Chapter 29 Ring-dykes between Glen More and Beinn Chàisgidle

Introduction

Two terms, constantly made use of in the present chapter, may be defined as follows:

- A ring-dyke is a dyke of arcuate outcrop, where there is good reason to believe that its arcuate form is significant rather than accidental. Only in rare instances are ring-dykes so completely developed as to show an entire ring-outcrop (Pl. 6)
- A screen is a narrow partition of older rock separating two neighbouring steeply bounded intrusions. Screens separating ring-dykes have arcuate outcrops. Often in Mull, a screen is formed in large measure of a ring-dyke; but the screens which have proved of most assistance in unravelling the history of the island consist of rock-masses other than ring-dykes (cf. (Figure 52), p. 308).

The number of ring-dykes has already been commented upon as one of the main features of Mull geology (p. 6). In nature, and on the one-inch Map, this feature is much obscured owing to the intersection of many of the ring-dykes by multitudes of Late Basic Cone-Sheets (Chapter 28). Accordingly, in (Plate 6), the cone-sheets are omitted. The reader must not think that the difficulties introduced by the presence of these cone-sheets are such as to render the interpretation of the ring-dykes 'uncertain. In the first place, there are several instances of ring-dykes, which are scarcely cut by cone-sheets—the Loch Bà, Felsite seems in fact to be cut by none at all. In the second place, even where the ring-dykes are freely cut, it is still quite possible to draw boundaries for them: the problem presents itself to the field-geologist in much the same light as the mapping of a band through grass-covered country, where exposures, though numerous, are discontinuous. In using the one-inch Map, Sheet 44, the reader must understand that heavy black lines have been printed to enable him to follow boundaries, which have been rendered inconveniently discontinuous by cone-sheet intrusion. He will also find that the more basic ring-dykes are lettered qD or qE, according as they are quartz-dolerite or quartz-gabbro; and that the more acid are lettered (along with several other intrusions) F or G, denoting felsite or granophyre as the case may be. W.B.W., E.B.B., J.E.R.

(Plate 6) shows clearly that the ring-dykes of Mull group themselves roughly about two centres (C_1 and C_2, (Figure 58), p. 338), the one situated in Beinn Chàisgidle, the other near the head of Loch Bà. In the present chapter, only the ring-dykes belonging to the former centre are dealt with; three important ring-dykes referable to the Loch Bà centre are reserved for Chapter 32. J.E.R.

The two centres of ring-dyke activity do not seem to have behaved quite independently, for it is easy to recognize in (Plate 6) a certain measure of dual control. In so far as they acted successively, the Beinn Chàisgidle centre functioned at an earlier date than that of Loch Bà. Probably, all the ring-dykes, included in the present chapter, date from the earlier part of the long period which saw the introduction of the Late Basic Cone-Sheets. This matter has already been discussed in some measure in the Time-Relations section of Chapter 28. It is furnished with many additional illustrations in the detailed account of Field-Relations given below.

Unlike the cone-sheets, the ring-dykes of Mull very seldom show chilling at their margins. Instead, one commonly finds a little marginal assimilation of country-rock. The ring-dykes, too, are on the average coarser in crystallization than the cone-sheets. Evidently their cooling was slow; and this, combined with their erect posture, has given favourable conditions for gravitational differentiation, of which several examples are discussed in Chapter 30.

The discussion of Field-Relations in the sequel is followed by a section on Petrology.

Field-Relations

The ring-dykes of Mull are much more elusive than the cone-sheets. This results, in large measure, from the relatively great bulk of the ring-dykes, and the rarity of smooth chilled margins, since both of these characteristics render it

impossible to learn much from examination of isolated exposures. In general, it has been found necessary to map the ring-dykes before it was possible to visualize their behaviour. The country in which they occur affords many excellent stream and hillside exposures, and where, as in much of the Glen More district ((Figure 52), p. 308), there is no great complication due to later cone-sheets, the mapping presents no particular difficulty. Great arcuate outcrops of gabbro, dolerite, granophyre, and felsite are revealed, sometimes running side by side, sometimes separated by screens of more or less complex constitution. The boundaries of these belts can be laid down on the map with precision, and, as they happen to cross important ridges and valleys, it is possible to realize that they are very steep. It has not been established whether there is any significant departure from verticality, but this point will be returned to in the description of the Loch Bh Felsite (Chapter 32). Anyone wishing to satisfy himself of the steep dyke-like character of the intrusions here considered would be well-advised to follow for a mile or so the felsite-dyke marked 6 ((Figure 52)) in its course across Allt Molach, or, what is equally striking, the south-eastern margin of the granophyre marked 11.

Allt Molach (Figure 52)

The Allt Molach District has just been mentioned. It was in this district that the number and importance of the Mull ring-dykes first became apparent; and it is hither that the geologist should still turn if he wants to investigate the subject to full advantage. Fortunately, no hard physical work is entailed, and the stream-section is 'crossed at one point by a driving-road, which renders it easy of access.. The description, which follows, supplies a detailed guide to much of the geology illustrated in (Figure 52), for even the complex internal relationships of the various screens bear indirectly—if only by way of contrast—upon the subject matter of this chapter.

Intrusions 1 and 2 of (Figure 52) stand for the Glen More and Ishriff Ring-Dykes respectively, both of which make prominent features on the one-inch Map. Their further consideration is postponed, as there are no exposures of either within (Figure 52).

Between 2 and 3 lies a Screen of basalt-lavas, poorly though sufficiently exposed. A fair number of Late-Basic Cone-Sheets (Chapter 28) traverse these lavas. In Allt Molach, compact non-porphyritic basalt-lavas, along with neighbouring gabbro 3, are cut by a 15 ft. felsite-dyke with 1 ft. basalt-margins (composite). This dyke figures prominently again in a tributary stream, half a mile farther north-west.

Intrusion 3 is a Ring-Dyke of quartz-gabbro. Between the outcrop of the composite dyke, mentioned above, and the bridge, by which the road crosses Allt Molach, this gabbro is.cut by three basalt-dykes. Just west of the bridge, it is cut by a Late Basic Cone-Sheet There is no evidence as to whether this cone-sheet cuts the neighbouring granophyre 4. The junction of 3 and 4 is exposed; there is no chilling, but, instead, a very narrow belt of merging, such as is common at a contact of plutonic rocks. There is no evidence whether 3 is later than 4, or *vice versa.*

South of Allt Molach, a narrow Screen of compact non-porphyritic basalt-lava locally separates 3 and 4. Perhaps the outcrop of lava shown, north of Allt Molach, as surrounded by 4, may really act as a screen between 3 and 4, but exposures are not full enough to decide this point.

Intrusion 4 is a granophyre-felsite Ring-Dyke. It is granophyre with acicular crystallization as exposed in Allt Molach; it is basic granophyre, but not acicular, in the stream-exposure between lava-outcrops 400 yds. farther north-east; it is granophyre in most of its exposures south of Allt Molach; but locally, where its outcrop narrows west of the lava-screen, 200 yds. south of Allt Molach, it assumes the character of felsite with a small felspar-phenocrysts. In Allt Molach, the granophyre is cut by a thin sub-acid cone-sheet, and also by a 12 ft. Late Basic Cone-Sheet, of which the chilled top is well-exposed. The junction of 4 and 5, though exposed, gives no clue to age-relations.

