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*Note on the Occurrence of Rocks allied to Monchiquite in the Island of
Fernando Noronha.*

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THE name of Monchiquite, first applied by Rosenbusch and Hunter (*Tscherm. Min. Mitth.* XI. 1890, p. 445) to a peculiar group of dyke rocks found in association with elæolite-syenite in Brazil, is rapidly becoming familiar to petrologists through the discovery of similar rocks from various other localities.

The Brazilian Monchiquites were described by Rosenbusch as black to grayish-black rocks, consisting of porphyritic olvine and pyroxene, with widely varying amounts of hornblende and mica, in a glassy¹ base usually crowded with hornblende microliths.

¹ Recently (*Journ. Geol.* IV. 1896, No. 6) L. V. Pirsson has brought forward evidence to show that the supposed glassy base in these rocks really consists of analcite.

In the United States similar rocks have been found in many localities, where they occur associated with *elæolite-syenite* as in Brazil. Rocks belonging to this type in Arkansas were divided by J. F. Williams into *Monchiquites* proper, containing *olivine*, and two varieties free from *olivine*, *fouchite* (containing *augite* and *hornblende*), and *ouachitite* (containing *biotite*, or *biotite* and *hornblende*). In Arkansas, the Lake Champlain district, and near Montreal, as well as in Brazil, the *Monchiquites* occur in association with rocks of great geological age. This group, however, is not confined to the older rocks. In the Bohemian *Mittelgebirge* rocks which are referred to *Monchiquite* by Rosenbusch occur as dykes in association with the Tertiary *phonolites* and *nepheline basalts*. Many of these rocks have been recently investigated by Hibsche (*Tscherm. Min. Mitth.* XIV. 1894, p. 95; and XV., 1895, p. 201.) They were originally described, however, more than 20 years ago by Borický (*Petrog. Studien a. d. Phonolithgesteinen Böhmens*, 1873; and *Petrog. Studien a. d. Basaltgesteinen Böhmens*, 1874) under the name of *trachybasalts*. According to Borický they occur in the form of wall-like dykes, 1 to 3 feet wide, in the *phonolites* of the north part of the Bohemian *Mittelgebirge* between Aussig and Tetschen, and are the youngest eruptive rocks in the district. He divides them into three groups, according to the prevalence in them of *felspar*, *nepheline* (*leucite*) and *nosean*; but all are characterised by a peculiar type of microstructure, viz. the interlacing *hornblende* microliths in a more or less glassy base. They are mostly free from *olivine*, and can therefore be referred to the *fouchite* variety of Williams.

It is to these *trachybasalts* of Borický that the rocks from Fernando Noronha, which are the subject of the present note, present the most striking similarities both in character and mode of occurrence. The rocks in question form part of a collection made by Mr. H. N. Ridley during his stay upon the island of Fernando Noronha in 1887 (see *Journ. Linn. Soc.* XXVII. 1891, p. 1). For some of these specimens there is no record of their mode of occurrence; but in the case of the specimens from Sponge Bay, on the south-east side of the main island, it is clearly stated in Mr. Ridley's notes that they occurred as dykes, up to 3 feet in width, running down from the East Hills (Morro Francez) to the sea, and traversing beds of *phonolitic tuff*. Examination of the sections of some of these rocks suggested at once comparison with the sections of Borický's *trachybasalts* in the British Museum collection.

The specimens collected between Cotton Tree Bay and Look-out Hill (Atalaia Grande) in section most resemble the Bohemian rocks. One

variety (specimens numbered 67 106, -112, -116, -117) is a gray rock, showing to the naked eye, in a dense groundmass, porphyritic prismatic crystals of hornblende and augite. Under the microscope the groundmass is seen to consist of a colourless base (mainly isotropic, but in patches feebly depolarising), which is densely crowded with long microliths of augite and brown hornblende, often arranged in radiating groups, and with small magnetites. The phenocrysts are long prismatic deep reddish-brown hornblendes, generally twinned, and prismatic purple pleochroic augites, often with green or colourless centres. Nosean in hexagonal sections also occurs; but in these specimens the mineral has suffered zeolitic alteration. Included in the hornblendes and augites are octahedra of magnetite, and apatite in needles or in clear sharply-defined hexagonal sections.

