Chapter 15 Rocks Of Lower Old Red Sandstone age plutons other than those of Glen Coe, Etive and Ben Nevis

Ultra-acid, acid and intermediate

Mullach nan Coirean [NN 123 663] and Meall A' Chaoruinn Granites

Let us start southeast of Loch Linnhe. The above-named two neighbouring bosses (2, (Figure 18), p. 129; (Figure 32)) just south of Ben Nevis, were mapped by Grant Wilson. Together they measure four miles by two; and both consist of a very pink or red medium-grained binary granite, much redder and with less ferromagnesian elements than the neighbouring Inner "Granite" (trondhjemite) of the Ben. They are, on the other hand, very similar to the Meall Odhar Granite of the Etive Complex (p. 171). The Mullach nan Coirean Granite is cut by a number of north-east dykes belonging to the Ben Nevis Swarm, so that it is earlier than the Inner "Granite" of Ben Nevis.

The resemblance of the Mullach nan Coirean and Meall a' Chaoruinn granites to one another is so close that it is probable that they are essentially one intrusion, and that the narrow strip of baked schist, forming the summit ridge between the two outcrops, may be regarded as part of the roof of a mass united below. This view is further favoured by the relation which seems to connect the sinuosities of the boundary of the Mullach nan Coirean Granite with the hill and valley system. It is probable, in fact, that we are dealing with a granite intrusion which has not yet been deeply bared by erosion. A similar example is afforded, it will be remembered, by the northern lobe of the Cruachan "Granite" where it penetrates the Cauldron-Subsidence of Glen Coe. E. B. B.

Moor of Rannoch "Granite"

The Moor of Rannoch "Granite" (7, (Figure 18)) is very conspicuous as the foundation of an extensive area of low-lying ground east of Sheet 53, and as such it early attracted attention. It enters Sheet 53 (Figure 32) for only a short distance between Blackwater Reservoir [NN 250 605] and Càm Ghleann. Much the greater part of its outcrop, measuring about 16 miles by 12, lies in Sheet 54 (Geol.), so that readers are referred to the corresponding memoir by Hinxman and others for a full description (1923, chapter 5). (Figure 18) of the present account brings out very clearly the geographical position of the Moor of Rannoch "Granite" in relation to the intrusive complexes of Glen Coe and Etive, numbered 6 and 8, and the lavas of Lorne, lying to the south-west. The Loch Laidon [NN 390 550] north-east fault is a sinistral wrench or tear-fault, which, though apparently earlier than the Lorne lavas, has strongly affected the Rannoch Pluton. The parts of this intrusion which lie north-west of the fault, including a detached outcrop west of Loch Tulla [NN 300 430], have been shifted some 4½ miles to the left as compared with the rest lying to the south-east (Read *in* Hinxman and others 1923, p. 63).

The main type represented in the Moor of Rannoch Pluton is a non-porphyritic slightly foliated pale grey hornblendic rock which is distinctly dioritic in appearance, save that it has large blebs of quartz standing out as knots on the weathered surface. These blebs are elongated along the foliation, as also are numerous lenticular dark inclusions.

Like the Starav Granite, it presents, in the district under consideration, a marginal porphyritic facies with which the interior non-porphyritic facies makes a merging contact. The marginal development is about half a mile wide, and, even apart from phenocrysts, differs from the interior in being pink, often free from hornblende and much less foliated — presumably it stiffened before the interior mass, full of crystals, had come to rest; but it still shows the characteristic blebs of quartz. Its porphyritic character is not very striking, and is due to the presence of fairly large pink felspars. H. K., G. W. G.

In the terminology adopted in the present edition, the main rock is tonalitic quartz-diorite, ranging to trondhjemite, where its abundant quartz takes it into the acid category; while the porphyritic facies is anything from trondhjemite, to biotite-granite approaching binary granite. To the east in Sheet 54 the porphyritic facies does not always occur at the edge of the pluton.

Although the porphyritic margin in Sheet 53 has been compared above with that of the Starav Granite, it should be noted that it is more acid than the nonporphyritic interior into which it merges, whereas at Starav the reverse is true. Still another arrangement, it will be remembered, holds in the Outer "Granite" of Ben Nevis, for there a more acid porphyritic interior merges outwards into a more basic non-porphyritic exterior, itself complex.

The margin of the Moor of Rannoch Boss in the neighbourhood of the Blackwater Reservoir [NN 250 605] crosses flat drift-laden country. It is well exposed, however, at Beinn a' Chrùlaiste where it is distinctly complex. To the south of this a narrow slice along the edge has been cut away by the Fault-Intrusion of Glen Coe. Under these circumstances it is not possible at present to express a firm opinion regarding three-dimensional shape. A strong suggestion, however, is afforded by scattered readings of the flow foliation. These were all taken in Sheet 54 (Geol.) though within a couple of miles of the western margin of the pluton; and they show that the foliation in this neighbourhood is everywhere steep or vertical, and that it swings round from a north-westerly strike in latitude 56° 39′ to a northeasterly strike in latitude 56° 42′. The more northerly observations were taken by E. M. Anderson. H. K., E. B. B.

It has already been pointed out that the Fault-Intrusion of Glen Coe is later than the Moor of Rannoch "Granite" (p. 165); and, of course, all or almost all the Etive Complex is later still. In agreement with this, dykes of the Etive Swarm cut the Moor of Rannoch "Granite" absolutely freely (Figure 18). Going back in time, one may recall how boulders with some particular features of marginal Moor of Rannoch "Granite" appear in a Càm Ghleann conglomerate belonging to the Glen Coe volcanic series (p. 147). All this suggests that the Moor of Rannoch "Granite" is one of the earliest igneous rocks of the district, though seemingly later than the lamprophyre sheets of chapter 16. It may still, along with these latter, quite well belong to the Lower. Old Red Sandstone suite, with which its position and lithology seem to connect it (p. 131). G. W. G.