Intrusion 5 is a Ring-Dyke of acid quartz-gabbro merging into granophyre. In Allt Moloch, it is cut by a big Late Basic Cone-Sheet of medium grain with well-exposed chilled top. This cone-sheet is in turn cut by two minor Late Basic Cone Sheets, and also by acid veins, the latter probably emanating from 6. Upstream from the big cone-sheet, the Ring-Dyke 5 is cut by two thin Late Basic Cone-Sheets, which are seen close to the junction of 5 and 6; the first of these runs north-west, and cuts veins from 6; the second runs north and south, and is cut by veins from 6. Thus Allt Molach supplies a local time-scale: 5 followed by Late Basic Cone Sheets, followed by 6, followed by more Late Basic Cone-Sheets.

North of Allt Molach, an important Screen of compact non-porphyritic basalt-lava wedges in at the outcrop between 5 and 6, or, where 5 locally fails, between 4 and 6. Exposures of these lavas are met with in a small stream 400 yds. north of Allt Molach, and continue northwards along the hillside well beyond the limit of (Figure 52). Near the southern edge of (Figure 52), a much less extensive screen of agglomerate and compact non-porphyritic basalt separates 5, on the one side, from 6 and 7, on the other. The agglomerate of this screen lies flatly on the lava (p. 197).

Intrusion 6 is a felsite Ring-Dyke carrying small felspar-phenocrysts. The Allt Molach exposure is so full of basaltic and doleritic xenoliths that it does not give a fair sample. A little tributary a few yards north of Allt Molach, and crags either side of the valley, are more representative. In the paragraph relating to Ring-Dyke 5, it has been shown that 6 cuts some Late Basic Cone-Sheets, and is cut by others. This relationship will be further illustrated in the succeeding paragraph on the Screen separating 6 and 7. Here, it is only necessary to draw attention to five Late Basic Cone-Sheets shown in (Figure 52) as cutting 6. The most prominent of these lies south of Allt Molach, and has been traced for about 500 yds. Its chilled top is well-exposed.

A Screen has been mapped for two thirds of a mile between 6 and 7. In Allt Molach, it consists of line dolerite, veined by 6 on the one side, and merging rapidly through digestion into 7 on the other. Probably, this dolerite consists of one or more basic cone-sheets greatly altered by the Ring-Dykes, which it separates. Half-way along its stream-exposure, this fine dolerite is cut by a thin dolerite cone-sheet, which is of later date than the veins from 6. South of Allt Molach, the dolerite of the Screen gives place to basalt-lava and agglomerate. The basalt is of the compact non-porphyritic type; it has two isolated out-crops, and in the more southerly of these is seen passing steeply north-west under agglomerate (p. 197). The field-relations of the agglomerate to the Ring-Dykes (6 and 7) are full of interest: acid material from 6, which merely veins the associated lava, floods the agglomerate; marginally, basic material from 7 also invades the agglomerate, but not to the same extent The agglomerate contains many fragments of a type identical with the intruding felsite; and, at first sight, it is difficult to believe that agglomerate and felsite are not vitally connected in origin. However, the evidence against this view is complete; the agglomerate is seen, in bare rock-exposures, to be cut by basic cone-sheets with chilled margins; and these basic cone-sheets are themselves freely veined by the acid material from 6, though not to the same extent as the agglomerate, which latter has in this respect reacted as an incoherent mass. Two of these interesting cone-sheets are picked out in (Figure 52), north-east of a basalt-dyke lettered M.

Intrusion 7 is a quartz-gabbro Ring-Dyke, no more than sufficiently exposed for mapping purposes. Its main interest lie in its relationship to the screen on the south-east; and this has been mentioned in the preceding paragraph. Only one Late Basic Cone-Sheet has been noticed traversing 7.

Intrusion 8 is a Ring-Dyke of granophyre with a acicular crystallization. It is pooilly exposed for the most part, though sufficiently to allow of its being mapped with certainty. It is cut by a few thin Late Basic Cone-Sheets. Allt Moloch furnishes a section of the contact 8–9, where it is fairly evident that 9 is earlier than 8.

Intrusion 9 is a Ring-Dyke of quartz-gabbro, which, north of (Figure 52), passes uphill into granophyre (Chapter 30). It is cut by a few basalt dykes and Late Basic Cone-Sheets. The Allt Molach exposure of its junction with 10 shows that 9 cuts 10. Thus Allt Molach supplies a fairly certain time-scale: 10 followed by 9, followed by 8. E.B.B.

A Ring-Dyke of quartz-gabbro, which may be a discontinuous portion of 9, reaches down to the south-west corner of (Figure 52), where it is separated from 8 by a felsite Ring-Dyke, that is unrepresented in the numbered sequence of Allt Molach. (C.T.C)

Intrusion 10 is a Ring-Dyke of quartz-dolerite. It affords an additional, but rather poor, example of uphill passage into granophyre. Its time-relations with 9 are stated above. E.B.B.

Between 10 and 11, and where 10 fails, between 9 and 11, there stands an important Screen, poorly exposed in Allt Moloch, but conspicuous on either side. North of Allt Molach, this screen consists of very steep dolerite cone-sheets with chilled margins. South of the valley, it is largely made of agglomerate and associated brecciated early dolerites, both cut by big dolerite cone-sheets with chilled margins. In the southern expbsures, there are also many thin basic cone-sheets, which may be of later date than 11. The massive dolerite cone-sheets, which figure so prominently in this Screen, are

more like Early (Chapter 21), than Late, Basic Cone-Sheets in their field-appearance, and are grouped accordingly on the one-inch Map. (C.T.C), E.B.B.

Intrusion 11 is a Ring-Dyke of non-porphyritic granophyre. The manner in which this granophyre truncates the more important of the cone-sheets occurring in the screen just described is strikingly exhibited both north and south of Allt Molach. The granophyre gives rise to soft grassy slopes, against which the crags, due to the dolerite-sheets, terminate abruptly. Several dykes, one of them composite, and also thin Late Basic Cone-Sheets, have been noted cutting 11.

Intrusion 12 is a Ring-Dyke of granophyre, distinguished from 11 by small phenocrysts of felspar and needles of augite. Probably 12 cuts 13, but this is not quite clear.

In Allt Molach, a Screen of doubtful tuff and lava separates 12 and 13.

Intrusion 13 is a great Ring-Dyke of quartz-dolerite, sometimes vesicular. It is freely cut by thin Late Basic Cone-Sheets.

Hill-slopes between Figure 52 and Figure 53

The main features of interest illustrated on the hill-slopes connecting (Figure 52) and (Figure 53) are:

a) The horizontal shifting of the ring-dykes by a fault which runs just south-west of the stream that rises on Monadh Beag. The fault and its effects are clearly shown on the one-inch Map.

b) The up ward bifurcation of the Ring-Dyke 9 of (Figure 52) a little south of the fault just mentioned. This interesting phenomenon is due to the contemporaneous employment of two ring-fissures by a single intrusion. Another example will be described presently in the case of the Glen More Ring-Dyke ((Figure 54), p. 322).

c) The upward transition of quartz-gabbro into granophyre in the two arms of the ring-dyke 9 (Chapter 30).

Anyone wishing to realize, without much expenditure of time, the continuity of the various ring-dykes, represented on the one-inch Map, will find very favourable exposures of the quartz-gabbro 3, where it shows through the grass as a long narrow ridge north of the fault referred to above. The felsite 6 is also admirably exposed, both north and south of the fault.

Maol nam Fiadh Figure 53.

(Figure 53) illustrates the geology of an interesting district south-east of Beinn Talaidh. The numbering of the ring-dykes is adopted from (Figure 52), already described.

