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## Chapter 11 Gruinard district

By the late William Gunn, with notes by B. N. Peach, J. Horne, C. T. Clough, and E. Greenly. The district described in this chapter is shown on Sheets 91, 92, and 101 of the Geological Survey Map of Scotland on the scale of (1:63360) one inch to a mile.

The district of Lewisian gneiss now to be described stretches from Enard Bay across the Coigach Hills and the mouths of Loch Broom and Little Loch Broom to Gruinard Bay, and thence inland southwards to a line drawn through Loch an Eilein, Loch na Moine Buige (the north-western branch of the Fionn Loch), Feachaisgean on the east side of Fionn Loch, the northern slopes of Beinn a Chàisgein Mòr, Lochan Feith, and a little south of Lochan a Bhràghad, to the head of Gleann na Muice. Several patches of thrust Lewisian gneiss, in the neighbourhood of Ullapool and in Strath Kanaird, which lie far to the east, will also be included in this chapter.

The patches of moved gneiss near Ullapool and in Strath Kanaird, as well as those unmoved inliers in Coigach, in the islands in Loch Broom, and near the entrance of Little Loch Broom, form comparatively low ground, though one of the masses south of Ullapool rises to about 1250 feet above sea-level. South of Gruinard Bay the undulating craggy ground east of the Gruinard River rises to 985 feet above the sea in Carn na Beiste, and to 1283 in Carn nam Buailtean. West of this river is Creag-Mheall Beag ([S1139](#)) [NS 764 820], whence the ground mounts up rapidly to the southward, until in some places near Loch Toll a' Mhadaidh it reaches above the 2250 feet contour-line. Beinn a' Chaisgein Beag, the most conspicuous isolated hill in the district, is 2234 feet. Nearly all the ground west of the Little Gruinard River is below 700 feet. The only important streams are the Gruinard River which runs through Loch na Sheallag, the Little Gruinard River draining the Fionn Loch, and the Inverivanie River which comes from Loch Toll a' Mhadaidh. The stream which flows down Gleann na Muice, a tributary of the Gruinard River, forms the south-eastern boundary of the district.

Though most of the gneiss-ground is here comparatively low, it is generally rough and rugged, forming low, steep, rocky hills, somewhat rounded in outline, but usually free from glacial drift, with deep intervening hollows, not seldom occupied by freshwater lochs. The general types of rock in this district agree in character with those described in the previous chapters. The prevailing type is a coarsely crystalline, grey, acid gneiss, generally containing biotite, sometimes also muscovite. In the southern part of the district the foliation is in the main well defined, with a fairly regular W.N.W. or north-west strike and a dip towards north-east. In the northern tracts, however, the foliation is often very rude and irregular, and the strike exceedingly variable. Often the gneiss is of a massive character, and in places merges into granite, with no trace of foliation. It is there that the largest basic and ultra-basic inclusions occur.

The gneiss generally presents many knots and lenticles, as well as large inclusions of a basic character, both massive and foliated. In a few places it contains large masses of peridotite or serpentine, pyroxenite and hornblendite, as well as pyroxene granulite, as in the ground to the north already described. It is traversed by numerous epidiorite dykes trending generally towards north-west or W.N.W. In the northern tracts these dykes are generally massive, while towards the south many of them have been wholly or partly converted into hornblende-schist. That they are not all of one age is proved by the crossing of one set by another. Another series of dykes of a green colour, weathering into rounded forms containing much biotite, are less acid than the epidiorites and more irregular in their course, which approaches more nearly to an east and west direction. They are cut through by the epidiorite dykes, and are therefore of older date.

To the east of the Gruinard River there lie bands of a finer-grained granulitic, regularly foliated gneiss containing abundance of white mica, and numerous quartz-veins which are not common in the cruder gneiss. The most important of these bands has a width, in places, of more than a hundred yards, and can be traced for more than a mile in a south-east direction. It displays a vertical foliation, and may be regarded as the result of the shearing movement which has also affected certain dykes, converting them into hornblende-schist.

Connected with the gneiss of this district a remarkable band of rocks of somewhat doubtful origin, but possibly sedimentary, stretches from near Beinn Dearg Bheag to Loch na Uidhe (one mile and a half S.S.W. of Little Gruinard), a distance of seven miles, with a width, in some places, of 200 to 300 yards. At both ends it apparently disappears under

the Torridon Sandstone. It includes quartz-rock and quartz-schist, quartz-hornblendeschist, hornblende-biotite-schist, and garnetiferous amphibolite, as well as fine-grained micaceous gneiss. These rocks are therefore much older in date than the movements which produced the granulitic micaceous gneiss east of the Gruinard River.