Ballachulish "Granite"

The Ballachulish "Granite" (5, (Figure 18); (Figure 32)) also early attracted attention from geologists, which is not surprising since it furnishes a conspicuous exposure on the south shore of Loch Leven at Ballachulish Ferry [NN 053 598]. The whole mass measures five miles from north to south, and two from east to west. It was first carefully mapped by Grant Wilson, but without subdivision. Later, T. R. M. Lawrie has separated it into early grey quartz-diorite or tonalite, mostly marginal, and later pink granite, mostly central. His mapping, reproduced on Sheet 53 and (Figure 32), shows that the interior granite has two separate outcrops. In both it definitely cuts the quartz-diorite; but it is impossible to say whether or no its two separate portions are strictly contemporaneous. One of them appears to be a central core, the other an incomplete ring-dyke.

References to Ballachulish granite in previous literature concern the grey quartz-diorite. This is a medium-grained rock with small spangles of biotite and less conspicuous hornblende; and unlike many tonalites it is devoid of foliation. A conspicuous feature is provided by an unusual number of xenoliths in various stages of alteration (chapter 18), a character that recalls the Fault-Intrusions of Glen Coe. Many of these xenoliths correspond with the adjacent sedimentary schists, while others, Lawrie has found, may be matched in the abundant closely associated basic intrusions to be described later on in this chapter. Some of the basic inclusions are quite large, and a good example is exposed in the stream bed a mile up Gleann a' Chaolais [NN 040 570]. This evidence confirms, what is clear on the map, that the Ballachulish Quartz-Diorite has interrupted the distribution of the basic intrusions clustered about it. The quartz-diorite is itself cut by a few dykes, presumably belonging to the Ben Nevis Swarm.

The schists are not deflected by the presence of the Ballachulish Pluton along most of the exposed contact. On the western side, however, they are turned towards the north-west, just as they are along the north-west margin of the Ben Nevis Boss. As has been pointed out in connexion with Ben Nevis, there are two possible alternative explanations (p. 184). The schists may perhaps have been pushed outwards during the intrusions of the magma, or they may perhaps have been dragged downwards during development of a subterranean cauldron.

The presence of so many small xenoliths in the Ballachulish Quartz-Diorite suggests that there may have been much piecemeal stoping of the type advocated by Daly (1914), or else that explosion helped make the cavity now occupied by the pluton. In the latter case much country-rock may have been blown into the air, or poured out carried by xenolithic

lavas.

In a roadside quarry at Rudh' a' Bhaid Bheithe [NN 025 595], about a mile north-east of Kentallen pier, the Ballachulish Quartz-Diorite is separated from gritty Appin Quartzite by about 30 feet of quite unusual whitish "granite" cut by pegmatite veins. The "white granite" band is vertical, and F. Walker in an interesting paper treats it as a strictly localised marginal facies of the normal grey quartz-diorite (1924). Lawrie, however, has found that in most of its short course to the north-east the "white granite" is separated from the quartz-diorite by a strip of quartzite; and he thinks that it is better interpreted as an early dyke, possibly a ring-dyke. Walker describes a merging junction between "white granite" and quartz-diorite, whereas Lawrie found a sharp contact — which suggests that slightly different exposures may have been available to the two observers. At any rate, there is complete agreement that at both its margins the "white granite" contains dark hornblende and biotite which, towards the interior, are gradually exchanged for almost colourless varieties, while concurrently iron sulphide becomes abundant — magnetic according to Lawrie (*cf.* pp. 38, 251). In keeping with these observations Walker points out that Analysis 27, p. 207, of the interior "white granite" shows a third of the iron combined with sulphur. Apart from this special feature the analysis has been matched by J. G. C. Anderson (1935b, p. 251) with one of the Inner "Granite" of Ben Nevis. This point will be taken up again in chapter 17, where it will be claimed that the "white granite" is a fairly good example of trondhjemite.

Coastal granites, Inversanda [NM 940 595] to Rudha na h-Earba [NM 912 555]

Grant Wilson has mapped a multitude of red granite veins in the schists on the north-west side of Loch Linnhe. They characterise a coastal zone reaching south-west from the north border of Sheet 53 almost as far as Inverscaddle Bay [NN 025 680].

South of this (3, (Figure 18)), Grant Wilson has mapped a discontinuous series of elongated narrow granite bosses at intervals along the shore of the loch as far south-west as Rudha na h-Earba [NM 912 555]. The prevalent type is a bright red quartzofelspathic granite like that of Mullach nan Coirean [NN 123 663]. On the western shore of Camas Shallachain [NM 980 625] there is much felspathisation and *lit par lit* injection of the schists, apparently in connexion with this suite of red granite intrusions. The phenomena recall those already described in relation to the Fault-Intrusion of Glen Coe.

What is shown at Rudha na h-Earba [NM 912 555] as granite overlain by a small outcrop of conglomerate (see Sheet 53 and (Figure 18)) has been found by J. G. C. Anderson to be more properly described as felspathised Moine Schist with granite veins. The conglomerate is described in chapter 19.

Most of the granite outcrops along Loch Linnhe are considerably shattered owing to movement along the Great Glen Fault. To judge, however, from the alignmentof those mentioned above, there seems no doubt that they are not altogether earlier than the movement which has taken place along this dislocation.

Strontian "Granite"

A "granite" (4, (Figure 18)), long known to Scottish geologists at various localities, has been named after the village of Strontian in Sheet 52 (Geol.). It enters Sheet 53 for a short distance at Gleann Feith 'n Amean [NM 870 623], north of Glen Tarbert [NM 910 600], and to a greater extent along the shore of Loch Linnhe. Here, between Rudha na h-Airde Uinnsinn [NM 870 523] and Cilmalieu [NM 898 557] it makes a ridge called Druim na Maodalaich [NM 875 535].

The Strontian "Granite" as a whole is a major complex. To the south-east it is cut off by the Great Glen Fault (Figure 18), which, running along Loch Linnhe, must bring it and associated Moine schists against the little-metamorphosed limestone that builds the islands of Lismore [NM 870 440] and Shuna [NM 920 490]. As exposed north-west of the Great Glen Fault it measures 17 miles by 7.