Another variety from the same locality (No. 67113) is a dense black glassy-looking rock, showing porphyritic crystals of hornblende and augite. Under the microscope it is seen to be much more like the preceding variety than the hand specimen would suggest. The phenocrysts are the same, viz. hornblende and augite with magnetite, apatite and nosean. In this case the latter mineral is quite fresh and perfectly isotropic, while many of the hexagonal sections show the characteristic inclusions. In the groundmass, which has the appearance of being a more perfect glass (but see Pirsson, *loc. cit.*) than in the preceding rock, the microliths are much more minute, and show flow structure. In a petrographical paper (*Am. J. Sci.* 37, 1889, p. 178) by G. H. Williams, on a collection of rocks from Fernando Noronha made by J. C. Branner in 1876, the augite (No. 115) from the tuff east of Morro Francez, according to the description, closely resembles the above rock, except that it contains nepheline instead of nosean.

A third variety (No. 67111), occurring as a dyke at the base of Look-out Hill (Atalaia Grande), is a black glassy-looking rock with porphyritic augites and brown patches of altered olivine. Under the microscope it is seen to differ from the rocks described above by the absence of phenocrysts of hornblende and nosean, and by the presence of olivine. The only phenocrysts are large purple zoned augites and altered olivines. These occur in idiomorphic crystals in an extremely dense groundmass, which is almost opaque except in the thinnest possible sections, and consists of an isotropic base, densely crowded with magnetite and minute microliths of augite and hornblende.

The specimens (Nos. 67063 and 67081) from the dykes at Sponge Bay which run down from the East Hills (Morro Francez) to the sea, closely

resemble the rock (No. 14) described by G. H. Williams (*loc. cit.*) as limburgite, which occurred as a dyke at the base of Atalaia Grande. They are dense black glassy-looking rocks showing porphyritic crystals of augite and hornblende with brown patches of altered olivine. Under the microscope the groundmass is seen to consist of an isotropic base, crowded with long microliths of hornblende and augite, with much magnetite. The phenocrysts are mostly augites in prismatic crystals, green in the interior with purplish brown borders. Hornblende crystals are not numerous, but are large with corroded borders, and in some cases they enclose augites. A characteristic feature of the rock is the numerous hexagonal sections of beautiful blue haüyne. Olivine occurs sparingly in altered crystals.

The rocks above described have all been characterised by the absence of feldspar. A specimen (No. 67072), however, from a dyke at Sponge Bay, traversing phonolite, shows the presence of feldspar in the groundmass. It is a dense black rock not markedly porphyritic, in parts minutely vesicular. Under the microscope the phenocrysts are seen to consist almost entirely of augites, having the same characters as in the preceding rocks, except that they are not so prismatic and vary in size so that the rock is not so distinctly porphyritic. Besides the augite, deep brown hornblende phenocrysts occur sparingly, and a few small altered olivines. The base is in parts isotropic, and in parts consists of lath-shaped feldspars: it is crowded with deep brown hornblende microliths with magnetite and small purplish augites.

A specimen (No. 67088) from the hill above Sponge Bay, and another from Morro Branco (67125), approach more nearly to feldspar-basalts. In external aspect they are very similar to the rock (No. 67106) first described, and show large porphyritic crystals of hornblende and augite in a light gray groundmass. In section the groundmass is seen to consist of an isotropic base containing small lath-shaped feldspars, granular augite and much magnetite. The phenocrysts are large prismatic augites and hornblendes, sometimes intergrown.