## Ultra-basic rocks of the Fundamental Complex

The rocks of this class include masses of serpentine and peridotite, various kinds of hornblende and pyroxenite, as well as knots or lenticles of hornblende and actinolite. The hornblende knots and lenticles are found in many places all over the district, and form one of the characteristic features of the gneiss. They are too small to be noted on the maps, and their general relation to the gneiss may be most conveniently studied in connection with the still more numerous class of basic inclusions into which they imperceptibly pass. The larger ultra.-basic masses, however, require a more detailed description. To the east of the Gruinard River these larger masses may be seen at Lochan an Daimh, 1½ miles E.N.E. of Gruinard House, and near the course of the stream which runs to the west of Carn na Beiste; in the Inverianie River east of Loch an Fhamhair, and by the side of a small loch 200 yards further north. Other masses occur to the west of Loch an Fhamhair, while a broad band stretches from a point on the Little Gruinard River, 1½ miles south of the bridge, nearly as far as Loch a' Mhadaidh Mor. Several bosses occur 350 yards west of the last-named loch. One of the most important of the masses lies on the west side of the Little Gruinard River near its mouth; another occurs as far south as Feachaisgean on the Fionn Loch. The rocks of this class are massive in character, usually dark in colour, but sometimes pale grey, brownish, or green.

At Lochan an Daimh, a mile and a half E.N.E. of Gruinard House, a black ultra-basic rock is well exposed from 50 to 100 yards south-west of the lake. It recalls the banded pyroxenites and hornblendites of the neighbourhood of Scourie.

One specimen ([S4459](#)) [NG 981 925] was found to be rich in hypersthene. Its other principal constituent is hornblende, and it contains, in addition, augite, olivine, and some magnetite. Another sample ([S4460](#)) [NH 981 925] of a somewhat different type is remarkable for the amount of olivine it contains, which is far in excess of any other constituent. These dark massive ultra-basic rocks are almost the only examples reported from this district in which olivine occurs in the Fundamental Complex in considerable amount. They may be described as olivine-hornblende-pyroxenites, but the specimen ([S4460](#)) [NH 981 925], which contains little or no hornblende, may be called olivine-pyroxenite.

Small masses of ultrabasic rock, which appear at several places in the ground east of the Gruinard River and south of Lochan na Cairill, are mostly dark-coloured pyroxenite or hornblendite, or grey peridotite, but they include such varieties as olivine-augite-rock (wehrlite), and lherzolite ([S8735](#)) [NG 978 893], ([S8738](#)) [NG 984 888]. Between the Inverianie and Little Gruinard Rivers also several bands and oval masses of peridotite and hornblende-pyroxenite make their appearance, often associated with early basic material.

By far the largest and most important of the ultra-basic masses that form part of the Fundamental Complex in this district *lies* to the west of the Little Gruinard River near its mouth. Its northern extremity is about 200 yards due south of the summit of the steep road, the spot which goes by the name of the Cadha Beag, and its general course is west of south from this point. The length of the mass is nearly two-thirds of a mile, and the breadth varies from 40 to 170 yards. The mass is mainly composed of one variety of material, a massive dark hornblende-rock, penetrated in places by bands and strings of light-coloured quartz and felspathic material. This acid material has much of the appearance and character of a pegmatite, but is of quite a different age from the rocks usually classed as pegmatites, and is in fact identical with much of the crude acid gneiss of the district. The black hornblendic mass, moreover, is traversed by ordinary pegmatites of the usual character, and is cut by three epidiorite dykes which cross it in a north-west direction. Masses and lumps of hornblende-rock, similar in character to the larger mass, occur in abundance in the surrounding gneiss, which, near the ultra-basic mass, has a vertical foliation, the strike of which is nearly parallel to the longer axis of the latter.

Masses of pale-coloured brown-weathering peridotite-like rock occur in several places on the western side of Loch Fada (two miles south-west of Little Gruinard). The largest of them, nearly 100 yards long, lies more than half a mile from the southern end of the loch, and about 150 yards from the loch side. The peridotite masses seem to occur as "eyes" in the gneiss, in the same manner as the knots of diorite and hornblende.

