THE MICROSCOPIC STRUCTURE OF SOME TASMANIAN ROCKS.

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I purpose to describe in this paper some aberrant members of the basalt family, which, although not common in this Island, are occasionally met with, and which are not only difficult of interpretation to the ordinary observer, but are sometimes a puzzle to the field geologist.

As is so well understood, the normal basalts are basic lavas (silica = 45 to 55%) of high specific gravity and dark colour, and are essentially composed of plagioclastic (labradorite), felspar, augite, magnetite, and often olivine. They cover considerable areas in the northern part of the Island, and isolated patches occur in the eastern and southern portions.

As far as is known, the Tertiary basalts as occurring here do not differ in their normal characteristics from the familiar types, with the exception of the fayalite basalt of One-Tree Point, and the melilite basalt of the Shannon Tier.

The varieties now enumerated and described are the abnormal accompaniments of the usual types which occur in but limited quantity, or are formed under peculiar local conditions.

No. 1.—Tachylyte, Bothwell.

(Sp. Gr.: Spherulitic, equal to 2·72; non-spherulitic, equal to 2·77.)

This is the glassy form of basalt, originating from the rapid cooling of the magma by contact with a cooler substance. It is commonly in thin selvage layers, but sometimes is met with, as at the locality quoted, in comparatively large lumps. It varies in colour from rich dark brown to intensely black, and when freshly broken has a shining vitreous lustre. It is sub-conchoidal in fracture, and, though hard, it is brittle. On weathering it often generates a thin film on the exposed surface of a beautiful pale to dark ultramarine blue, which renders it an object of curiosity and interest. External nodular spheruloids are occasionally prominent on the surface, which show a pronounced radiating structure. It may vary to a structure known as variolite, and in a single example which has come

under my notice the tachylyte has, apparently, become interwoven into this spherulitic substance.

It also occurs at Fern Hill, near Deddington, and, in a lesser quantity, at Burnie.

Microscopical Characters.

This is a basalt glass, yellowish brown and structureless, containing large opaque spheroidal segregations inert on polarised light, and only capable of being examined towards their edges, which, being thinner, transmit a little light. In this part their colour is dark brown, becoming slightly purple at the periphery, which is roughly crenulated. Over their thinnest areas they may be seen under a $\frac{1}{8}$ objective to be crowded with globulites and thin rods, the latter essentially trains of globulites forming longulites, and arranged mostly radially towards the circumference. Their arrangement side by side resembles that of hairs on the coat of a furry animal. This structure ceases on approaching the crenulate border. The smaller dark brown crenuli, or segregations, in the rock are too dense to transmit light. Many of them are surrounded by an absorption area, in which the glass is bleached to a pale yellow, and incipient areas of this description are scattered everywhere, giving the field a somewhat mottled appearance. These spheroids appear to be independent of the cracks in the glass, and which pass through them undeflected, which suggests that these segregations were the latest phase in the consolidation of the rock. The glass of which the rock consists is covered with a network of fractures, and trains of globulites have occasionally collected along the cracks, which are also frequently the depositories of minute granules of magnetite. With a high power, globulites may be discerned in abundance everywhere in the glass.

No. 2.—Limburgite.

(From Burnie-Waratah Railway. Sp. gr., equal to 2·8.)

This is a dense, hard, and extremely tough rock, so much so that it became notorious during the construction of the railway connecting Burnie and Waratah, where it occurs as a narrow band at the 7-mile. It is dark, almost black, in colour, and very fine-grained in texture.

Microscopical Characters.

This is a felspar-free basalt, with augite and olivine, equal to limburgite (Rosenbusch) and magma-basalt (Boricky), and has many of the features shown by slices of Bohemian

magma-basalts, and described by Boricky in his work on the basalt rocks of Bohemia (1). Such rocks occupy a position between the basic and ultra-basic rocks, and Rosenbusch has given the name of limburgite to those with abundant olivine, with the intention of detaching them from basalts, and of emphasising their position as extreme members of the nepheline and melilite effusive series. Limburgite has been recorded from Cape Verde, Kilimanjaro, and Madagascar, besides the European occurrences. Judd and Cole (2) describe it from Lamlash (Holy Isle), Arran (2).

The constituents of the Burnie rock are olivine, augite, and magnetite, in a brown glass devitrified by the development of globulites and crystallitic rods.

Augite is in colourless crystals, porphyritically dispersed, and, as numerous small laths and prisms, vertical sections give an extinction angle up to 36°-40°.

Olivine is abundant and fresh, giving numerous characteristic hexagonal sections in the zone (010), (001). Its crystals are often corroded and scattered, and cracks introduce inclusions of the base.

Magnetite is present in fair quantity in well-formed crystals and minute grains.

The base is a brown glass with globulites, belonites, and microlitic laths of augite. Some of the rods may, perhaps, be incipient felspars. The globulites cluster more densely round the borders and in the neighbourhood of the larger crystals, forming semi-opaque aggregations. Amygdaloidal cavities are discernible, some beautifully fringed with zeolites, some with an isotropic periphery and a faintly-polarising crystallitic centre.

