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## Chapter 18 Gaodhail and Cruachan augite-diorites

### Introduction

(Plate 5) (p. 165) shows the position of two great plutonic intrusions known as the Gaodhail and Cruachan Augite-Diorites, and lettered H on the one-inch Map, Sheet 44. They lie in the course of a host of Late Basic Cone-Sheets (Chapter 28), and are only preserved as disconnected lenticles among these sheets. In spite of the complication thus introduced, it has been found possible to draw approximate boundaries for the diorite-masses; and it is very striking how nearly the two intrusions balance one another on either side of the axis of symmetry that runs north-west through Loch Bà. W.B.W.

The diorites are coarse-grained needle-rocks characterized by acicular augite. They vary considerably from point to point, and in one locality (pp. 217, 321) furnish what is regarded as an example of gravitational differentiation (Chapter 30). J.E.R.

Under the guidance of Dr. Harker, who visited the district with the writer during the early days of the enquiry, these rocks were at first regarded as hybrids, since they undoubtedly exhibit many of the phenomena of crystallization associated with hybridization. The phenomena observed have been subsequently proved, as will be shown in Chapter 30, to be characteristic also of internal migrations accompanying gravitational differentiation. Accordingly, since Mr. Richey has shown that the rocks of the present chapter, in one locality, give indications of gravitational differentiation, it seems wise to regard each of the two great masses as the product of a single intrusion in which internal migration has occurred; though possibly their history may have been complicated by some absorption of xenolithic material. W.B.W.

The multitude of Late Basic Cone-Sheets cutting the augite-diorites is so great that it effectually obscures most of their other field-relations. In the Gaodhail River, however, just below Gaodhail, and again in Allt nan Clàr, at Tomslèibhe, the Gaodhail Diorite is seen to be cut by a massive craignurite cone-sheet with narrow basic margins. It is probable, though not certain, that this sheet belongs to a very early stage in the intermittent development of cone-sheets so characteristic of Mull (Chapter 19). In keeping with this, there is some evidence that the Gaodhail Diorite is earlier than the Early Basic Cone-Sheet that constitutes the gabbro of Beinn Chreagach Mhòr. Gabbro is found in the lower part of the Gaodhail River which seems to belong to the Beinn Creagach Mhòr Sheet ( (Figure 36), p. 238), and a slice of the diorite taken from near the gabbro (the junction is not exposed) shows strong contact-alteration when examined under the microscope ([S14731](#)) [NM 6064 3825]. E.B.B. The remaining subject-matter of the chapter is discussed under two headings: Field-Relations and Petrology.

### Field-relations

#### Gaodhail Augite-Diorite

Lenticles of the Gaodhail Augite-Diorite are well-seen in the following exposures:

1. For 100 yards above the upper path, west side of Glen Forsa, in the tributary stream adjoining the main river a little below the mouth of Allt an Eas Dhuibh.
2. River Forsa, 200 yards below mouth of Gaodhail River, and just upstream from outcrop of a thick craignurite cone-sheet, lettered al on the one-inch Map.
3. From 600–1000 yallds up the Gaodhail River.
4. The two northern tributaries of the Gaodhail River. The country-rock downstream is mainly gabbro ascribed to an Early Basic Cone-Sheet ((Figure 36), Chapter 21).

5. Slopes south and south-east of Lòn Bàn, Gaodhail River. The rock of the slopes south-east of Lòn Bàn is rather more acid than usual.

6. The Tomslèibhe stream and the slopes of Beinn Talaidh. The largest of these exposures is where the path to Tomslèibhe Cottage crosses the stream. The diorite is unusually acid at this point. W.B.W.

### **Cruachan Augite-Diorite**

Stream-exposures of the Cruachan Augite-Diorite are afforded by the River Clachaig, Allt na h-Eiligeir, and in Coire Mòr. The Clachaig district is particularly interesting, for, on climbing from the bottom of the glen westwards on to An Cruachan, one finds that the lenticles of country-rock, showing between cone-sheets, become increasingly acid, so that at the hill-top one is dealing with granophyre and felsite in place of diorite—no attempt has been made to show these acid portions separately on the one-inch Map. Taken in conjunction with other examples of much the same kind this transition is regarded as due to gravitational differentiation, and is discussed under this heading in Chapter 30.