Much the greater part of the complex lies in Sheet 52, with a southerly extension into Sheet 44, and the whole has been described by MacGregor and Kennedy (1932). These authors recognise three main members, which in order of time, position and increasing acidity are as follows:

1. Outer Member — tonalite, a medium- to coarse-grained grey biotite-hornblende-quartz-diorite, probably as a rule intermediate, and with a prevalent flow-foliation.
2. Mid Member — porphyritic "granodiorite", grey, but distinguished from (1) by flesh-coloured phenocrysts of perthitic orthoclase. The rock probably ranges from intermediate to acid.
3. Inner Member — biotite-granite, finer in grain than (1) and (2), pink in colour and acid.

Of these three the tonalite (1) is typically exposed in Gleann Feith 'n Amean [NM 870 623] and, just outside the border of Sheet 53, in Glen Tarbert [NM 910 600]; while the porphyritic "granodiorite" (2) makes most of Druim na Maodalaich [NM 875 535]; and the granite (3) provides bands that cross the schists of Glen Galmadale and, further south, cut the "granodiorite" (2).

Marked deflection of country-rock is shown in Sheets 52 and 53 in the course followed by the quartzite of the Moine Series which is mapped (in Sheet 53) across Gleann Feith 'n Amean [NM 870 623], Glen Tarbert [NM 910 600] and Creach Bheinn [NM 872 577] to reach almost to Cilmalieu [NM 898 557]. This deflection has already been referred to magmatic pressure of the Strontian Complex (p. 117).

A striking feature of the outer edge of the tonalite (1) in the Glen Tarbert [NM 910 600] neighbourhood, is its verticality. Another is the presence of a fringing zone characterised by innumerable small intrusions of a fine-grained pale-grey granite, too small to show on the map. In the same zone there is a multitude of little bosses of hornblendite and appinite, of earlier date than the tonalite, but obviously closely related thereto.

The Strontian Complex as a whole is cut by a few broad east-west dykes of salmon-pink felsite in addition to several later west-north-west Tertiary dolerites.

The lithological similarities shown by the rocks of the Strontian, Ben Nevis and Etive Complexes are so obvious that probably no one questions their being products of a single long period of igneous activity. At present they are tolerably close neighbours situated either side of the Great Glen Fault. If this latter is a wrench with 65 miles of horizontal displacement, the Strontian Complex may have formed at a much greater distance than now separates it from the other two (chapter 21); but this would not introduce any serious doubt as to its essential contemporaneity with them.

Thus we are led to accept the Strontian Complex as of Lower Old Red Sandstone age, with always the possibility that it may be a little older. The felsite dykes which cut it cannot, on the basis of experience elsewhere in Scotland, belong to any later period, unless possibly the Tertiary. The question, therefore, arises: why do these dykes run east-west instead of north-east parallel to the dykes of the Ben Nevis and Etive Swarms? No firm answer can be given. The difference of direction, as Richey has pointed out (1939, fig. 2, pp. 403, 410, 429), extends far beyond Sheet 53, and is in some way connected with the Great Glen Fault. It may, perhaps, be due to difference of age. (Figure 33) (p. 196) shows early felsite and andesite dykes in the Glen Coe region, which exhibit no tendency at all to adopt the direction later taken by the dykes of the same region forming the Etive Swarm.

Small plutons of appinite, biotite-augite-diorite, monzonite, kentallenite, cortlandtite

North-West of Loch Linnhe

Let us exclude the Glen Scaddle "epidiorite", considered in chapter 9. This still leaves, north-west of Loch Linnhe, the many minute outcrops of appinite (S10937) [NM 8922 6362] noted above as occurring in a restricted zone just outside the tonalite member of the Strontian "Granite" Complex, where this latter crosses Glen Tarbert [NM 910 600]. The geographical relationship is so definite (here and elsewhere in Sheet 52, Geol.) as to render it certain that the appinites concerned are pre-tonalite members of the Strontian Complex (MacGregor and Kennedy 1932, p. 107).

South-East of Loch Linnhe

In the portion of Sheet 53 south-east of Loch Linnhe all the rock types mentioned in the title of this section are so often and so closely associated with one another and with small outcrops of "granite" as to leave no doubt of approximate

contemporaneity. At the same time, if Sheet 53 stood by itself, there is no geographical connexion with a major "granite" pluton, which might not be ascribed to accident. Fortunately, however, we can turn back to (Figure 18), p. 129, which covers a much larger area; and here it is manifest that the Ballachulish (5) and Garabal (9) centres have functioned as significant foci about which most of the characteristic little basic bosses of the South-West Highlands are gathered. A suggestion of consanguinity between the basic intrusions known at the time from Sheet 53 and the Ballachulish quartz-diorite was first advanced by Teall (1897); and afterwards the same general proposition was strongly argued by Hill and Kynaston (1900). Now that the subject has been fully examined the conclusion seems inescapable. The evidence furnished by the Garabal centre will be found in Dakyns and Teall (1892), Hill and Kynaston (Beinn Bhuidhe area, 1900, pp. 535–43; also Hill *in* Hill and others 1905, p. 94; Kynaston *in* Kynaston, Hill and others 1908, p. 95), J. G. C. Anderson (Arrochar area 1935a; Glen Falloch [NN 360 230] area, 1937b) and Nockolds (1941). Independent confirmation can be derived from Anderson's demonstration that the Beinn a' Bhuiridh hornblende-mica-diorite is identical in composition with an Arrochar pyroxene-mica-diorite (Ana's. V and D, 1937a, p. 518). The Beinn a' Bhuiridh diorite, as (Figure 18) shows, is indisputably part of the Etive Complex. Supported by this finding it is reasonable, though not conclusive, to regard the basic intrusions between Beinn a' Bhuiridh [NN 093 283] and Glen Orchy [NN 260 350] and Loch Tulla [NN 300 430] as also belonging to the Etive centre. Two minute kentallenite outcrops near Loch Avich [NM 920 140] seem non-committal, but they have been, with probability, referred to the Loch Melfort [NM 800 120] centre (Hill and Kynaston 1900, pp. 534, 546; Kynaston *in* Hill and others 1905, p. 98).