In the present note only a brief account of this group of rocks has been given, mainly with the view of pointing out the analogies which they present in character and geological occurrence with the Tertiary igneous rocks of the Bohemian Mittelgebirge. In both localities we have these Monchiquite dykes associated with phonolites and nepheline-basalts. In Fernando Noronha the relative age of phonolite and nepheline-basalt has not been satisfactorily made out. Professor Branner was unable to come to any definite conclusion on this point. Mr. Ridley, from the

appearance of alteration of phonolite by basalt in certain localities, considered that the phonolite was anterior to the basalt. It may be pointed out, however, that the localities he mentions (Look-out Hill, Morro Branco) are just those in which Monchiquites occur, and that the basalts he speaks of may belong to these exceptional rocks rather than to the nepheline-basalts which constitute the prevailing rocks of the island. As in Bohemia, so in Fernando Noronha, the phonolite is found occupying the prominent peaks (Mount St. Michael, the Peak, Atalaia Grande, etc.), and has the appearance of having been injected into older rocks. We are inclined, therefore, to venture the opinion that the sequence of the rocks in Fernando Noronha will be found to be the same as in the Bohemian Mittelgebirge, viz. nepheline-basalt, phonolite, trachybasalt, and that in both localities these youngest Monchiquite dykes represent the later stages in the differentiation of an elæolite-syenite magma.

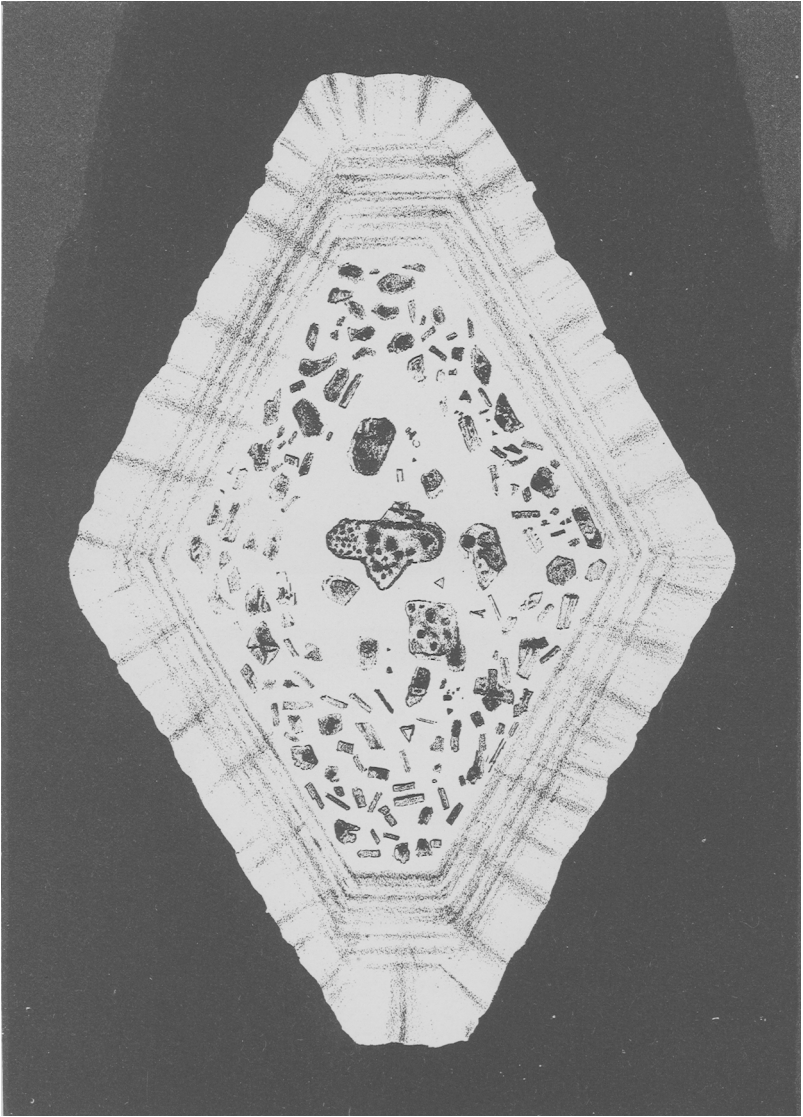
In a future paper I hope to give a more detailed account of these and other rocks from Fernando Noronha, and to supplement that account with analyses of the principal types.