### **Petrology**

Under the title augite-diorite, for want of a better, we here group a number of somewhat coarsely crystalline rocks of intermediate to sub-basic composition. They are represented by the two above-described intrusive masses that are symmetrically disposed on either side of Loch 131, and possess sufficient likeness to each other to render it certain that they have had a similar origin and solidified under similar conditions. They present in the size and character of their mineral constituents, and also in their type of crystallization, an exaggerated reproduction of rocks that approach the border-line between craignurite and the Talaidh Type of quartz-dolerite described in Chapters 19 and 28. There is so much evidence of suddenly disturbed equilibrium, accompanying pronounced changes in the composition of the magma during the period of its crystallization, that the normal character of the rocks might be doubted. It is felt, however, that a magma of basic craignurite-composition might furnish such rocks if allowed to consolidate under conditions of a more nearly plutonic nature; and that the disturbances in equilibrium might well result from the interaction of a partially solidified magma and its own acid differentiate. Owing to the evidence being complicated by the later intrusion of cone-sheets in great numbers, it is inadvisable to speculate too freely upon the true origin or nature of the rocks concerned; but it is worth recalling that according to Mr. Richey (p. 217) there is practically conclusive proof that the north-eastern mass becomes increasingly acid upwards in its north-eastern extremity.

### **Gaodhail Augite-Diorite**

A conspicuous feature of this intrusion ([S2117](#)) [NM 610 382], ([S14740](#)) [NM 6158 3703], ([S14742](#)) [NM 6157 3676] is the occurrence of narrow columnar crystals of brownish augite ( (Figure 32)A, frequently greater than a quarter of an inch in length, intimately intergrown with magnetite and crossed by salitic striations in a manner identical with the columnar augites of the intrusions of Talaidh Type (p. 302). It must be remembered, however, that a similar augite often separates from the definitely hybrid zone that results from the interaction of granophyre and gabbro (p. 353). The felspar is most commonly in large plate-like or elongated tabular crystals, composed of andesine-oligoclase, and edged with an irregular zone of perthite with an edging of orthoclase.

Occasionally the felspar is perthite with an edging of orthoclase. The interspaces are filled with felspathic and quartzose matter, frequently in micrographic relationship. Large crystals of apatite are a feature, and are concentrated more particularly in the more acid portions. The columnar augites have in many instances been transformed into green fibrous hornblende ([S14746](#)) [NM 6021 3716], and the plagioclase felspar increased in alkalinity by subsequent albitization.

These rocks sometimes contain fine-textured xenoliths that, apart from alteration, are of Talaidh Type, but field-evidence makes it quite clear that such xenoliths must be referred to an earlier source than the Late Basic Cone-Sheets. Under the microscope, they are seen to have suffered a considerable amount of granulitization and recrystallization of their augite, iron-ore, and felspar ([S14732](#)) [NM 6026 4032]. In other cases ([S14737](#)) [NM 6161 3773], there has been much resorption of basic material with subsequent crystallization of a pyrogenetic hornblende within the limits of the xenolithic patches. Here, too, in addition to the usual columnar augite, we meet with that cervi-corn variety so frequently developed