Intrusion 1 is the Glen More Ring-Dyke. It enters the south-east corner of (Figure 53) as quartz gabbro. Northwards, it merges gradually into granophyre—at first, coarse-grained and acicular; farther on, fine-grained and acicular; and, finally, in the north slope of Coire Ghaibhre, fine-grained and non-acicular. This change is dealt with again in Chapter 30; here it is only necessary to point out that, though exposures are often poor, they are connected by a fairly continuous depression with rock rising on either side. In Coire Ghaibhre, the course of the Glen More Ring-Dyke is marked out in striking fashion. If, for instance, one looks from Torness on the Glen More road, one is impressed by the abrupt termination of crags of Beinn Bheag Gabbro (Chapter 22) against a grassy slope due to Glen More Granophyre. The crags just mentioned are themselves separated by-lanes of grass following the outcrops of Late Basic Cone-Sheets. Of course, the distant view does not show whether these sheets are cut by the granophyre, but, fortunately, clear stream-sections in Coire Ghaibhre prove that the granophyre is here untraversed by sheets; there can be no doubt, in fact, that the Glen More Granophyre cuts the host of Late Basic Cone Sheets, which intersect the Beinn Bheag Gabbro in neighbouring exposures, on either side.

Just west of the termination of the Glen More Ring-Dyke, granophyre of a similar type is met with, but may be distinguished by the fact that it is freely cut by Late Basic Cone-Sheets. Moreover, this granophyre is traceable south-westwards for some distance past the Glen More Ring-Dyke, so that there can be little doubt that the two are quite

different intrusions.

A large part of (Figure 53) illustrates a Screen which separates the northern terminations of 1 and 2. The main element in this screen is afforded by Late Basic Cone-Sheets, separated, here and there, by lenticles of lavas, dolerite, gabbro, etc. the lavas are porphyritic basalt, sometims with pillow-structure; the dolerite includes representatives of Early Basic Cone-Sheets; the gabbro in Coire Ghaibhre belongs to a severed continuation of the Beinn Bheag mass.

Intrusion 2 is the Ishriff Ring-Dyke of granophyre passing northwards uphill into felsite. In the stream-sections of Doir' a' Mhàim, it is seen to be free of the numberless Late Basic Cone-Sheets that figure so largely in the Screen just described. Traced towards its termination in Maol nam Fiadh, it is found to be cut by many Late Basic Cone-Sheets. The inference is that the more westerly cone-sheets of the Late Basic Group are here of later date than the more easterly (p. 229).

Between 2 and 3, a poorly exposed Screen intervenes. Tuff, and perhaps lava, are seen in the first stream north of the southern margin of (Figure 53); and some felsite in the second. Farther north, 2 comes against 3, only to part company again and expose agglomerate, which is eventually lost sight of among Late Basic Cone-Sheets.

Intrusion 3 is a Ring-Dyke of quartz-gabbro, which merges up-hill into granophyre (Chapter 30). The acid western part of 3 is freely cut by Late Basic Cone-Sheets. The junction of 3 and 6 was found exposed at two localities, but age-relations were not clear.

Intrusion 4 is a Ring-Dyke of granophyre. It is freely cut by Late Basic Cone-Sheets.

Between 4 and 6, stands a Screen largely composed of compact basalt-lavas.

Intrusion 6 is a Ring-Dyke of Felsite with small felspar-pbenocrysts. An isolated protrusion of 6 into the lavas of the Screen, just referred to, is interesting for its marginal development of a very perfect fluxion-breccia consisting of fragments of flow-banded felsite enclosed in a felsitic base. 6 is freely cut by Late Basic Cone-Sheets.

For a quarter of a mile, a coarse quartz-gabbro can be traced north and south almost across the outcrop of 3. It seems to be later than almost all the cone-sheets traversing 3 4, and 6 in its vicinity.

Intrusion 9 is a Ring-Dyke of sub-acid granophyre, which, in its down-hill continuation in (Figure 52), is represented by quartz-gabbro (Chapter 30), E.B.B.

Glen More Ring-Dyke: 1 of (Figure 52) and (Figure 53)

The Glen More Ring-Dyke, owing to its exterior position, is easily identifiable on (Plate 6) (p. 307). It consists essentially of quartz-gabbro with subordinate associated granophyre. Starting near Beinn Talaidh, the Ring-Dyke has a six-mile continuous arcuate outcrop through Glen More to Cruach Choireadail, where it branches, and, for a space, terminates ((Figure 54), p. 322). It is brought to light by erosion, again, in two valleys, Coir' a' Mhàim and Coir' an t-Sailein, situated either side of Corra-bheinn. It is hidden for a little beyond Coir' an t-Sailein, but then is traceable for a couple of miles northwest through Tòrr na h'Uamha; and, very probably, a northward continuation is to be recognized in (Plate 6), east of Beinn Fhada.

The complex relationships of the Glen More Ring-Dyke with the Late Basic Cone-Sheets have already been dealt with in Chapter 28 (p. 299), and the association of gabbro and granophyre at various points of the dyke supplies the main subject-matter of Chapter 30. Accordingly, the present account is mainly devoted to two other features, namely, the exposures which enable the intrusion to be followed in the field, and the very interesting branching phenomena evident in Cruach Choireadail, Coir' a' Mhàim, and Coir' an t-Sailein. (C.T.C), E.B.B.

Exposures

The northern termination of the Glen More Dyke has been sufficiently dealt with in the description of (Figure 53). South of this, along Glen More till Loch an Ellen is past, the exposures of the abbro are scattered owing to their separation by

spreads of moraine, peat, and alluvuim; but they are sufficiently numerous to introduce no significant uncertainty in drawing boundaries on the map. The most extensive of these exposures are met with:

1. About 100 yds. up from the Glen More road, on either side of an eastward flowing stream which crosses the road, 500 yds. south of the big bend near Torness.

2. Between the road and the valley-bottom, from Loch Sguabain to Loch an Eilein.

3. Above the morainic cover of the south-east slope between Loch Sguabain and Loch an Eilein. A junction with lavas is seen along this line, and the lavas are conspicuously traversed by white granophyric strings which likely originated, in some sense, from the Glen More intrusion. E.B.B, G.V.W.

West of Loch an Ellen, the Glen More Ring-Dyke consists in part of gabbro, in part of granophyre (see one-inch Map and (Plate 6)) The boundary between the two types is rather sharply marked, and does not show any definite tendency to follow the contours of the hill-slope. It is, therefore, an association which cannot be attributed simply to gravitational differentiation (see Chapter 30). (C.T.O.), E.B.B.

The granophyre of this complex part of the Glen More Ring-Dyke extends in a marked southwards bulge to the foot of Loch Airdeglais. A stream entering the loch from the west gives a very interesting exposure of the southern end of the bulge, and shows it to have a unique type of junction with the adjoining rocks—probably lavas. Instead of, as elsewhere, presenting an almost smooth boundary, the intrusion penetrates the country-rock in all directions as irregular veins. Perhaps, the acid strings, already commented upon, in the border-zone of lavas above Loch Sguabain and Loch an Eilein are part of this phenomenon, less strongly developed; Unfortunately, the connecting exposures east of Loch an Ellen are too poor to furnish detailed information. G.V.W.

From Loch an Ellen westwards and northwards, exposures of the discontinuous outcrop assigned to the Glen More Ring-Dyke are so numerous that they need not detain us in their enumeration.