On the north-east side of Beinn Dearg Bheag, close to the margin of the basic gneiss, where it alternates with strips of acid gneiss, two masses of a very singular rock make their appearance. It is soft, saponaceous, and light coloured, probably composed chiefly of talc or chlorite, together with another light-coloured mineral. Some of it is purple ( ?penninite), probably from oxidation. The gneiss on each side is of an unusual appearance, probably from the presence in it of some of this peculiar mineral which, however, has not yet been determined.

The only example of pyroxene-granulite observed in the Lewisian Gneiss of this district was obtained from the neighbourhood of Gruinard. House. To the south of the little stream which crosses the road near the keeper's house, and close to the east side of the road, there may be seen an oval boss of dark-coloured rock about 50 yards in length. It contains the same pyroxene and hypersthene as the black pyroxenites from Lochan an Daimh, and the presence of garnets makes it resemble the pyroxene-granulites from the Lochinver, Scourie, and other districts. It is a hornblende-pyroxene-granulite.

## Early basic rocks of the Fundamental Complex

The rocks of this class which contain felspar are more acid than those which have just been described, but their mode of occurrence in the Fundamental Complex is very similar; indeed, the two classes of rocks often occur together, and sometimes pass into one another by almost insensible gradations. The basic rocks include pyroxene-granulites, massive diorites, and amphibolites, the ordinary basic knots both foliated and unfoliated, and larger masses of somewhat the same character as the knots which will be described as basic gneiss. The ordinary basic "knots" are almost universally distributed over the district, and it is not usual to find any considerable section of the gneiss, without examples, though in some places they are much more numerous than in others. In comparison with these knots the larger masses of basic gneiss are rare. The principal places where they are found are on the west side of Loch Fada, to the north of Loch a' Mhadaidh Mor (two miles S.S.E. of Little Gruinard), and around Beinn Dearg Bheag, on the south side of Loch na Sheallag, especially east and west of the northern flank of that mountain, where the largest and most numerous examples may be seen. Less important masses lie to the north of Loch Toll an Lochain.

The mass of which the relations are most clearly exposed crops out about  $\frac{1}{4}$  mile E.N.E. from the northern end of Loch Ghiubhsachain (west of Loch na Sheallag), where it forms an irregular oval 350 yards by 250 yards, the longer axis lying north-east ([S6350](#)) [NH 008 816]. The rock of which it consists is well-foliated and often a rather evenly-banded basic hornblende-gneiss. Some portions are so dark as to be scarcely distinguishable at first sight from the basic dykes, but differences in structure and even in the form and habit of the hornblende become apparent on further examination.

Three leading facts about these early basic rocks deserve notice — (1) their foliation is parallel to that of the acid gneiss; (2) they have a north-east strike; and (3) they are cut by the basic dykes. All round their Margins the surrounding gneissose foliation bends, so as to conform with them; in no case was any discordance between the two rocks detected. Long strips and lenticles of acid gneiss are included in them and conform to the trend of the basic rock. Their strike is decidedly north-east, or rather somewhat "crescentic": tending to east on the northeastern extremity, to which the general form of the mass conforms. They seem thus to act like eyes or nuclei of resistance to the general flow of the acid gneiss, whether we regard that as a fluxion or as due to mechanical movements. They would thus appear to be older than the acid gneiss, and therefore the oldest rocks of the district.

Finally, there can be no ambiguity as to the relation between these basic gneisses and the basic dykes, which, even when the composition of the two rocks may be very nearly the same, can be traced straight through them, as uninterruptedly as through the acid gneiss. There is not the smallest indication of their being, the source of the dyke material, and a vast interval of time must have elapsed between the two, for the whole gneissose system was complete before the dykes forced their way into it. A specimen. showing the junction of one of the dykes with the foliated diorite, is in the collection at Jermyn Street. The dykes can also be clearly seen to cross the junction of the basic and acid gneisses.

On the east side of Lochan na Bearta (three miles east of Fionn Loch), a narrow zone of gneiss includes some thin sub-parallel bands of compact yellowish-green epidiorite with long slender prisms of black actinolite. The zone extends for about a quarter of a mile in a south-west direction, and varies up to twelve yards in width. Some of the actinolites are

nearly an inch long, and all are large in comparison to the other constituents of the rock ([S5110](#)) [NH 001 802].