We shall now restrict attention to Sheet 53 and start with isolated occurrences in the north.

Two very small outcrops of appinite are indicated in the map of Ben Nevis, (Figure 31). They cannot with any certainty be claimed as more than casual associates. They might for instance be interpreted as contamination products. The more southerly (S14046) [NN 135 716] constitutes a local marginal facies, only inches wide, of the porphyritic Subzone 4 of the Outer "Granite". It is seen in the large stream round which the tourist track zigzags on its way to the summit The more northerly was found by J. G. C. Anderson on a conspicuous crag 100 yards north by east of the hydro-electric surge-chamber (easily located on the ground). It merges into surrounding coarse quartz-diorite of Subzone 3.

Another tiny outcrop of appinite occurs, in isolation, a mile north-east of the summit of Binnein Beag [NN 222 677] (S14082) [NN 2271 6854].

The Ballachulish group of little basic bosses, mostly mapped by Grant Wilson and reproduced in (Figure 32), illustrates very well:

1. The tendency for close association of the various basic types with one another and with small "granitic" occurrences.
2. Their somewhat earlier age than the main Ballachulish and Etive Plutons.
3. The certainty that kentallenite and closely related biotite-augite-diorite have existed as rather potash-rich basaltic liquids charged with large phenocrysts of olivine and augite — this last point is revealed by the frequent occurrence of chilled basaltic facies full of big crystals of olivine and augite; and it supports the commonly held opinion that gravity-concentration of early phenocrysts may have played an important part in the development of kentallenite.

Beginning in the west we find appinite in Eilean Balnagowan (S7002) [NM 952 537].

Then on the mainland, a mile and a half to the south-east, a dyke of kentallenite (S8830) [NM 9668 5222] is met with in the glen draining west from Beinn Sgluich [NM 970 516].

Also on the mainland, but a mile and a half north-east of Eilean Balnagowan, Rudha Mòr supplies a shore section of biotite-augite-diorite (S7055) [NM 968 563].

Inland, two miles further north-east, Ardsheal Hill [NM 995 568], above Ardsheal [NM 995 574] House, has proved, on careful study by F. Walker, to be a veritable museum of types (1927). The summit-complex consists mainly of orthoclase-olivine-basalt passing into kentallenite, and of appinite passing into hornblendite. There is also a little granophyre — granophyric groundmass is a commonplace among appinites. Some of the summit appinite has green hornblende and may be intimately inter-banded with kentallenite, at the same time presenting sharp junctions. On the

other hand, towards the south, appinite with brown hornblende occurs, apparently penetrating into, and reacting with, kentallenite. Walker concludes that "there can be little doubt that both main types [appinite and kentallenite] originated from the same magma basin, and the change from a pyroxenic to a hornblendic facies may possibly be attributed to migration of aqueous and other fluxes produced, during crystallisation, in increasing concentration in the liquid portion of the magma". The only Geological Survey slice from the summit-complex is a biotite-augite-diorite (S7054) [NM 995 569] with more hornblende than usual. To the east of the summit-complex Walker has mapped five very small outcrops, one of granophyre, three of biotite-augite-diorite and one of kentallenite; while to the south he found a little patch of granodiorite (1927, fig. 2).

A mile further north-east, across Kentallen Bay, the type kentallenite (S7053) [NN 009 577] is exposed in a fair-sized roadside quarry. The railway adjoins and cuts through the outcrop, while Kentallen railway station and pier lie a little to the north. The handsome black kentallenite, once worked as an ornamental stone, is pierced by a few white felspathic segregations, which may be thin and straight, or broad and patchy (S15873) [NN 0105 5784]; (S15874) [NN 0105 5784]; (S15875) [NN 0105 5784]. Some of these veins carry large gleaming biotites which clearly link them with the parent kentallenite — they are not offshoots of the neighbouring Ballachulish quartz-diorite pluton. Similar felspathic segregation has been noted by Kynaston in the Glen Orchy [NN 260 350] kentallenite (*in* Kynaston and Hill 1908, p. 94).

The kentallenite of Kentallen [NN 008 573] was first described and figured by Teall in his *British Petrography* (1888, p1. xvi; 1), but without, at that early date, recognition that much of the felspar was orthoclase — as one might expect from the abundance of biotite. After it had been mapped by Grant Wilson for the Geological Survey in 1896, it was re-described by Teall, who pointed to its analogies with olivine-monzonite (1897, p. 22). In following pages of the report, in which this description occurs, reference is made to two similar outcrops mapped by Hill near Beinn Bhuidhe [NN 203 187] and Loch Avich [NM 920 140] in 1892 and 1896 respectively (Figure 18) — but localities were confused in 1897 (*cf.* Hill and Kynaston 1900, p. 502). Since then several additional exposures of this exclusively South-West Highland type have been encountered, making about a score, including one in Colonsay west of (Figure 18).

Still west of the Ballachulish Pluton one of the biggest of these small outcrops of kentallenite has been mapped by Grant Wilson in Glen Duror [NN 010 543]. It is described as much decomposed.

Now let us cross the Ballachulish Pluton. On its north-east side, Grant Wilson and Lawrie have mapped quite a few minute basic bosses within a mile north of Sgòrr Dhearg [NN 056 558]. The largest lies half a mile north of the summit and is kentallenite with a little associated appinite. Another, 300 yards north of the summit, is biotite-augite-diorite.

Two miles to the south, we find an irregular belt of appinite (S11364) [NN 0495 5322]; (S114434)-and appinitic diorite, which serves as an approximate south-east border to the quartz-diorite of the Ballachulish Pluton, occupying this position with a short break for almost two miles. It is sometimes in contact with the quartz-diorite, but is more often separated by a strip of Appin Quartzite or Leven Schist, much baked. Where the appinite belt projects eastwards it encloses a small outcrop of decomposed cortlandtite (S11442) [NN 0544 5288].