Upward branching

The type-example of upward branching is displayed on the slopes of Cruach Choireadail, and is illustrated in (Figure 54) (p. 322). The Glen More Ring-Dyke at the bottom of the valley, roughly 500 ft. above sea-level, is 500 yds. wide. At 750 ft. above sea-level, it sends off a horizontal sheet in a south-westward direction. This horizontal sheet is roughly 600 yds. long and 400 ft. thick, and its horizontality is emphasized by its showing a vertical development of rude columnar jointing.. At the north-east end of the sheet, the parent dyke continues upward, now reduced to 300 yds. in width; while, at the south-east end, as it were to compensate for this reduction, an additional dyke rises, measuring 200 yds. across. Both of these upward dykes thin out completely when followed for half a mile north-westwards. This tapering can, in part, be ascribed town upward termination of the dykes; but, at the same time, it is clear that the dykes do not terminate upwards along horizontal lines, since nothing is seen of them in An Coireadail, west of the Cruach, and their next exposures, in Coir' a' Mhàim, are notably on lower ground.

(Plate 6) illustrates, sufficiently clearly, a tendency for both branches of the Cruach Choireadail exposure to manifest themselves in Coir' a' Mhàim and Coir' an t-Sailein, on the two sides of Corra-bheinn. Coir' a' Mhàim approximately reproduces the Cruach Choireadail phenomena of upward branching based upon a connecting horizontal sheet. In Coir' an t-Sailein, the two branches converge downwards upon one another.

It seems fair to claim these exposures as furnishing an occular demonstration of the simultaneous employment of two parallel fissures by the ascending magma of a ring-dyke. (C.T.C.)

Tòrr na h-Uamha

The Tòrr na h-Uamha outcrop does not show the branching phenomena just described; but it is grouped as part of the Glen More intrusion on account of its alignment and its similarity of lithological type. In Tbrr na h-Uamha, it is of basic character, whereas, in what appears to be its severed northward continuation, east of Beinn Fhada, it grades uphill

towards granophyre (Chapter 30). In its more westerly (and northerly) parts, the Tòrr na h-Uamha outcrop is very freely cut by Late Basic Cone-Sheets. This, at first sight, distinguishes it from the greater part of the Glen More intrusion; but, as already stated, a strikingly dual relationship in regard to Late Basic Cone-Sheets can be adduced within the limits of the Coir a' Mhàim outcrop (pp. 299, 313), so that it is independently certain that a fair number of Late Basic Cone-Sheets are later than the Glen More Ring-Dyke, although perhaps the majority are earlier. E M.A., J.E.R.

Ishriff Ring-Dyke

(2 of (Figure 52) and (Figure 53))

Several circumstances combine to emphasize the individuality of the Ishriff Granophyre. In fact, this ring-dyke is traceable for some four miles in arcuate outcrop from near Beinn Talaidh to the foot-slopes of Cruach Choireadail before it comes in contact with others of similar lithological type; and then it no can longer be singled out. In most of this course, it has gabbro of the Glen More Ring-Dyke, on its outer side, and a screen largely composed of lava, on its inner. On the slopes of Cruach Choireadail, a very well-defined narrow screen of baked rock, probably in large measure Late Basic Cone-Sheets, is interposed between the Ishriff and Glen More Ring-Dykes.

Allt Molach and a very minor neighbouring burn, north of Ishriff, give no exposures of the Ishriff Granophyre; otherwise, every little stream which crosses its outcrop—and there are four of them omitted from the one-inch Map between Ishriff and Maol Tobar Leac an t-Sagairt—reveals its presence. Hillside exposures are rare except on Maol Tobar Leac an t-Sagairt.

The Ishriff Ring-Dyke falls well within the period of Late Basic Cone-Sheets, as has been described already in relation to (Figure 53), and also in Chapter 28, p. 299. The age-relations of the Ishriff and Glen More Ring-Dykes have not yet been determined.

(C.T.C), E.B.B.

Beinn Chàisgidle

((Plate 6), p. 307).

In the central region about Beinn Chàisgidle, all the ring-dykes indicated in (Plate 6) are freely cut by Late Basic Cone-Sheets. In Socach a' Mhàim, the proportion of sheets is so overwhelming that the boundaries assigned to ring-dykes must be regarded as somewhat tentative. Elsewhere, they are sufficiently well-defined. From Màm an Tiompain along the Maol Uachdarach ridge, a feature, which helps greatly in the mapping of the ring-dykes, is the occurrence of conspicuous screens which are apt to weather out at the surface in low broken rocky ridges. These screens consist mostly of intrusive dolerites which have been to some extent brecciated by explosion before the advent of the ring-dykes. The screens also include a certain proportion of agglomerate and basalt-lava.

The contrasted relationships of ring-dykes and cone-sheets, in the Glen More and Beinn Chàisgidle districts, must not be taken as suggesting that the ring-dykes are of earlier date near the Beinn Chàisgidle centre, than they are towards the Glen More periphery. Very likely, it means no more than that the Late Basic Cone-Sheets, so prominently developed in Beinn Chàisgidle, are later than the great majority of those in Glen More (p. 300). J.E.R.

Petrology

The ring-dykes to be discussed in this chapter show, as an assemblage, a wide range of composition, passing from quartz-dolerite and gabbro, fairly rich in olivine-pseudomorphs in their more basic members, to felsite and granophyre, essentially composed of alkali-felspar and quartz. In several cases, such variations in composition are methodically linked together within the exposed limits of an intrusion in such a manner as to suggest differentiation of the mass in place. The detailed consideration of this side of the subject, is reserved for Chapter 30. In other cases, there is well-established evidence of assimilation, or hybridization, of one mass by another at, and near, their mutual contacts.

The following petrological account is primarily intended as a supplement to the field-descriptions, that have already been given, of (Figure 52) and (Figure 53). The opportunity is taken at the end of the section to describe somewhat fully the Sgùlan Type of olivine-bearing quartz-dolerite (qD of one-inch Map), since this particular variety does not figure prominently in other chapters of the Memoir.

In the following summary of petrological characters, the numbers 1 to 13 are used as in to distinguish various members of the ring-dyke-complex therein depicted.

Petrology of Figure 52 and Figure 53

Intrusion 1

The Glen More Ring-Dyke, in its extension to the west of the region shown in (Figure 52), has supplied most of the material for the petrological descriptions given in Chapter 30. Elsewhere, its intermediate and acid phases are represented by three specimens (S18673) [NM 6367 3430], (S18674) [NM 6367 3430], (S18675) [NM 6362 3427] obtained from the more southerly stream of Coire Ghaibhre ((Figure 53)). Two of these were collected at a point where a wall impinges on the stream from the south, and in them we have a reproduction of the augite-diorite type described in Chapter 18.

The other specimen, taken from a point further up stream, is a granophyre rich in oligoclase and soda-felspar.

Intrusion 2

The Ishriff Ring-Dyke has not been sliced.

Intrusion 3

A doleritic rock (S17428) [NM 6294 3133], collected from Allt Molach (Figure 52), shows a hypidiomorphic medium-grained type of crystallization of its constituent olivine, augite, and labradorite, with conspicuous early-formed magnetite, and a fair proportion of late-formed quartz. Olivine is entirely replaced by chlorite and serpentine, and the basic felspar is in large measure albitized. The rock, as a whole, agrees closely with the type of quartz-gabbro that forms the lower portion of the Glen More Ring-Dyke (Chapter 30). Followed to the north (Figure 53), it passes upwards, through an augite-diorite facies, into granophyre, but representatives of these intermediate and acid phases have not been examined microscopically.