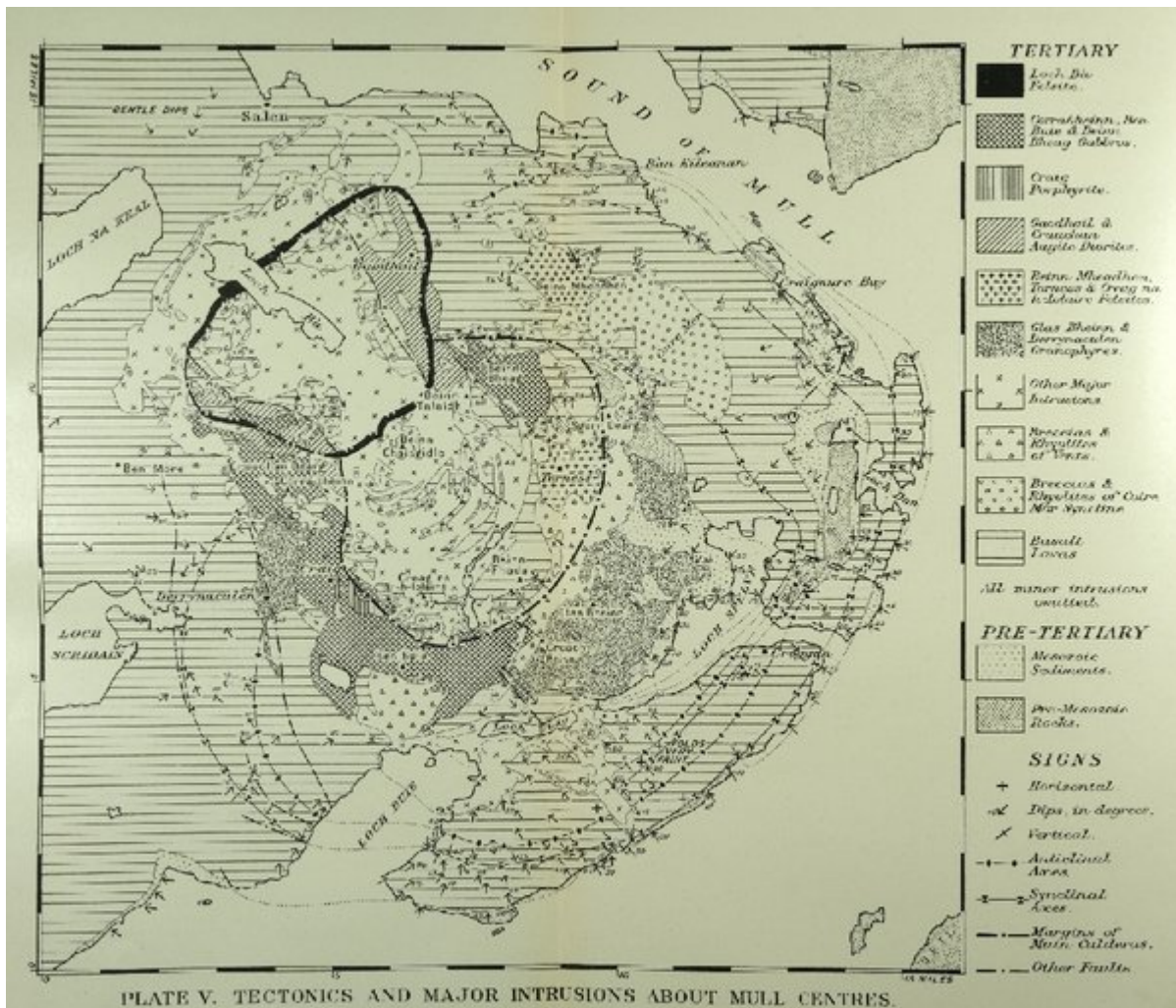
in the Late Basic Cone-Sheets of Talaidh Type.

Turning now to a few examples that reproduce in clear fashion some of the features of interaction discussed in Chapter 33, we note a rock ([S14357](#)) [NM 6188 3538] in which original augite has been converted in whole or in part, with evident signs of corrosion, into a greenish-brown pyrogenetic hornblende. The bulk of the rock has a rather coarse granophyric matrix, including moderately large individuals of albite-perthite, with subordinate orthoclase. Apatite is extremely abundant in the alkaline plagioclase feldspars and perthite. In another case ([S14811](#)) [NM 6061 3813], a rock from the Gaodhail River composed mainly of fairly large crystals of oligoclase and ophitic augite, the oligoclase crystals have been attacked by an acid granophyric magma, that has added to them an irregular casing of perthite and filled the spaces between the crystals with micro-granophyric material ( (Figure 32)B. The augite likewise has in some parts of the rock been granulitized with the separation of magnetite, and in other parts, though resorption, has given rise to the usual greenish-brown pyrogenetic hornblende of the hybrid rocks.