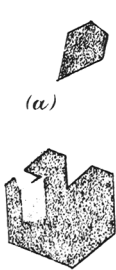
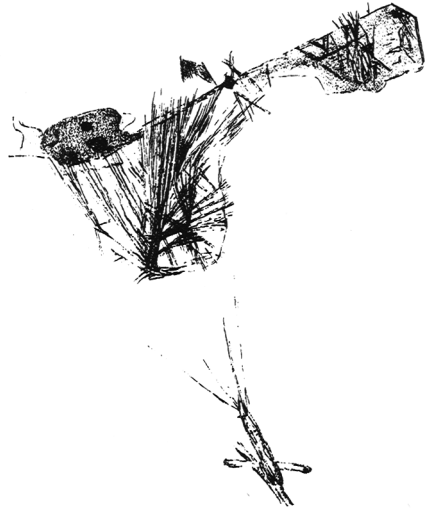
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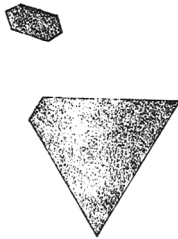
Fig 3.

Copied from original partly coloured plates.





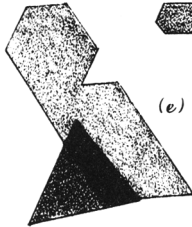
(a)



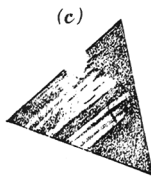
(b)



60°



(d)



(e)

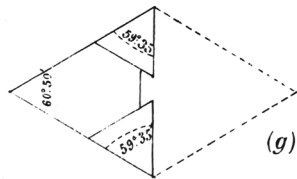


61°18'

(f)



(g)

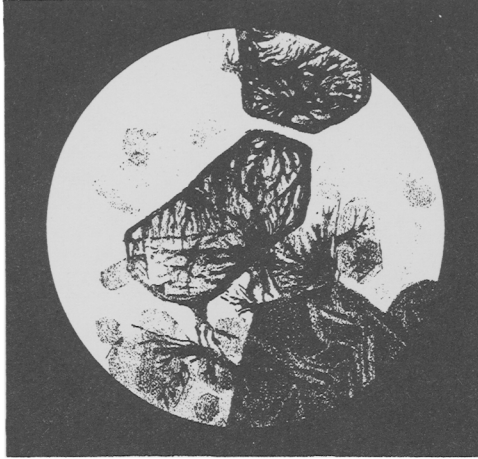


(h)

60°30'

59°30'

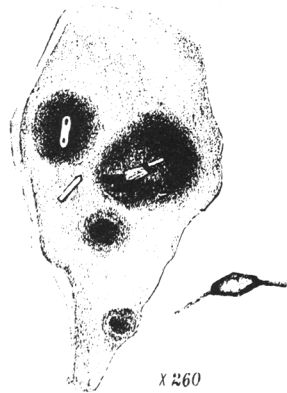
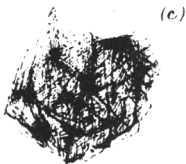
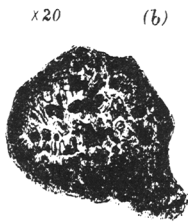
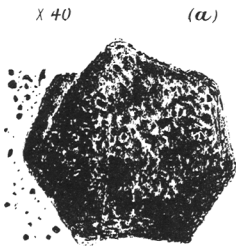
59°30'



x27



x70



x 260