North-east of the tip of the appinite extension just mentioned, and a mile west of the mapped footpath leading south from Ballachulish, a tiny isolated exposure consists of biotite-augite-diorite, to the north, and of kentallenite, to the south.

Beyond this, for a mile along Allt Eilidh [NN 067 530] there lies a minor "granitic" boss. A slice (S11363) [NN 0690 5309] shows this to be trondhjemite, much like the Inner "Granite" of Ben Nevis. Grant Wilson noted abundant "pyrites", a feature recalling the "white granite" (trondhjemite) described west of the Ballachulish Pluton (p. 188). The Allt Eilidh [NN 067 530] trondhjemite is now flooded to give a fishpond, but Grant Wilson previously had found a small central outcrop of beautifully fresh cortlandtite (S11441) [NN 0516 5294].

A mile to the south, Glen Creran [NN 030 480] affords important exposures of three bosses of biotite-augite-diorite. The most south-westerly, between two houses, Salachail and Barnamuc, (S11362) [NN 0584 5094] is associated with two outcrops of kentallenite, which lie respectively at its north-western (S11357) [NN 050 504]; (S11358) [NN 050 504]; (S11360) [NN 0514 5009]; (S11361) [NN 0514 4998]; (S11435) [NN 0521 5056]; (S11438) [NN 0523 5057]; (S11445) [NN 0484 5030] and southern ((S11439) [NN 0519 4970], (S11440) [NN 0519 4970] extremities. Of the above (S11358)

[NN 050 504]; (S11435) [NN 0521 5056]; (S11438) [NN 0523 5057]; (S11440) [NN 0519 4970] are marginal kentallenitic types which show a strong contrast between large phenocrysts of olivine and augite and a fine-grained basaltic matrix. Grant Wilson collected (S11358) [NN 050 504] half a mile north of Barnamuc [NN 048 499] as the fine-grained edge of the northern kentallenite against the biotite-augite-diorite. This suggests that the kentallenite here is the later of the two — but possibly the kentallenite chilled against schist which was subsequently displaced by diorite. A neighbouring specimen (S11435) [NN 0521 5056], apparently collected in the bed of the River Creran [NN 060 510], is described as from a dyke cutting kentallenite. Both the chilled edge of the dyke (kentallenitic basalt) and the country-rock (kentallenite) are well seen in the slice. Taking the little complex as a whole, Grant Wilson found that the biotite-augite-diorite, as well as the two associated kentallenites, chills against external schist. One slice (S11359) [NN 0520 4994] shows that appinite is associated with the biotite-augite-diorite, but to what extent is not known. The specimen came from the Barnamuc [NN 048 499] tributary to the Creran, above a sheep-fold.

A quarter of a mile further up Glen Creran we find the middle member of the Creran trio, east of Salachail. A specimen has been analysed (S14113) [NN 0620 5109] and is so rich in potash that the rock has been classed as monzonite — all the biotite-augite-diorites approach this type. Grant Wilson again records chilling at contact with the surrounding schist.

Another mile upstream, the most easterly of the Creran trio is met with downstream from Corbhainn [NN 084 516] south of Meall an Aodainn [NN 080 525]. It is a particularly handsome rock (S11431) [NN 0757 5147], with conspicuous large green augite crystals scattered through a greyish white base. If more conveniently placed it would make a fine ornamental stone.

From the Creran trio we may now turn to a mile south-south-east of Barnamuc [NN 048 499], where Sheet 53 and (Figure 32) show a small boss of appinite one mile north-east of Glenure House [NN 043 481]. This is a generalisation, for much of the outcrop consists of a decomposed "granitic" rock, perhaps originally tonalite (S11432) [NN 0531 4856]; but marginal specimens are appinite (S11433) [NN 0510 4875]; (S11434) [NN 0526 4888].

A mile to the south-east again, in Glen Ure [NN 070 475], Kynaston found still another dioritic outcrop, in contact this time with the Cruachan "Granite". This proves to be baked biotite-augite-diorite (S10125) [NN 060 475], and the occurrence has already been described as showing that the "granite" is later than the diorite (p. 170).

Northwards once more, half way between Glen Ure [NN 070 475] and Glen Coe, Maufe mapped unusually basic kentallenite north-east of Ser na h-Ulaidh (S11573) [NN 1169 5239]; (S11574) [NN 1184 5233].

Then east of the same mountain, in the corrie of Gleann Chàrnan [NN 135 500], Kynaston found ultrabasic appinite (S8267) [NN 122 515], allied to hornblendite, cutting a coarse breccia made of schist. This breccia is shown on Sheet 53 as Old Red sediment, but reasons have already been given for interpreting it as explosion-breccia occupying a volcanic neck (p. 151).

Four miles to the north again, two small bosses of appinite (S11036) [NN 1152 5810]; (S11037) [NN 1158 5810] occur beside the old Glen Coe road near Leacantuim [NN 117 577] ((Figure 10), p. 70). With them there is closely associated biotite "granite", much decomposed. There are also acid segregation veins consisting mainly of quartz and felspar, often in micrographic intergrowth. A few long needles of hornblende grow in from their sides (S11906) [NN 1162 5817].

An augite-bearing diorite occurring along the inner branch of the Glen Coe Fault, at the south-east corner of the Cauldron-Subsidence is mapped as Early Fault-Intrusion in (Figure 29), p. 164. It is a hornblendic rock, with small augites (S9133) [NN 257 490]; (S13406) [NN 250 489], and is not very like the biotite-augite-diorite of the little bosses listed above. On the other hand, it is well-nigh identical with the Beinn a' Bhuiridh diorite (S7603) [NN 088 281]; (S7604) [NN 085 277]; (S8265) [NN 116 284]; (S8266) [NN 09 28]; (S9018) [NN 0810 2756] described by Kynaston at the south-east corner of the Etive Complex (*in* Kynaston, Hill and others 1908, p. 85); and this it will be remembered has been matched chemically with a small boss of biotite-augite-diorite from Arrochar (p. 191). E. B. B.

