowledge of the geology of the district around Half-moon Bay and the shores of the eastern part of Paterson's Inlet, and have collected from bushmen and prospectors some information respecting the west coast of the island north of Mason's Beach.

As I have mapped it, it would appear that in this part the country is mainly formed of granite, intersected by dykes of later date. Where I examined the district around Half-moon Bay, and along the shore of the eastern part of Paterson's Inlet, the rocks are gneissic schists, traversed in an east to west or north-west direction by massive intrusions of hornblendic syenite. These syenitic intrusions in every respect resemble—nay, to all appearances, are identical with—the syenites of Bluff Hill, on the mainland, and I am inclined to think that, however altered, the other rocks of the district are not greatly different in age. The less-altered rocks on the south side of Paterson's Inlet would, it appears to me, support this assumption. .. ..

From this district come two of the most conspicuous minerals in Mr. Skey's list. These are beryl and tourmaline. Both of these minerals are found together in a felspathic band, forming a selvage to one of the syenitic intrusions already mentioned. The tourmaline occurs in considerable plenty; the beryl is not so common, but yet not rare, and occasionally fine large crystals are to be found. The syenitic band runs nearly east-and-west along the north shore of the Inlet, and, from what I could gather, gets much more massive as it is followed to the westward.

Along the south side of Paterson's Inlet the rocks are of a different character, being subschistose and not so much altered; but in their structure it may be traced that originally

they were formed of fine-grained slaty breccia, sandstones, and slates. These rocks are also much intersected by dykes of a syenitic character. They also contain numerous irregular reefs of quartz, some of which are of very considerable size. On the coast-line east of Little Glory Harbour, and thence to Big Glory Harbour, I collected the rocks of this formation; and since my return Mr. James Thomson, of Half-moon Bay, forwarded a box of specimens collected further west, on the same side of the Inlet. I crushed a sample of the quartz from the sea-coast, but, though gold proved present, it was in quantities too small to pay. Strong traces of copper are found in a large quartz reef on the east side of Big Glory Harbour, and Mr. Thomson's collection included quartz containing galena, but this also in quantities too little to pay. The manganese-ore containing traces of cobalt was forwarded by Mr. Thomson, while the iron and kaolin clay were part of my collection from Little Glory Harbour and the coast-line.

At the time of my visit there was some excitement in Half-moon Bay on account of the supposed discovery of silver-ore in the rocks of the south side of Paterson's Inlet; and as I passed on my way to Port Pegasus I was shown a substance resembling kaolin clay which was supposed to be silver-bearing. I recommended that the samples should be sent to Sir James Hector, with the request that they should be tested for silver; but they have not yet arrived at the Colonial Laboratory. Mr. Russa, of Invercargill, just before my leaving, showed me some of the same or a similar material, resembling kaolin, and from him I obtained the small piece which Mr. Skey has proved to be argentiferous. Mr. Russa told me the specimen came from Paterson's Inlet. I have since written to Mr. Thomson to forward a sufficient sample of this clay, but it has not yet arrived.

The same formation as that from which these ores have been collected stretches along the west coast of the north part of the island, and along the coast of this part forms what is called the Ruggedy Ranges. These, from samples of the rock shown to me, contain similar reefs of quartz to those south of Paterson's Inlet, and at one place a copper-lode has been found, from which samples were sent to Melbourne some years ago, and were assayed at the Bank of Australia assay-office, and gave returns as high as 25 per cent. of copper, which was considered a good and encouraging result from specimens taken from the surface outcrop. I give the assayer's report below.

When I was last in Half-moon Bay a party was there on their way to give the reef a further trial, but had been wind-bound for several days, and at the time I left there was little probability of their getting away for some time.

Large bodies of marble rock resembling that from Caswell Sound, and certainly not inferior to it, are found not far distant from the copper-lode, and near Rugged Island there are large deposits of manganese-oxide.

South of Paterson's Inlet for the most part the country is formed of a soft grey granite, but there are belts of other rocks associated therewith, consisting of gneiss and mica rock, schistose or granular, and, in the Tin Range, very considerable bodies of a quartzose rock having a granular texture.

The typical granite rock is highly felspathic, and weathers into remarkable conical or dome-shaped mountains, of which Lee's Knob, on the east side of the main range and five miles north of Port Pegasus, is a remarkable example. The Deceit Peaks, to the west of the main range, are formed of the same rock, but have not the same regularity of outline as the granite hills on the east side.

Towards the southern extremity of the island, and west of the south arm of Port Pegasus, are two isolated mountains, called respectively Gog and Magog, which are also formed of granite, and are remarkable objects in the landscape.

The granite, where I examined it most carefully, towards the northern end of the Tin Range and in Lee's Knob, has numerous strong veins of felspar, and felspar and mica mixed. Small garnets abound in some parts, and there is a great abundance of glassy quartz closely approaching rock-crystal, which chiefly occurs in nests and segregations in the felspathic veins. The gneissic rocks are well seen on the shores of the north arm of Port Pegasus, more especially in a small bay three-quarters of a mile east of the landing-place.