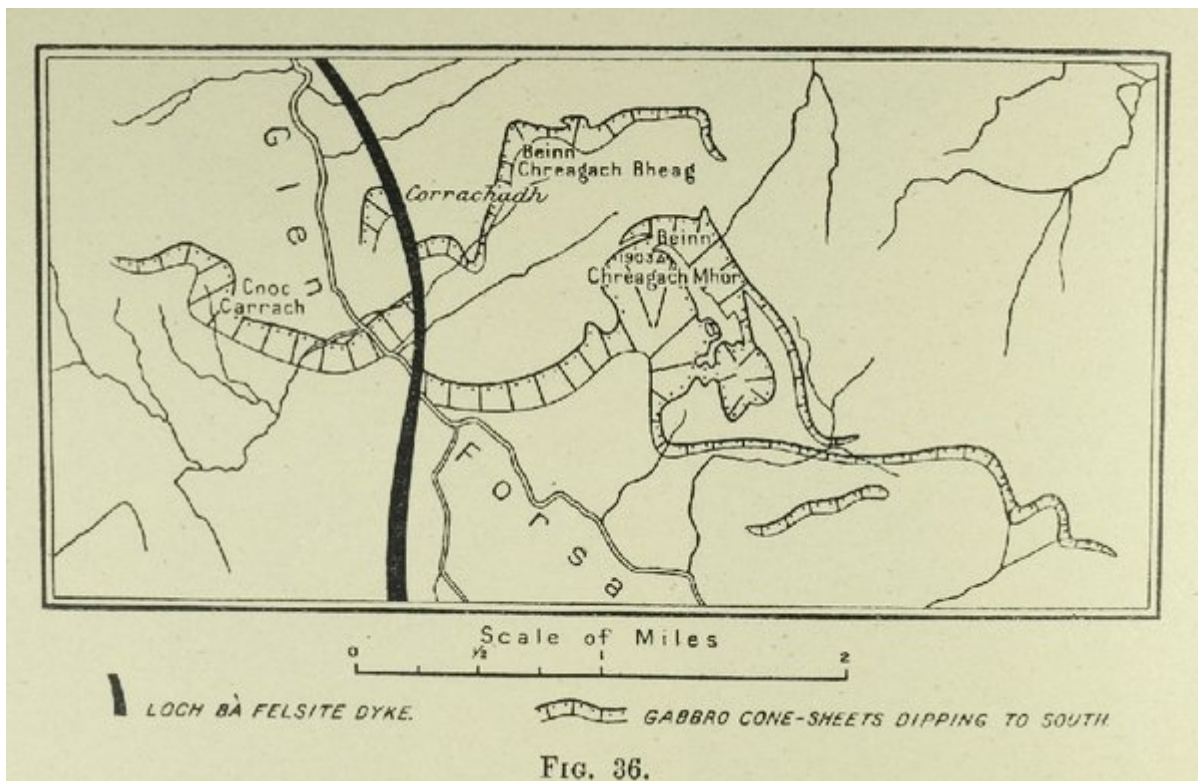
Intense granulitization of augite and conversion to hornblende and magnetite may also be noticed in a granophyric rock ([S14731](#)) [NM 6064 3825] that consists mainly of perthite and augite. This rock is clearly xenolithic and has basic clots of augite, magnetite and hornblende; but it is probable that in this instance contact-alteration may be responsible for some of the changes observed, since the exposure occurs close to a gabbro that is regarded as a continuation of the Beinn Creagach Mbar Sheet ( (Figure 36), p. 238).

### **Cruachan Augite-Diorite**

The Cruachan mass as exposed to the north-north-west of Beinn a' Mheadhoin ([S19955](#)) [NJ 7236 2953], ([S19956](#)) [NJ 7138 2833], ([S19957](#)) [NJ 7120 3211], ([S19958](#)) [NJ 7035 3032] presents the same general characters as have been described above. It is equally coarse in its crystallization, and carries an identical assemblage of minerals. One specimen ([S17958](#)) [NM 5867 3239] compares with the abnormal rock described above as coming from the Gaodhail River ([S14811](#)) [NM 6061 3813]. It shows well the attack of early formed oligoclase-andesine crystals by the granophyre that forms their matrix. The crystals have been irregularly resorbed and further modified by solid-transfusion of alkaline material, while new growths of alkaline character have been added. The original augites have been attacked in a remarkable manner, resorbed, and in some cases regrown with a separation of magnetite. In other cases the augite has passed to fibrous green hornblende. Pseudomorphs in magnetite, chlorite, and hornblende suggest the original presence of olivine in the basic portions of the rock, and it would seem in this instance that we are dealing with the results of interaction of an acid magma on an early consolidation of gabbroic composition. H.H.T., E.B.B.