VOLCANIC ROCKS: *Ben Nevis, Glen Coe, Lorne*
BASALT, ANDESITE, RHYOLITE.

DYKES: *Mostly of Nevis and Etive Swarms.*
PORPHYRITE, MICRODIORITE, LAMPROPHYRE, PORPHYRY.

INCLINED SHEETS: *Loch Fyne.*
QUARTZ-PORPHYRY.

ULTRA-ACID, ACID and INTERMEDIATE PLUTONS.
GRANITE, QUARTZ-DIORITE: 1 *Ben Nevis*; 2 *Mullach nan Coirean*; 3 *Loch Linnhe*; 4 *Strontian*; 5 *Ballachulish*; 6 *Glen Coe*; 7 *Rannoch*; 8 *Etive*; 9 *Garabal*; 10 *Loch Melfort.*

BASIC and ULTRA-BASIC PLUTONS, *including a few giant xenoliths*
APPINITE, MONZONITIC AUGITE-DIORITE, ETC., including
K = *KENTALLENITE.*

FIG. 18. Map of igneous rocks of South-West Highlands referred to Lower Old Red Sandstone Period

(Figure 18) Map of igneous rocks of South-West Highlands referred to Lower Old Red Sandstone Period.

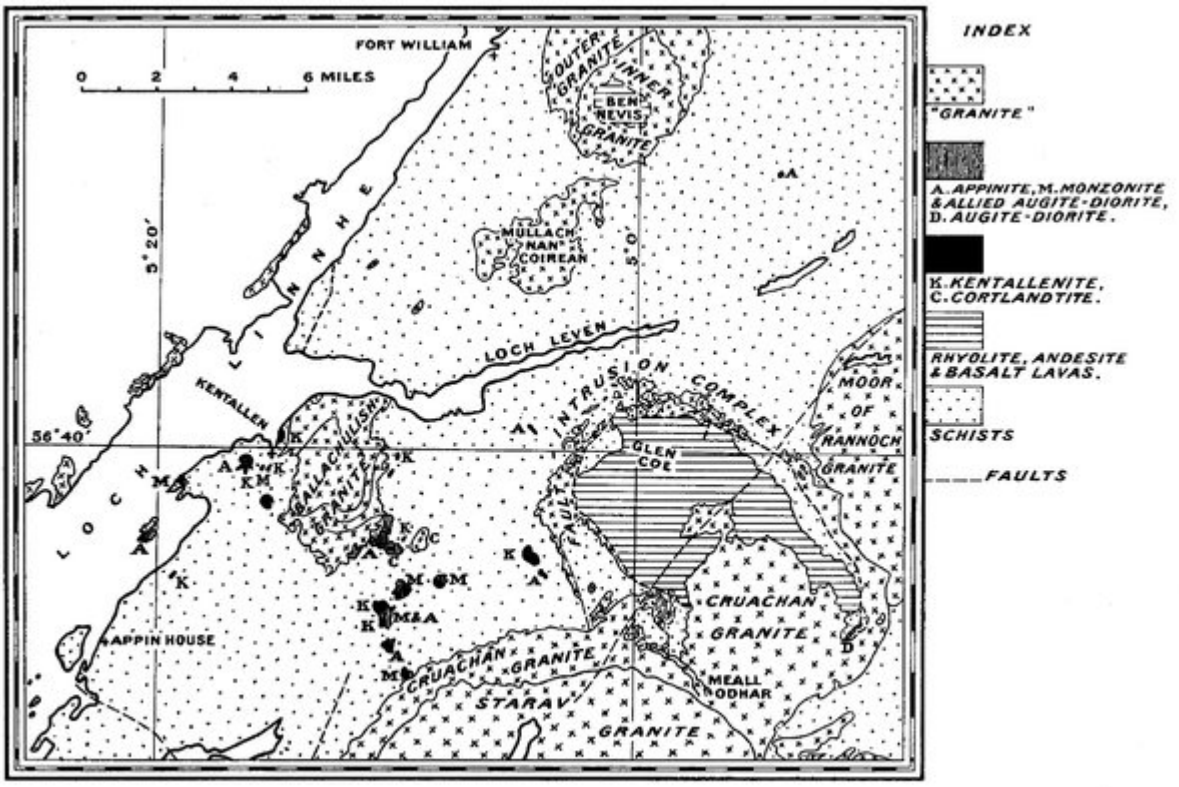

FIG. 32. Map of plutonic and volcanic rocks of Sheet 53 referred to the Lower Old Red Sandstone Period

(Figure 32) Map of plutonic and volcanic rocks of Sheet 53 referred to the Lower Old Red Sandstone Period.