Intrusion 4

A specimen (S17432) [NM 6279 3133] from this mass, as exposed in Allt Molach (Figure 52), is composed mainly of elongated crystals of albite, fringed with orthoclase and micropegmatitic growths. There is a small proportion of definitely individualized quartz, which generally occurs as irregular patches, but occasionally exhibits crystal-boundaries. The original ferromagnesian mineral was not abundant and is now entirely decomposed. A feature of the section is the occasional bending and breaking of the felspar laths. Such deformation has been noted in the case of other rocks of similar character.

Intrusion 5

An example, collected from Allt Molach (S17434) [NM 6269 3134] to the east of the cone-sheet lettered I in (Figure 52), is of a rock that approaches more nearly to augite-diorite (Chapter 18) than quartz-gabbro in composition, although mapped for convenience as qE. An early crystallization has led to a development of somewhat stumpy crystals of oligoclase with associated hypidiomorphic augite and magnetite, together with a few pseudomorphs after olivine. The oligoclase is zoned marginally by, and converted locally into, albite, and there is a residium of alkali-felspar and quartz. Apatite is an important accessory. The acicular type of crystallization, so frequently developed in rocks of this composition, is wanting in the slice (S17434) [NM 6269 3134]; but, in the stream section, the rock is seen to be variable in structure and sometimes acicular.

Contact 5–6

The Ring-Dyke 5 is represented by a specimen (S17437) [NM 6262 3135] collected from Allt Molach, where it is veined by Ring-Dyke 6. This in many respects reproduces features of the augite-diorites, such as cervicorn augite (p. 303), zoning and corrosion of andesine by alkali-felspar, and a fairly abundant acid mesostasis; but some of this acid mesostasis may have penetrated from 6, and one notes the influence of the latter intrusion in a development of granulitic clusters of augite and rhombic pyroxene, which, it is clear, in some instances have formed in the place of pseudomorphs after olivine.

Intrusion 6

A specimen (S17439) [NM 6267 3149], collected from the small tributary stream immediately north of Allt Molach (Figure 52), represents the small-felspar type of Ring-Dyke 6. It is a felsite in which the chief phenocrysts are little rectangular crystals of orthoclase and albite. These are accompanied by subordinate oligoclase and corroded augite, both of which may be cognate xenocrysts rather than porphyritic constituents. The matrix is composed of crowded minute equidimensional crystals of alkali-felspar set in a quartz-residuum that has little or no tendency towards micropegmatitic intergrowth with the neighbouring felspar. The section shows the rock to be veined with felsitic matter, and, on the field-evidence, it would appear that these veins are auto-genetic as far as the enclosing rock is concerned. Another specimen (S17438) [NM 6258 3136], taken as representing-the xenolithic facies of this ring-dyke as exposed in Allt Molach, is closely comparable to the felsite (S17439) [NM 6267 3149] described above, except that it is of slightly coarser texture and is crowded with xenoliths. Many of the xenoliths appear to have been derived from olivine-free basalt-lavas similar to those lettered B in (Figure 52). They exhibit a beautiful micro-granulitic structure of their component minerals—augite, felspar, and magnetite. Considerable-assimilation has been effected by the felsite, and all stages of contamination may be studied. One of the chief effects is the production in the felsite of a pyrogenetic greenish hornblende as minute crystals (Chap 33). Specimens (S18678) [NM 6308 3277], (S18679) [NM 6308 3277], (S18680) [NM 6308 3277], (S18681) [NM 6308 3277], (S18682) [NM 6308 3277] taken from the eastern side of the small detached mass of the Ring-Dyke 6, where it is exposed in the second streamlet to the north of the southern margin of (Figure 53), illustrate the intrusion-breccia which here constitutes the margin of the felsite. The chief fragments are of a fluxional rhyolite, such as might have formed on the rapid early consolidation of the ring-dyke felsite. There are also a few enclosures of olivine-free lava of basaltic composition. The matrix is generally of a felsitic character, but, exceptionally (S18681) [NM 6308 3277], quartz, in equidimensional grains, predominates over the alkali-felspar that functions as a base.

Screen 6–7

The screen, that separates the Ring-Dykes 6 and 7 in the Allt Molach section (Figure 52), has been so altered by these intrusions that its original nature is obscure. It is probably, however, of complex nature, in large measure consisting of Late Basic Cone-Sheets. A specimen (S17460) [NM 6241 3221] was collected at a point where the basic material of the screen was manifestly veined by more acid material, that appeared, in the field, to he attributable to the felsite 6. The microscope-section shows a medium-grained basic rock in which a porphyritic tendency of the original felspars can easily be detected. The structure of the rock as a whole is decidedly granulitic with augite, rhombic pyroxene (pseudomorphed), plagioclase, and magnetite, all well represented. There are areas, however, that simulate closely the ocellar structure of camptonites. These areas have a relatively coarse texture, and the minerals present are hyperathene, biotite, augite, quartz, and alkali-felspar. The hypersthene is restricted to the margins of the areas and occurs as stumpy crystals, occasionally unaltered, but more frequently replaced by fibrous hornblende. The biotite usually builds poecilitic plates that occur either at the margins of the areas, or in the adjoining granulite; it also appears as smaller crystals within the areas, and is always marginally corroded. Hornblende occurs in various forms. It is usually grown about the corroded augite, and is then of a deeply coloured, well-formed pyrogenetic type. The paler varieties of hornblende, also replacing augite, are clearly of later formation than the darker varieties where the two are seen in contact. Quartz and alkali-felspar show micrographic intergrowth. Altogether, these areas, which are interpreted as the result of the introduction of acid material from Ring-Dyke 6, reproduce characters described in connexion with the hybrid types dealt with in Chapter 33.

Another specimen (S17440) [NM 6257 3136], taken from the assimilation-zone that connects the screen with Ring-Dyke 7, reminds one of certain rocks entering into the composition of the granulitic zone that borders the Ben Buie Gabbro near Loch Fuaran (Chapter 22). It does not, however, permit of interpretation without the study of additional material.

Intrusion 7

The Ring-Dyke 7, as represented by a specimen (S17441) [NM 6255 3136] from Allt Molach (Figure 52), is of quartz-gabbro type, containing a few pseudomorphs after olivine.

Intrusion 8

Ring-Dyke 8, as exposed in Allt Molach (Figure 52), is a felsite (S17444) [NM 6237 3138] composed of crystals of microperthite and albite in a matrix of micropegmatite and free quartz. Groups of magnetite and augite crystals play a subordinate part. The augite is much corroded and frequently edged by an alkaline variety (aegerine-augite), and relics of a more basic plagioclase (oligoclase) may be detected as survivals in the centre of sonic of the more alakine felspars.

Intrusion 9

The Ring- Dyke 9 is represented by three specimens which were chosen to show the upward passage of quartz-gabbro into granophyre. The most basic of these (S17442) [NM 6217 3133], collected from Allt Molach (Figure 52) about 700 feet above sea-level, is an olivine-bearing quartz-gabbro. The intermediate variety (S17443) [NM 6244 3225], from Monadh Beag (one-inch Map), at a height of about 1550 feet above the sea, has the usual characters or these rocks, and is allied to the augite-diorites of Chapter 18. The highest specimen (S17461) [NM 6235 3234], from about the 1600 foot level on Monadh Beag, is a basic granophyre or craignurite. The types resemble those fully described in Chapter 30. Here it is only necessary to mention, that the sliced intermediate specimen (S17443) [NM 6244 3225] contains a xenolith of a type similar to the Late Basic Cone-Sheets, and that, by reason of assimilation, there has been a development of pyrogenetic hornblende as in the hybrids described in Chapter 33.

