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NOTES ON SOME VOLCANIC ROCKS OF THE NORTH ISLAND OF NEW ZEALAND.

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(1) ERUPTION OF ACID VOLCANIC ROCKS IN THE TAUPO-ROTORUA DISTRICT.

IT has long been known that sheets of acid volcanic rocks cover a wide area in the central part of the North Island. These rocks have usually been called rhyolites, and it has been tacitly assumed that they were lava-flows; though their great horizontal extension and the absence of scoriaceous surfaces above and below suggested that if they were lavas they must have had a great fluidity not usually associated with acid rocks.

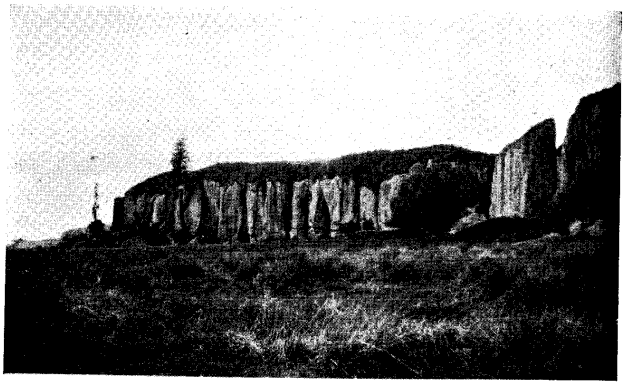

FIG. 1.—Outcrop of ignimbrites at Hinuera Valley.

At the same time, vertical jointing was pronounced, and indicates a condition of rest during cooling. There are no volcanoes in the district from which rhyolitic lavas could have flowed.

Microscopic examination showed that the rocks are actually fine tuffs formed mainly of glass particles in which crystals of feldspar, with less frequent quartz, and occasionally hypersthene, or perhaps hornblende, are embedded. It is obvious in several preparations that the glass particles bend round the crystals and that they were therefore of a viscous nature when they were deposited. This viscous condition could only have been due to a high temperature.

A typical example is found in the columnar rock which is the most conspicuous material in the gorge of the Waikato River at Arapuni. Here at the base of the columnar rock there is a thin layer, 6 in. thick, of quite incoherent material, which is found to consist of fine and thin glass shreds. For 6 ft. above this the rock is compact, with a lustre that is almost vitreous; and in section this portion has the minute glass shreds of which

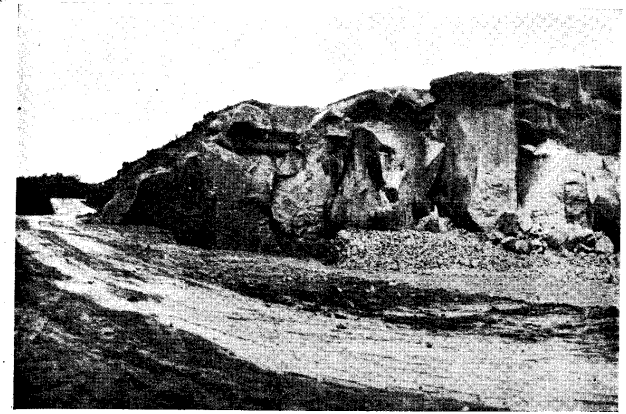

FIG. 2.—Outcrop of ignimbrite near Litchfield.

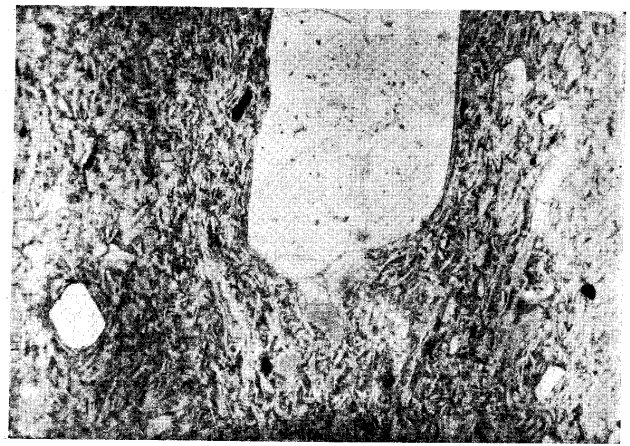

FIG. 3.—Microphotograph of section of ignimbrite from Arapuni (50 diameters.) The glass particles bend round the crystals of feldspar.

it is composed firmly welded together, as well as bending round the crystals. At the top of this 6 ft. the rock becomes gradually less compact, and at the top of its 40 ft. or 50 ft. it becomes almost earthy. This difference is due to the less complete welding, but it is found, too, that at the same time the material of the glass particles has undergone incipient crystallization, and has developed a rudimentary axiolitic structure. In other localities, notably at Motutere, on the east shore of Lake Taupo, well-formed spherulites are present in rocks that show the tufaceous structure most distinctly, while axiolitic structure is developed fully in other parts.