Some three hundred yards north-west of Loch a' Mhadaidh Mor a band of basic gneiss, 60 yards in width, and crescentic in shape, seems to form a great part of the circumference of a circle, of which the massive diorite described below constitutes the centre. The rock is fairly-well foliated, and is bounded on either side by a grey very acid gneiss. Two massive basic dykes, trending north-west, cut this basic band in a marked manner at a considerable angle, and also cut the foliation of the adjoining gneiss which is parallel to the edge of the basic band. Other masses of basic gneiss or foliated diorite are found on the west side of Loch Fada, some of which are in association with the ultra-basic rocks already noticed.

Among a mass of more basic knots, a beautiful diorite, quite unfoliated in parts, occurs as a lenticle east of Loch Ghiubhsachain. Another coarse massive diorite, very fresh in aspect and with large white feldspars, has been referred to above. It shows itself about 500 yards to the north-west of Loch a' Mhadaidh Mor, has an oval outline, and measures about 130 yards in length and 75 in breadth. It does not appear to be intrusive, in the gneiss, but rather to be one of the numerous "eyes" of early basic material, older than the acid gneiss which surrounds it, though in character it differs somewhat from that of the usual knots. Other large oval masses of basic rock occur in the gneiss to the south-west of Creag na Sgoinne, five miles south-east of Little Gruinard.

The leading feature of the Fundamental Complex in this district may be regarded as the extraordinary abundance of the knots of basic material included in the gneiss. These inclusions are scarcely ever quite absent for many yards at a time, but are apt to occur sporadically in groups. Their longer axes are usually parallel to the strike of the gneiss. In shape they are sometimes oval, sometimes sigmoidal. As the oval form only occurs in the massive gneiss, it has been supposed that the sigmoids are due to drawing out of the original ovals in general movements of the rock. But the sigmoids also occur in very massive gneiss. Where the gneiss is thinly foliated, the knots become more scarce, or even disappear.

These conspicuous and abundant inclusions consist for the most part of a dark hornblendic rock, often not distinctly foliated, and usually not very coarse. There is often, indeed, no striking external difference between them and the material of the dykes. They are of all sizes from mere little kernels or groups of hornblende-crystals up to lenticles 200 to 300 feet long. "Very often they occur as confused aggregates or irregular lumps. Some of them are composed of a beautiful broad-bladed hornblende, with scarcely any feldspar. Some are epidotic. They may be regarded either as products of segregation, in common with the acid gneiss from an intermediate magma, or as included fragments of an older rock-system, caught up in great intrusions of acid gneiss which now forms the bulk of this region. The larger knots, containing feldspar, are sometimes faintly banded, and connect this type of rock with the basic gneisses above described. They can be shown to be cut by the dykes, as clearly as is the basic gneiss.

Around the Ordnance Station on Creag-Mheall Beag, two miles north-west from Loch na Sheallag, the black basic eyes are so numerous and so liable to decomposition that large potholes have been formed in the crude gneiss, both on horizontal surfaces and on steep craggy faces, by the decay and weathering out of the basic lumps, which, here and in most of the places to be still mentioned, are formed of a massive unfoliated rock, enclosed in a crude acid gneiss of a pegmatitic character. One of the finest sections in which these features are displayed is exposed 600 yards to the north-west of Loch an Fhamhair, about a mile and a half from Creag Mheall Beag, where a cliff, 50 to 60 feet high and 100 feet long, is crowded with basic eyes. Another fine section of a similar kind may be seen about 600 yards due west of the same loch. Characteristic examples are also common in the neighbourhood of the Cadha Beag, to the south of Second Coast, and east of the Gruinard River to the north of Lochan na Cahill. In various places the basic material collected in knots and lenticles appears to form as much as one-half of the bulk of the rock.

To the north of Loch na Sheallag, and between it and Loch an Eich Dhuibh, besides basic knots like those above described, there occur others formed of a foliated rock, which may be called a basic gneiss. The foliation of these lumps is very erratic, and has apparently no connection with that of the adjacent gneiss, though sometimes there may be no great discordance between them. In these cases it would appear that an earlier foliated basic rock has been caught up, broken into fragments, and subsequently enclosed in a coarse acid intrusive rock of a pegmatitic character. This case is analogous to that of the large masses of basic gneiss, and of ultra-basic rock already noticed from this district. Inclusions of gneissose rock, possibly of a somewhat different type from any yet mentioned, occur in the neighbourhood of Loch