Intrusion 10

The Ring-Dyke 10 has not been sliced.

Intrusion 11

A specimen (S17445) [NM 6177 3133] of the Ring-Dyke 11, as exposed in Allt Molach (Figure 52), is a granophyre. It is made up largely of oblong crystals of albite and microperthite in a micrographic matrix that contains a fair proportion of free quartz. Augite and magnetite, never abundant, have suffered corrosion, and the augite is frequently replaced by green hornblende. The quartz sometimes shows crystal-outline, while epidote, chlorite, and acicular hornblende occur together in what, presumably, were drusy cavities.

Intrusion 12

The Ring-Dyke 12, near the head-waters of Allt Molach (Figure 52), is also a granophyre (S17446) [NM 6154 3145] which consists mainly of alkali-felspar with subordinate quartz, and contains pseudomorphs after acicular augite with associated magnetite. The felspar is albite and microperthite, and occurs as rectangular phenocrysts of various sizes, which sometimes have skeletal' outgrowths. The matrix contains irregular and acicular crystals of alkali-felspar and a fair proportion of micrographic material, that both edges the phenocrysts and occurs interstitially.

Intrusion 13

This Ring-Dyke introduces us to a somewhat special type of quartz-dolerite which is made the subject of the following description.

Sgùlan type of quartz-dolerite

Most of the intrusions lettered qD on the one-inch Map, belong to this type, and material is available for study and comparison from several occurrences:

1. The Sgùlan Mòr Ring-Dyke, numbered 13 on (Figure 52) (S17218) [NM 6098 3143], (S17448) [NM 6132 3146], (S17449) [NM 6132 3146], (S17924) [NM 6119 3160].

2.The southern projection of the Beinn Chàisgidle quartz-dolerite (S17925) [NM 5986 3236] into agglomerate, and the main outcrop of this dolerite (S17921) [NM 6073 3292], (S17922) [NM 6095 3292], (S17923) [NM 5994 3285] on the southern face of Beinn Chàisgidle.

3.Beinn nan Lus (S17980) [NM 5970 3985] within the arc of the Loch Bà Felsite Ring-Dyke of Chapter 32, and Beinn na h-Uamha (S17980) [NM 5970 3985] outside the same.

The Sgùlan Type of quartz-dolerite is distinguished from the quartz-gabbros described in Chapter 30. primarily by its finer texture. On this account, the dolerites in the hand-specimen are dark grey rocks, and do not show the pronounced black and white character of the gabbros. Texture is wonderfully uniform throughout intrusions of this type, even though some of the masses are of large dimensions. Another characteristic is a tendency to possess drusy or vesicular cavities that are usually invaded, at any rate marginally, by mesostatic material. This invasion of vesicular cavities by mesostasis has been recognized to be a common characteristic of quartz-dolerites and tholeiites ever since Sir Jethro Teall<ref>J. J. H. Teall, The Amygdaloids of the Tynemouth Dyke, *Geol. Mag.,* 1889, p. 481.</ref> drew attention to it in connexion with the Tynemouth Dyke of the North of England.

Under the microscope, sections in most respects show the same general characters as are met with in the quartz-gabbros and associated differentiates (Chapter 30). Some are definitely basic rocks with conspicuous small pseudomorphs after olivine, and contain only a subordinate amount of acid mesostasis (S17449) [NM 6132 3146]. Others are on the border-line between basic and intermediate (S17921) [NM 6073 3292], and thus lead to varieties (S17922) [NM 6095 3292] showing affinities with the basic members of the craignmites (Chapter 19).

The distinguishing fine texture of the Sgùlan Type, as compared with the quartz-gabbros, does not carry with it any essential difference in habit of the crystalline constituents.

The vesicles and druses alluded to above are frequently filled with quartz and chlorite in their more central portions (S17449) [NM 6132 3146], (S17921) [NM 6073 3292].

Where the rocks have been altered by the thermal action of neighbouring intrusions, the material filling the druses has been replaced in large measure by fibrous hornblende (S17925) [NM 5986 3236] or small crystals of augite (S17979) [NM 5856 3993], (S17980) [NM 5970 3985]. As a whole, the dolerites have suffered considerable alteration, especially in the replacement of olivine by chlorite and serpentine, and in the albitization of the basic felspars.