These facts show at once that such rocks as the columnar material at Arapuni are not rhyolite lavas, but are fine-grained vitric tuffs which were actually deposited at a temperature at which such material is viscous (960° Centigrade). The actual method of eruption was probably similar in its general nature to that described by Fenner as associated with the sand-flow at Katmai, in the valley of Ten Thousand Smokes, in Alaska. Fenner describes the eruptive material there as similar to ignited fine carbonate of magnesia which flows like a fluid. Lacroix compares its condition to that of milk when boiling over, and considers the eruptive matter to have been a type of nuée ardente. The type of rocks formed in this way varies greatly, but it is suggested that they should all be included in a separate group, for which the name "Ignimbrite" seems satisfactory. These observations and deductions will be described more fully in the "Transactions of the New Zealand Institute." It is merely stated at the moment that this type of eruptive activity accounts for the occurrence of flat-lying columnar rocks over a great stretch of country which extends at intervals from Mercury Island in the north to Taumarunui in the south, from Te Kuiti on the west to the upper Mohaka on the east. Many of the so-called rhyolites in this large area must not be regarded as lava-flows; they were actually formed from dense clouds of incandescent volcanic glass still in the semimolten or viscous state.

(2) MOTUROA ISLAND, MERCURY BAY.

The earliest publication that dealt with the geology of New Zealand in any detail is contained in the work written in German and descriptive of the voyage of the Austrian frigate "Novara" round the world. The geology of New Zealand is comprised in Part I, Vol. 1, of the geological portion of the work. (The German titles are here translated into English.) The volume contains a number of beautifully executed maps and illustrations. There are two chromolithographs, and the more striking of these is described in the list of illustrations (p. xiv) as "Moturoa, trachyte rocks in Mercury Bay, east coast of the North Island." It is found opposite p. 80, where it is entitled "Moturoa, in Mercury Bay, North Island (columnforming trachyte). Ch. Heaphy del. Grephe lithogr." The illustration actually depicts a remarkable development of columnar rocks.

It seems that the actual locality represented in this illustration of 1864 has not been visited by any geologist since that date, and, as lately, at least, geologists have failed to find its real position, it was thought that a record of it is desirable. The Geological Survey bulletin that deals with this district, written by C. Fraser and J. H. Adams in 1907, makes no reference to the plate mentioned or to the "Novara" voyage. Failure to find the actual locality is perhaps due to the fact that the island Moturoa in Mercury Bay has no resemblance to the beautiful lithograph.

During a recent visit to Mercury Bay advantage was taken of the opportunity to endeavour to find this interesting structure. It was clear at once that Moturoa Island at the entrance to Mercury Bay was not the original of the plate. Ohena Island, too, six miles distant, though showing a fine example of columnar rock, was obviously not the original locality depicted. Many other islands in the bay were visited, but without successful result until at the north end of Mercury Island the forms of the rocks showed at once that a small bay in that locality was the actual subject of Heaphy's drawing. The columnar rock itself was found to be hypersthene basalt, though the material of Great Mercury itself seems to be everywhere else rhyolite tuff. It is probable that Heaphy was informed by the Natives that these basaltic islands were Moturoa, for this merely means long island, though the word *roa* may mean high as well as long.

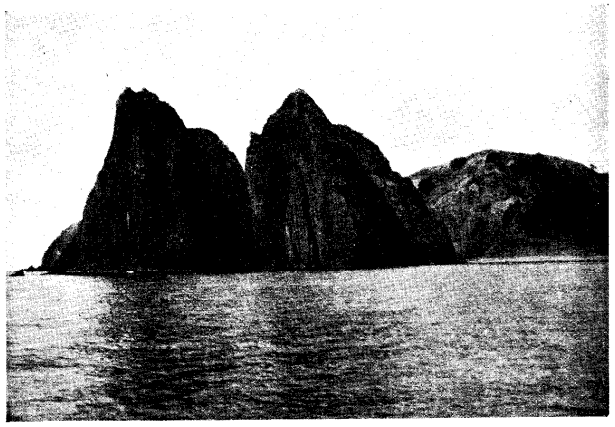

FIG. 4.—View of basaltic rocks, north end of Great Mercury Island.