Ghiubhsachain. Such gneissose knots, though comparatively rare, are important from a theoretical point of view. They are usually lenticles of biotite-gneiss, from a foot to three feet long, included in the massive gneiss in the same manner as the basic knots, and they generally occur among groups of the latter. The gneiss of the knots possesses a decidedly different character from any of the gneiss of the country, inasmuch as it has more biotite, contains epidote, and is usually more distinctly foliated. Often this foliation coincides with the long axes of the lenticles, and therefore parallel to the foliation of the surrounding gneiss; but in several cases, the foliation of the lenticles has been observed to lie across the longer axis, and to be in complete and striking discordance with that of the massive acid gneiss which surrounds it. These facts appear to indicate that the knots and lenticles are true inclusions in an igneous magma.

## The acid portion of the Fundamental Complex

Though it has been found convenient for purposes of description to divide the area south of Gruinard Bay into two portions, the gneiss cannot be said to present distinct characters in each of them. In both tracts it is marked by the presence of biotite. Muscovite-biotite-gneiss, however, appears to be more common in the north, where the foliation and strike are very irregular. In the southern part, on the other hand, the foliation is fairly-well defined, and shows a general strike to W.N.W. or north-west. The quartz-hornblende band that stretches from Loch na' h Uidhe, about a mile and a half above the mouth of the Little Gruinard River, to the northern end of Loch Ghiubhsachain, on the west side of Loch na Sheallag, forms a convenient boundary between the two portions. South of that band the regularly-dipping gneiss forms a tract from 2½ to 3 miles in width, the greater breadth being west of the Little Gruinard River. In this part of the strip at a few places the foliation for some distance is vertical, but in general the strike remains between north-west and W.N.W., with a steep dip to N.N.E. or northeast.

Everywhere the gneiss is fairly uniform in character. It is a coarse grey acid biotite-gneiss, containing the eyes or lenticles of basic material above described. Sometimes, as already remarked, the basic portions weather out, producing a pitted surface. In some places, where large feldspars have been developed, the rock passes into a variety of augen-gneiss, as north of the Fionn Loch, on the west side of Loch Mhic 'Ille Riabhaich, near its northern and southern ends, about a mile further west. Coarse augen-gneiss also occurs quarter of a mile S.S.E., and two-thirds of a mile east of Loch an Iasgair (three and a half miles south of Little Gruinard). In various places gneiss of a very crude character appears to be a kind of mixture of early pegmatite with basic material. Between Loch Ghiubhsachain and the northern end of the Fionn Loch the grey gneiss shows its typical characters. It is a massive acid rock, mainly composed of quartz and feldspar, generally coarse in character, and sometimes very much so, usually containing biotite, sometimes also white mica. It displays large individuals of orthoclase, like that of the pegmatite veins, which in some places forms strings and irregular groups. Almost everywhere the characteristic kinds of basic or ultra-basic material are to be seen. The foliation dips steeply to the northeast or north-north-east, at angles of 40°–60° increasing to 70°–60° in the northern part, and in a few places becomes vertical.

The planes of foliation, which are often convoluted, are not better marked here than in a foliated granite, and the rock will break in any direction. In places this gneiss resembles a type of rock which has been regarded as derived from the incorporation of pegmatite on a large scale; in fact, one specimen from a crag east of Loch Toll a' Mhadaidh has actually been described as a pegmatite ([S4660](#)) [NG 99 81], and another specimen from the north end of the same crag ([S4661](#)) [NG 99 81] as a muscovite-biotite-gneiss.

Grey acid gneiss, with scattered flakes of biotite, or biotite and muscovite, and abundant small knots and lenticles of biotite and hornblende, forms the predominant rock of the early complex near the south edge of the tract between Feachaisgean (Fionn Loch) and the Lochan Feith. The early banding elsewhere traceable as having been in existence before the intrusion of the basic dykes is here often very obscure, and in some places there may be room for doubt whether such a banding ever existed. The later foliation, however, corresponding to that of the basic dykes is generally strongly developed. It usually strikes W.N.W., and dips steeply in a N.N.E. direction, and parallel to the axial planes of many folds which affect the earlier banding. Prominent "augen" of feldspar, which occur in the gneiss in some places, are particularly well seen in a crag about half a mile south-west of Lochan Cnapach (three miles east of Fionn Loch).