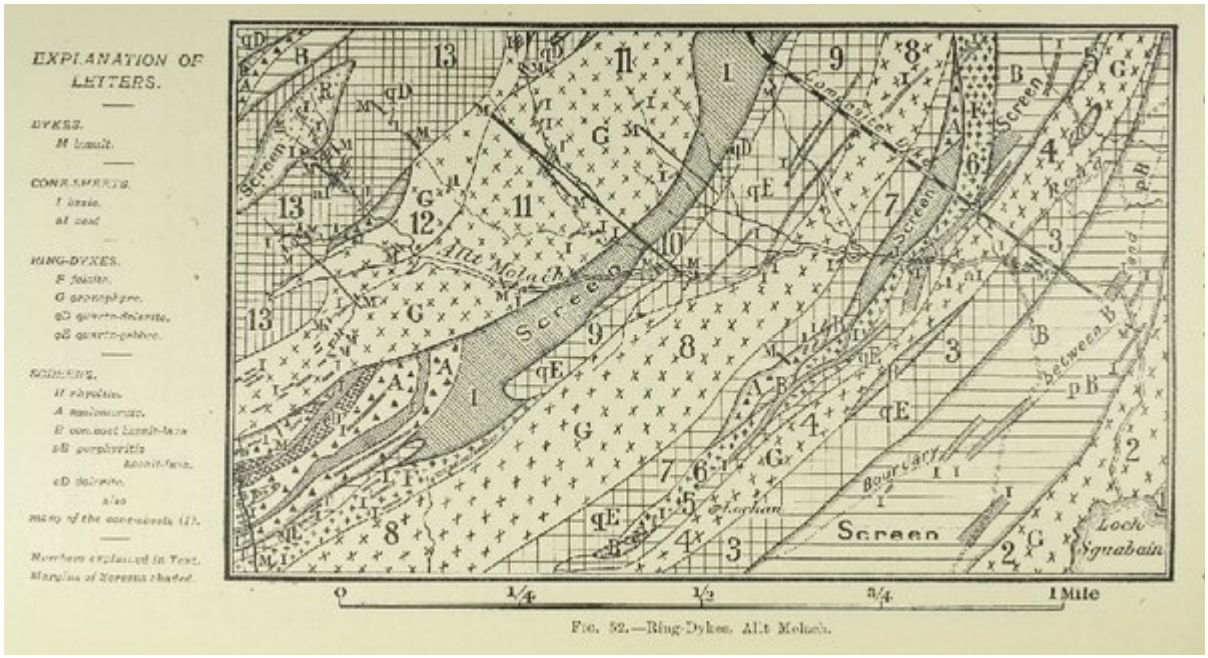
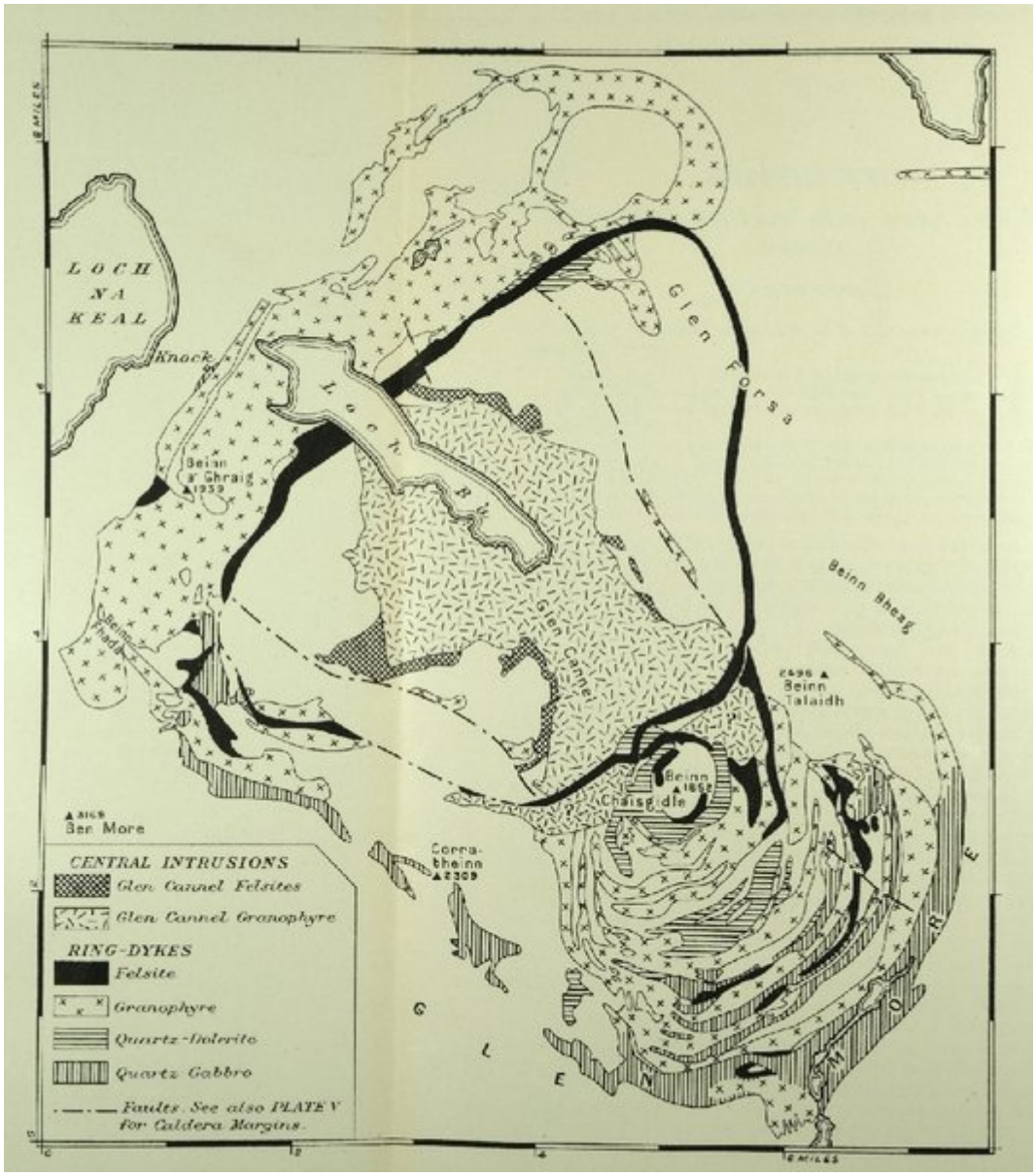


Fig. 52.—Ring-Dykes, Allt Melach.

(Figure 52) Ring Dykes, Allt Melach.



(Plate 6) Map showing ring-dykes

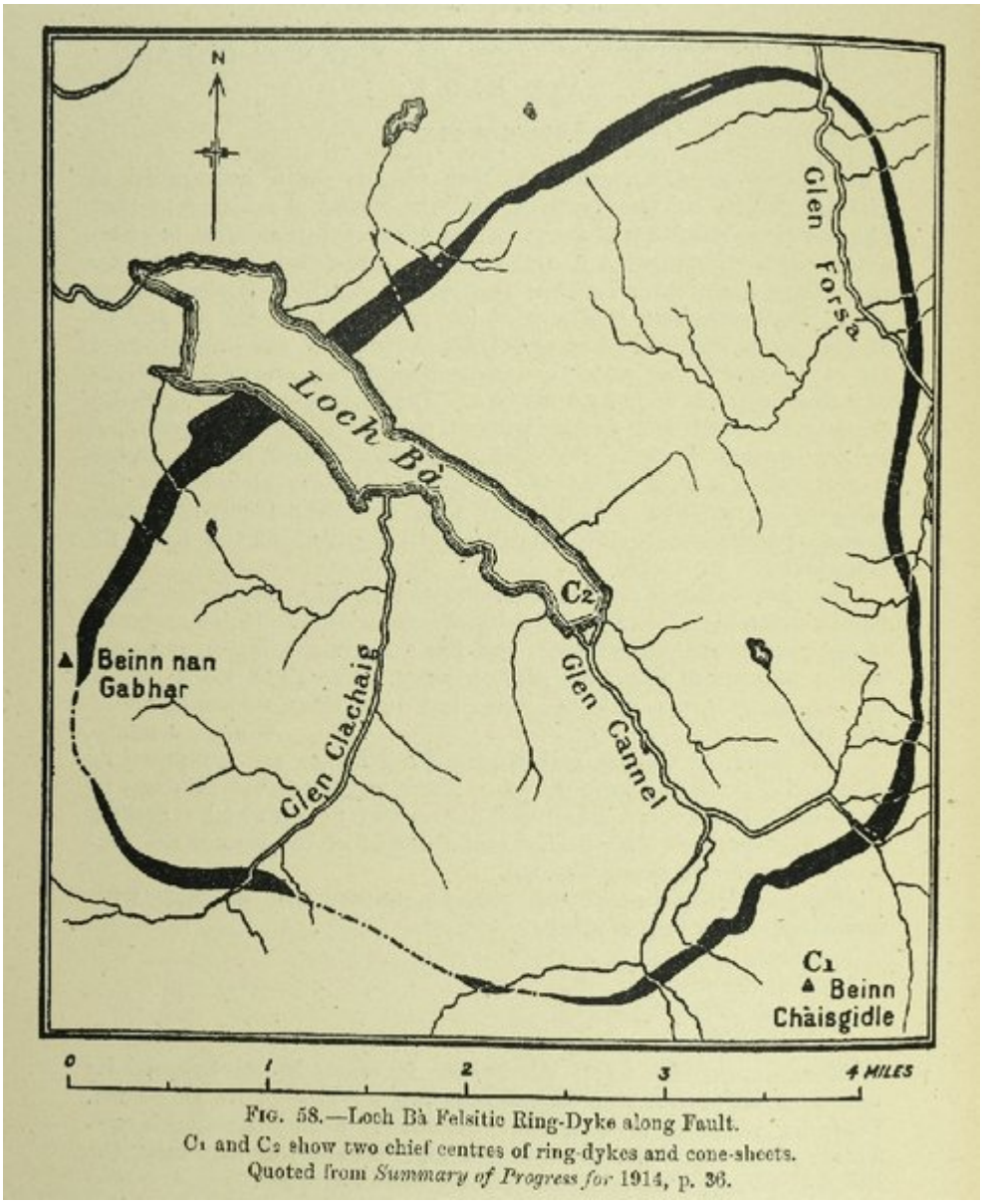


FIG. 58.—Loch Bà Felsitic Ring-Dyke along Fault.
C1 and C2 show two chief centres of ring-dykes and cone-sheets.
Quoted from *Summary of Progress for* 1914, p. 36.