(Plate 5) Map showing calderas, major intrusions, and folds



(Figure 36) Early Basic Cone-Sheets of Beinn Chreagach Bheag and Beinn Chreagach Mhòr probably displaced at Loch Bà Felsite.



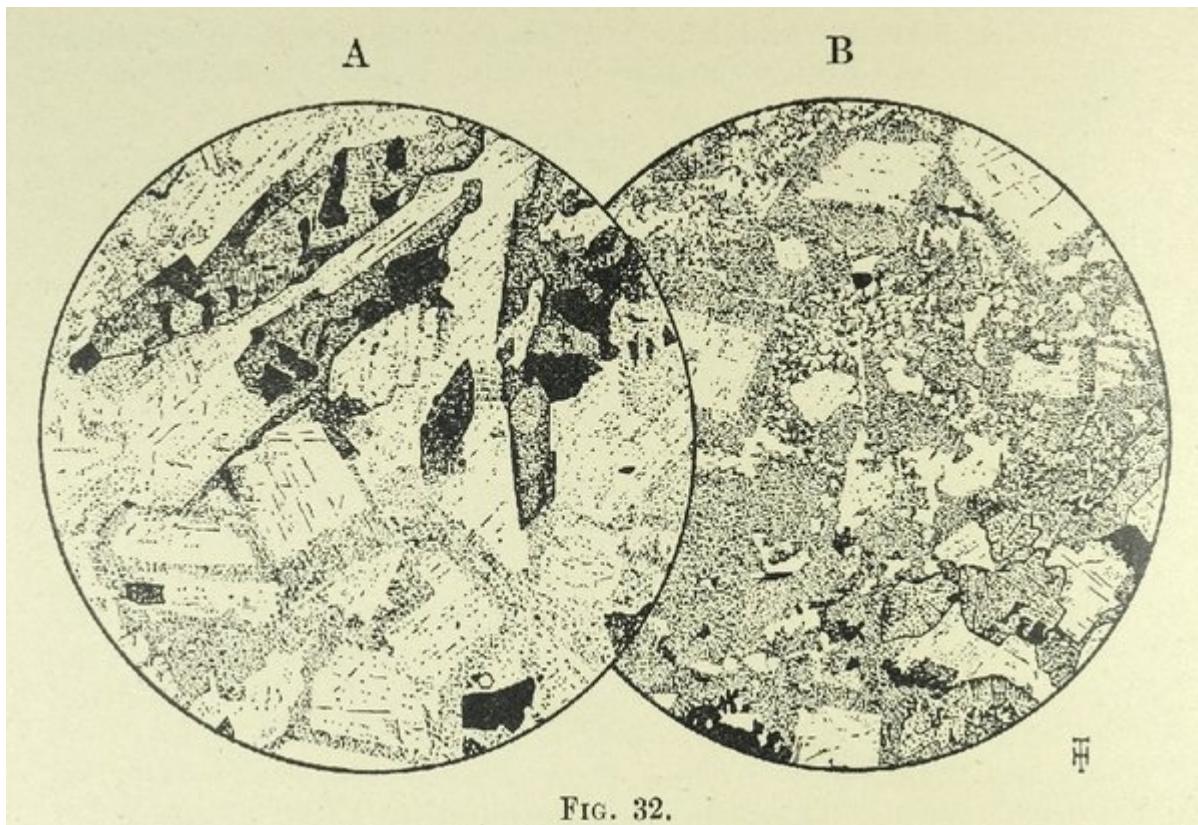


FIG. 32.

(Figure 32) A [(S14740) [NM 6158 3703]]  $\times 17$ . Augite-diorite of Gaodhail mass (Tomslèibhe). Large columnar crystals of augite intimately associated with magnetite. Tabular crystals of oligoclase-andesine irregularly fringed with turbid alkali-felspar. Interstices frequently occupied by quartzo-felspathic matter in micrographic relationship. B [(S14811) [NM 6061 3813]]  $\times 17$ . Augite-diorite of more acid character from the Gaodhill River, showing signs of interaction between its basic and acid components. The rock consists of partially resorbed ophitic augite and oligoclase in a micrographic matrix of quartz and turbid alkali-felspar. The oligoclase is fringed with perthitic orthoclase.