No. 3.—Basaltvitrophyre (Glassy Basalt).*

(From Sheffield.)

This is, microscopically, one of the most attractive rocks occurring in this State. It is usually intensely black, although rarely of a dark grey-brown colour, with a shining vitreous lustre, having commonly numerous veins and patches of milk-white to glassy zeolitic magma, which, in

(1) Petrographische Studien an den Basaltgesteinen Böhmens, 1874, pp. 53–60.

(2) On the Basalt Glass of the Western Isles of Scotland, Q.J., Geo. Soc., 1883, p. 459.

* As Pitchstone, "The Geology and Palaeontology of Queensland and New Guinea," Jack and Etheridge, 1892.

Minerals of Tasmania, 1896, page 68.

the cavities, crystallises into definite forms, and then shows clusters of chabazite, phillipsite, with beautiful patches of mesolite interspersed. It is extremely brittle, and thus easily reduced to fragments.

Microscopical Characters.

This is the glassy form of basalt, a true vitreous basic lava, with pheno-crysts of olivine sparsely scattered in a structureless glass of a pale yellow tint, occasionally deepening into gamboge. Apparently, it occurs massive, and does not form a mere tachylytic selvage. It, consequently, falls into Rosenbusch's division of basaltvitrophyres. It is a volcanic product, which is typically represented by the Kilanea lavas in the Sandwich Islands, and its structure is strikingly repeated in slides of modern lava from Hawaii. The olivine crystals are nearly as fresh-looking, and have the same inroads of the corrosive magma.

Like the same form in the Sandwich Islands, the glass is wonderfully clear, a marked contrast to the opaque nature of so many European tachylytes. It carries small colourless or yellowish globulites, some with opaque margins, but the bulk of the iron, instead of separating out into magnetite, would seem to have been used up by the olivine. There are no complete displays of perlitic structure, but it is incipient, and some of the porphyritic crystals are surrounded by a perlitic ring associated with globulites. The strain phenomena are instructive. Several olivines have tufted fissures proceeding from their borders into the surrounding glass, arranged like cilia, evidently the result of the strain of crystallisation, upon the glass. These fissures sometimes connect two fissures, and spring, too, from larger cracks, which traverse the glass in various directions. The same crystals under partly-crossed nicols show a reaction rim, which in plain light is seen to be a granulated border. Wherever the smaller fissures are numerous, they are associated with granulation, yellow translucent globulites. The crystals of olivine often enclose the glassy base in ovoid and circular forms, some of which are prolongations of the base, being connected with the outside magma by a narrow neck. I could not detect more than a crystal or two of augite and triclinic felspar. In the darker portions of the glass zeolitic cavities occur with spherulites round their margins. Elsewhere a spherulite exists with an approach to an axiolitic nature, being elliptical in form, with an elongated medium axis.

No. 4.—Hydrated Olivine Basalt.

(From Native Point, Perth.)

A rock of abnormal physical character, inasmuch as it is invariably heavy from the absorbed moisture, and soft to a degree. It is pale brown in colour, showing a variety of tints between almost yellow to a fairly-dark shade. On exposure to atmospheric action, it commonly fractures in all directions, and finally breaks up into fragments. It closely resembles the tuffaceous substance known as palagonite. It was obtained in sinking-holes in the locality mentioned.

Microscopical Characters.

This structure is that of a normal basalt. The porphyritic mineral is olivine, and augite in the form of grains and minute prisms is embedded in a plexus of narrow lath-shaped felspars. There is a glassy base, and large patches of zeolitic substance (chabazite ?) and vesicles crowded with minute spherulites. Magnetite is present in small quantity. The twinned felspars give extinction angles up to 27°, and are probably labradorite.

The most important mineral is the olivine, which exhibits interesting alteration features. The crystals have the irregular forms which intra-telluric minerals receive from the attacks of the magma at the crisis of eruption, and are invariably margined with a deep orange or brownish-red border, consisting of fine fibres perpendicular to the contour. The interior is of a citron-yellow colour, and both the interior and the border have assumed a pleochroic nature. The former is serpentinous (sometimes chloritic), and the latter, in all probability, is a hydrated ferric oxide. No fresh olivine remains in the rock. The change sometimes proceeds until the precipitate of ferric oxide colours the whole crystal, and occasionally we see it result in laminæ with the cleavage lines, pleochroisms, and red and green interference colours of biotite. This mineral is very similar to the hydrated silicate of iron, lime, magnesia, and soda called "iddingsite," but its general features indicate that it is a pseudomorph after olivine. For a discussion of this kind of replacement, see H. H. Arnold-Bemrose on the Microscopical Structure of Carboniferous Dolerites and Tuffs. Q.J., Geol. Soc., 1894, p. 617.