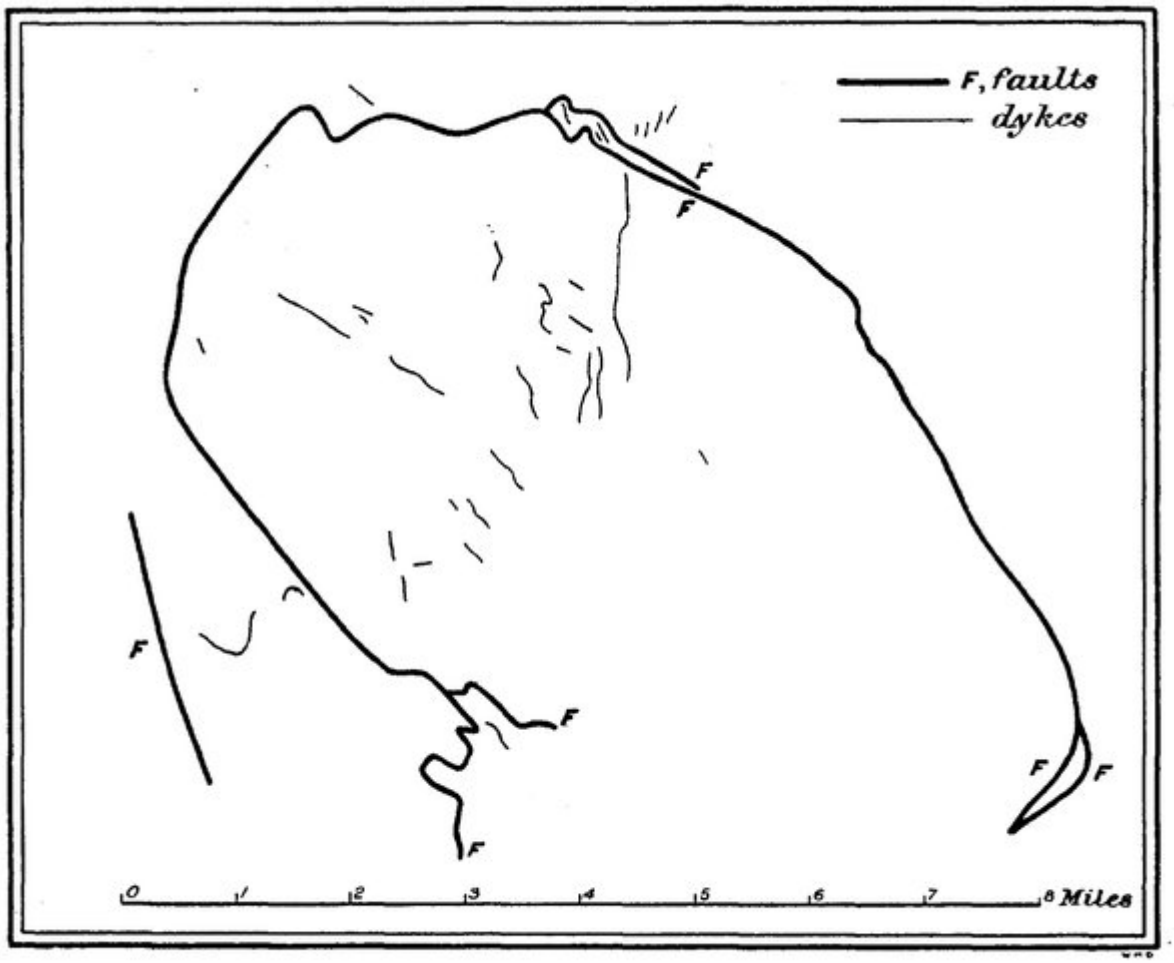

FIG. 33. Map of early felsite and andesite dykes of Glen Coe

(Figure 33) Map of early felsite and andesite dykes of Glen Coe.

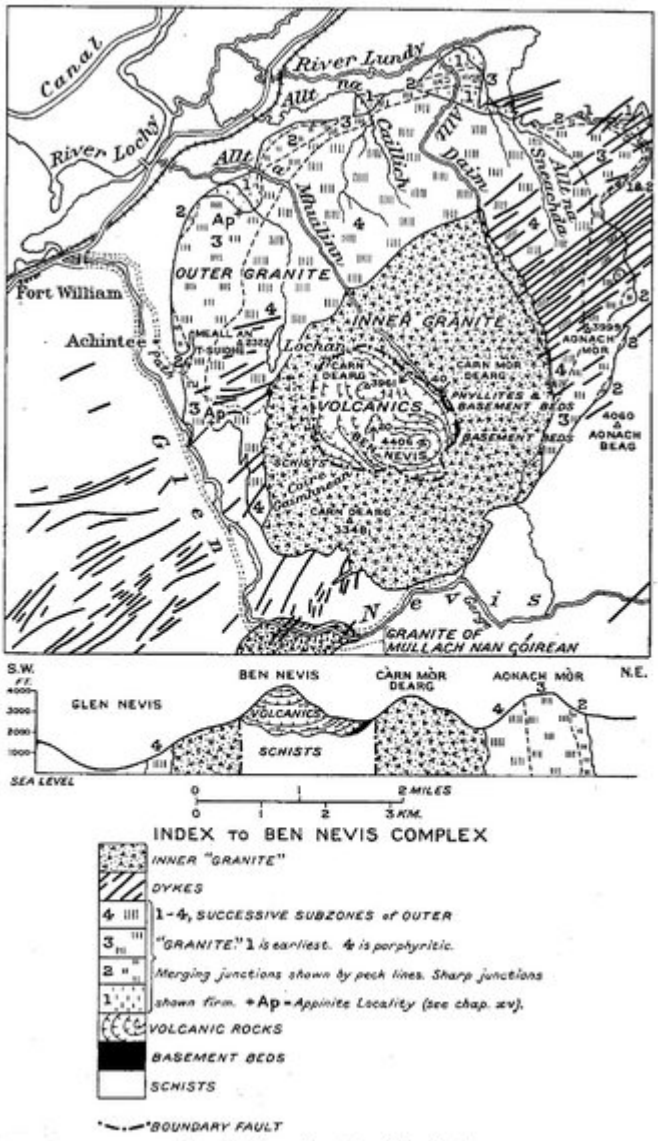

FIG. 31. Map and section of Ben Nevis

(Figure 31) Map and section of Ben Nevis.