(Figure 58) Loch Bà Felsitic Ring-Dyke along Fault. C1 and C2 show two chief centres of ring-dykes and cone-sheets. Quoted from Summary of Progress for 1914, p. 86.

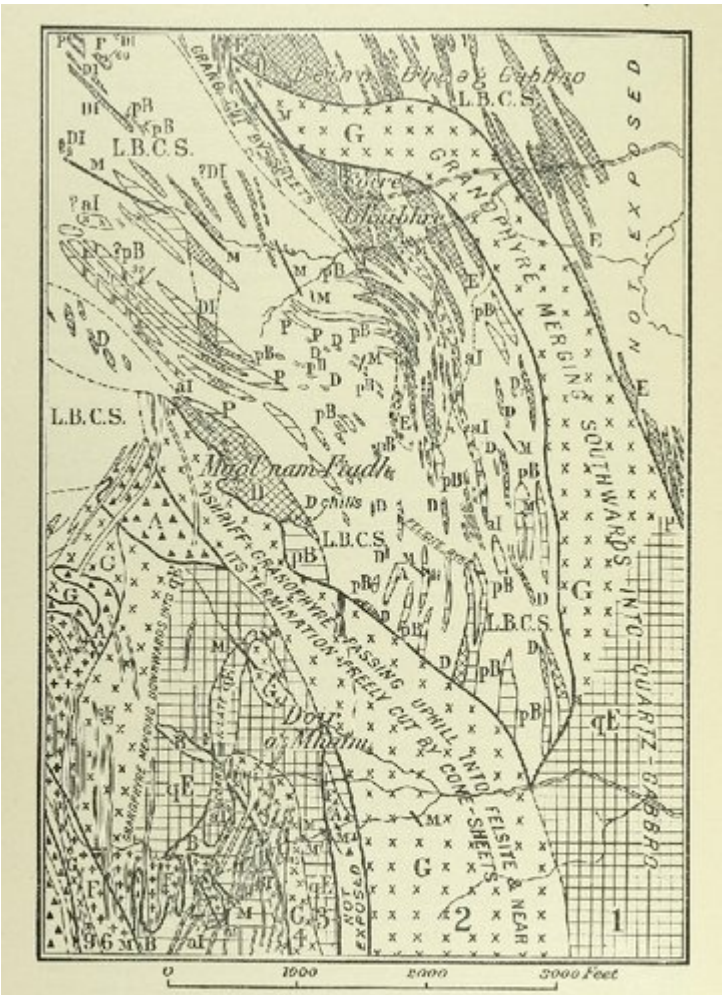


FIG. 53.—Ring-Dykes, Maol nam Fiadh.

Dykes: M basalt,

Cone-Sheets: DI dolerite; aI acid; L.B.C.S. Late Basic Cone-Sheets (shown without ornament).

Ring-Dykes: F felsite; G granophyre; qE quartz-gabbro.

Screens: A agglomerate; B compact basalt-lava; pB porphyritic basalt-lava; P pillow-lava; D dolerite; E gabbro; also many of the cone-sheets.

Numbers as in Fig. 52, *see* Text.

(Figure 53) Ring-Dykes, Maol nam. Fiadh. Dykes: M basalt, Cone-Sheets: DI dolerite; aI acid; L.B.C.S. Late Basic Cone-Sheets (shown without ornament). Ring-Dykes: F felsite; G granophyre; qE quartz-gabbro. Screens: A agglomerate; B compact basalt-lava; pB porphyritic basalt-lava; P pillow-lava; D dolerite; E gabbro; also many of the cone-sheets. Numbers as in Figure 52, see Text.

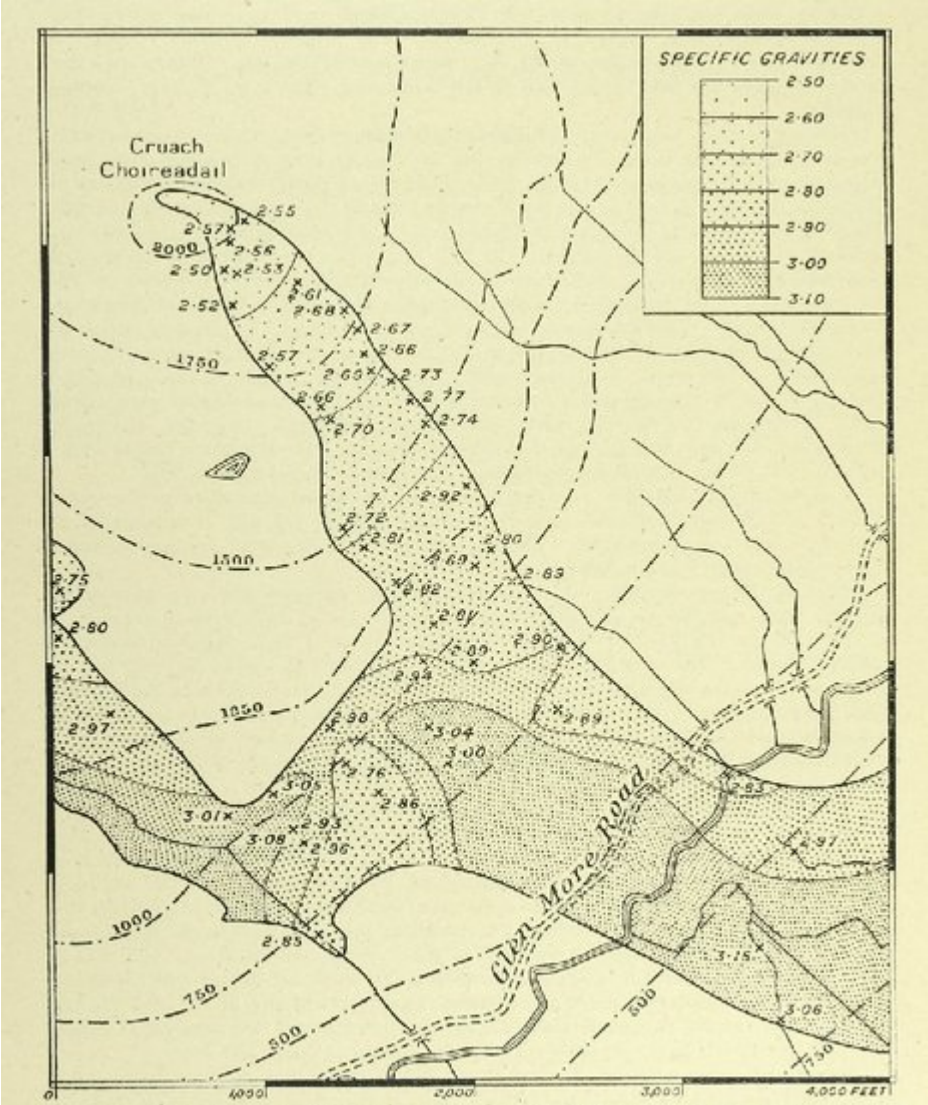


FIG. 54.—Map showing Density-Stratification in differentiated Ring-Dyke, Cruach Choireadail, Glen More (Locality 1). The extreme products exposed are olivine-bearing quartz-gabbro and granophyre.

(Figure 54) Map showing Density-Stratification in differentiated Ring-Dyke, Cruach Choireadail, Glen More (Locality 1). The extreme products exposed are olivine-bearing quartz-gabbro and granophyre.