(3) TUHUA ISLAND.

Mayor Island, in the Bay of Plenty (Tuhua Island of the Natives), is well known as the source of the obsidian which in former times was so largely used for cutting purposes and was distributed by barter throughout New Zealand. Though thus interesting to geologists, the relative remoteness of the island in the open sea has kept it rather isolated. The physiography of the island has, however, been described by Goldsmith, Bell, and Thomson, and some of the rocks by Zirkel, Hutton, von Wolff, and Bartrum. The writer visited the island in November, 1930, with the object of studying the occurrence of the volcanic glass and of comparing it with similar material in the Taupo-Rotorua district.

It was somewhat surprising and interesting, however, to find rocks that contained minerals which are striking additions to those that had been previously recorded. As has been stated by Bartrum, the rocks are more properly classed as comendites than amongst the pantellerites, as was done by von Wolff.

On the east side of Omapu Bay a dense grey lava occurs in places. As with the greater number of Mayor Island rocks, this lava contains phenocrysts of sanidine and anorthoclase, and some of aenigmatite. Around the crystals of anorthoclase and sanidine microlites of aegerine and cossyrite are arranged in the form of a border, thus giving rise to a well-developed ocellar structure. The rock also contains an abundance of dark-blue arfvedsonite. In places the rock is slightly vesicular and small crystals of aegerine project into the open spaces. The aegerine crystals are found to have the typical development of augite crystals and have an extinction angle of 3 degrees. A large ejected boulder found on the crest of the spur and half-way between Opo Bay and the edge of the ancient crater contains frequent crystals of the rare triclinic amphibole aenigmatite and much sky-blue arfvedsonite. An ejected block at Opo proved to contain an

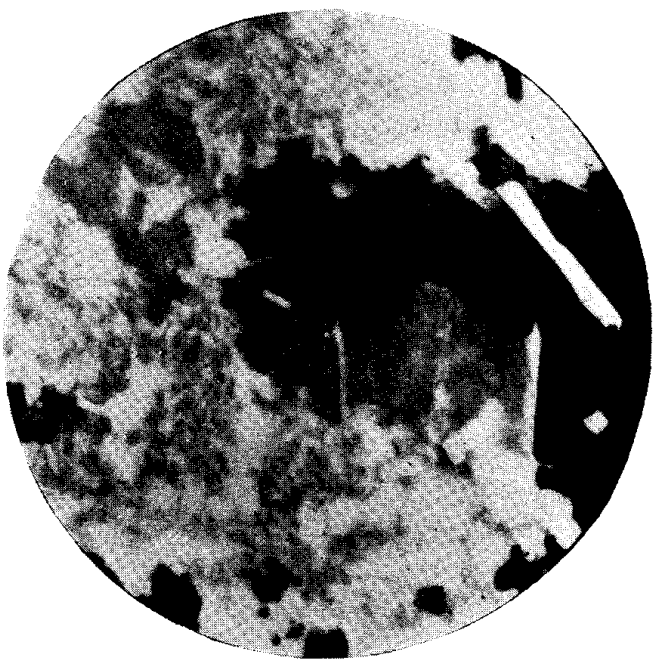

FIG. 5.—Rock-section of comendite from Mayor Island, showing tuhualite (grey), cossyrite and arfvedsonite (black) imbedded in colourless feldspar. × 100.

abundance of aegerine, cossyrite, indigo-blue arfvedsonite, and a mineral that is apparently a new amphibole with the extraordinary pleochroism of colourless, to purplish violet, to deep violet. The amphiboles in this rock were in mossy growths that were scattered in the groundmass throughout the slice. In another ejected block the same minerals were found, but the structure is typically eutaxitic. The cossyrite in this case is a little redder and the arfvedsonite less strongly blue, and much of the violet amphibole is in relatively large grains.

The occurrence of such minerals is of special interest, because the alkaline hornblendes have been found but rarely in New Zealand. It is proposed to name the violet variety "tuhualite" from the name of the island on which it was found. It is hoped this season to visit the island again and search for the lavas in which this mineral occurs *in situ*.