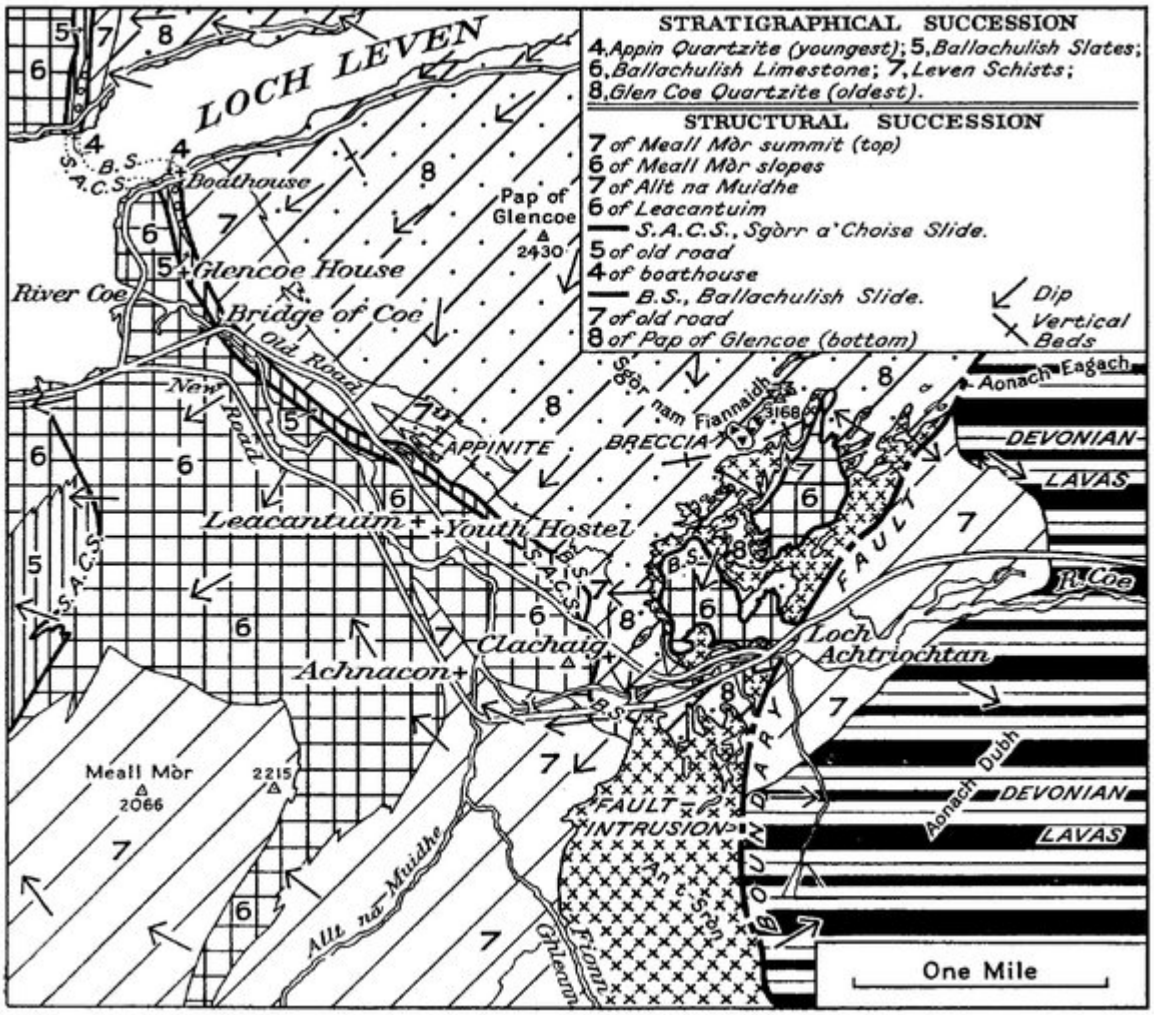

FIG. 10. Map of Lower Glen Coe

(Figure 10) Map of Lower Glen Coe.

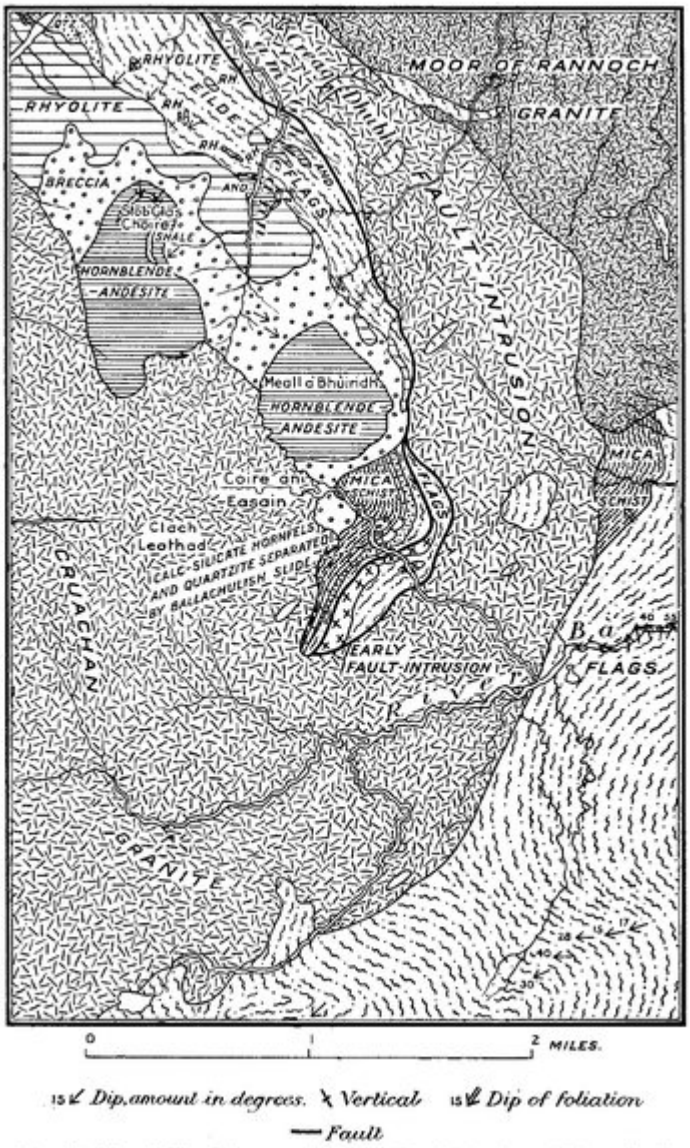

FIG. 29. Map of Càm Ghleann and Coire an Easain. North-east dykes omitted

(Figure 29) Map of Càrn Ghleann and Coire an Easain. North-east dykes omitted.