At the head of this small bay there is, on its west side, a heavy reef of quartz full of iron-sulphide and traces of copper. Samples of this reef, known as Cross's Reef, I was informed had been sent to Melbourne, and, as reported, gave 5dwt. of gold and 13dwt. of silver to the ton. I tested for gold, but found none. This reef runs nearly east and west, and, on the opposite (eastern) side of the small bay, about one chain distant, it is seen to have greatly changed in character, and to be for the most part composed of felspar.

At the landing-place, survey-camp, and beginnings of the township that is to be, the rock is granite, with small veins of glassy quartz. At the head of the north arm of Port Pegasus, and along the lower course of Pegasus Creek, the rocks are schistose, with bands of pure mica rock, and reefs of quartz, felspar, and mica, or, in other words, the elements of granite; but the minerals are so coarsely crystallized, and the crystals so free of entanglement among each other, as is the case with normal granite, that one scarcely inclines to speak of such a rock as a granite.

These schistose and gneissic rocks are here, on the shore of the harbour, divided into two outcrops, as seen in section. They cannot be easily traced to the north, in which direction their exposures trend, although the strike of their lamination is between W.N.W. and N.W. South of the Tin Range there is a table-land about 750ft. above the sea, ending in a fringe of broken hilly country on the north side of the harbour. In the direct line of the crest of the Tin Range I sank a hole to the bed-rock, and found the rock pure mica, and so soft that for 18in. or 2ft. it was easily dug into with the shovel. But more to the north and west of this, at the same and higher elevations, the rock is granite—which, however, disappears at 1,000ft. on the west slope of the Tin Range—and mica and quartz rock, forming the higher part of the range.

The tin-bearing bands are segregations of quartz in the mica rock, which are traceable in the fashion of small reefs or leaders, sometimes continuously for a considerable distance.

The particular segregation-band in which tin-ore has as yet been found contains, besides the tin-ore, considerable quantities of wolfram, and at places a form of topaz is plentiful. The form of spinel mentioned in Mr. Skey's paper comes from the tin-deposit on the extreme southern end of the range, as does the peculiar blue variety of zinc-blende determined by him.

The sample of fluor-spar tested in the Laboratory was given me by a prospector, who stated that it came from Doughboy Bay; and I should say that its occurrence there is not improbable, seeing that the radical of the mineral is found in the topaz mineral obtained by myself from the Tin Range.

Topaz- and garnet-sand is plentiful in the alluvial deposits of the low ground within the watersheds of Pegasus and Smith's Creek, and is a great annoyance in collecting the tin-sands, more especially the grey topaz-sand. I have marked on the plan the areas of alluvial deposit over which stream-tin had been found at the time I left the Port Pegasus district. I am not aware that any fresh areas had been discovered, and none have been reported since.

Assay of Copper-ore.

Assay-office, Bank of Australasia.

Nos. 1, 2, 3, and 4: Mixed, principally copper-pyrites.—400gr. gave 74gr. of copper, or 18 per cent.

No. 5: Pyrites, with a little green pyrites.—Not enough in quantity to assay.

No. 6: Pyrites and black oxide.—400gr. gave 100gr. of copper, or 25 per cent.

Nos. 7 and 8.—Ditto.

No. 9: Not properly a copper-ore, but a substance called allophane, having from 2 to 4 per cent. of copper in its composition.—400gr. of this gave 12gr., or 3 per cent., of copper.

WILLIAM PATTERSON, Assayer.

I have made selections of all that is worth assaying, and have sent the numbered samples corresponding with the assay. The whole seems surface only, and, I think, gives very good encouragement for further search.—W. P.

ART. L.—*Descriptive Geology of the District between Napier and Ruapehu Mountain* viâ *Kuripapanga and Erehwon.*

By H. HILL, B.A.

[*Read before the Hawke's Bay Philosophical Institute, 7th October, 1889.*]

THE geological character of the country between Napier and the extinct volcano Ruapehu, *viâ* Kuripapanga, has not, as far as I am aware, been published, nor do I think that route has been traversed by any one connected with the Geological Survey. In January of the present year, in company with Messrs. Petrie and Hamilton, I visited Ruapehu for the second time, and the following passing notes were taken during my journey by this route:—

The road might be described as running due west from Napier along the parallel of 39° 30′, and for all practical purposes it might be taken as being on the same parallel as Ruapehu and Egmont, the two highest and largest extinct volcanoes in New Zealand. The distance between Napier and Ruapehu by road would be about 110 miles; but as the crow flies the distance is about seventy, Ruapehu being about midway between Napier on the east and New Plymouth on the west of the North Island. As far as Kuripapanga, fifty miles from Napier, the drainage belongs to the Hawke's Bay river-system; but beyond this the chief drainage is into Cook Strait and the South Taranaki Bight. The country between Napier and the Erehwon plateau resembles an inclined plane, through which run river-valleys transverse to what was at one time a great plain of denudation for most of the East Coast country, extending from Poverty Bay southward as far as the Wairarapa Valley. Generally it may be said that the road to Ruapehu and the volcanic district south of Lake Taupo by way of Kuripapanga passes through the country drained by