Muscovite-biotite-gneiss is typically developed in the neighbourhood of the Cadha Beag between a quarter and half a mile west of the bridge over the Little Gruinard River. It is a coarse grey acid gneiss, with the usual abundant inclusions of basic material. In some places the rock is well foliated, in others where no foliation is apparent the rock really becomes a OP), granite in structure ([S5509](#)) [NG 941 900]. A similar rock ([S5515](#)) [NG 950 881] appears at a place half a mile W.N.W. of Loch an Fhamhair (one and a half miles south-east of Little Gruinard). Other rocks of this type occur on the west side of the narrows of Loch a' Mhadaidh Mor ([S5514](#)) [NG 965 871] and in a slack 600 yards north-west of Loch an Fhamhair ([S5513](#)) [NG 954 882].

Throughout the northern part of the Gruinard district, at many places besides those here mentioned, the gneiss is of so massive a character, with little or no definite foliation, that it becomes granitic in structure as well as in composition. From this condition stages can be recognised wherein a faint foliation appears in the arrangement of the acid and basic material on a large scale, though not traceable in a hand specimen. A further stage of differentiation is presented by the foliation of the acid material round the basic and ultra-basic masses or lenticles, but this arrangement has no one definite direction. Where the basic or ultra-basic mass is of considerable size, the foliation in the gneiss is more or less parallel to its sides, and extends for some distance, so as to give rise to a well-defined strike over a limited area. At the Cadha Beag, for example, where a large ultra-basic mass stretches for half a mile in a north-east direction, the strike of the contiguous gneiss runs in the same direction the whole of the distance. In spite of such local examples, the strike of the gneiss throughout the northern part of the district is much more irregular than in the southern. Only at a few localities, as near Second Coast, to the north of Fisherfield, and in the neighbourhood of Mungasdale (one mile N.N.E. of Gruinard House), can a fairly regular north-west strike be observed. The foliation planes are usually vertical, and their strike often trends towards the E.N.E. or north-east. This apparently abnormal direction may have been here the original arrangement of the early foliation, as is still the case in the district south of Scourie. The large basic and ultra-basic masses present their greatest length in this direction, and there seems to be some evidence, apart from that of these masses, that the general strike of the gneiss was at first E.N.E. or north-east.

No difference of character, however, can be traced between the gneiss having this strike and that which strikes north-west. Both rocks are of the same coarse type, and the two directions of strike are not confined to definite areas but alternate in an irregular manner over a large extent of country. Possibly the two foliations may have been produced at the same time, the difference in direction being due to undulations or foldings of one original foliation.

Further evidence of variation in the strike of the gneiss may be observed in the ground on the north side of the lower part of Loch na Sheallag, where two directions in the foliation have been traced at right angles to one another, neither direction being predominant. Again, in the areas south of Loch an Eich Duibh, and between that loch and Loch na Sheallag, the coarse grey acid gneiss shows a poor and irregular foliation, which, though often very obscure, may be found striking in some places north-west, and in others east or north-east. The gneiss contains here many inclusions of foliated and unfoliated hornblende or actinolite, as well as several patches of fine well-foliated basic gneiss, which may be seen to be fragments of a larger mass. On the fine exposures of gneiss along the Cadha Beag road to the west of the foot of the Little Gruinard River, with their abundant basic and ultra-basic inclusions, to which reference has already been made, light seems to be thrown upon the actual process of manufacture of the gneiss. Broad bands of quartzo-felspathic material are there seen to surround and irregularly enclose knots and riasses of basic material. It appears as if the gneiss as there displayed consists of masses of diorite and hornblende, which have been interpenetrated by a later acid rock of a pegmatitic character. (Plate 6), (Plate 7), (Plate 8), and (Plate 13). represent some of the structures of the gneiss in this district.

Between the northern end of the gneiss area at Mungasdale, on the east side of Gruinard Bay, and Enard Bay, a distance of 12 miles, a number of small inliers or bosses of gneiss project through the lower beds of the Torridon Sandstone. They all lie on the eastern side of a large fault, which is believed to cross the mouths of Loch Broom and Little Loch Broom, and to have a downthrow to the west of several thousand feet. Six of these inliers lie to the east of Achnahaird Bay, four in the neighbourhood of Achiltibuie (Baden Bay), several on the Horse Island and Carn nan Sgeir, and the rest near the entrance of Little Loch Broom.

In most of these places the prevalent rock is a coarse hornblendic gneiss, more nearly allied in character to that of the Loch Inver district than to that of Gruinard. It is often of a pink colour, or reddened, as if by staining due to the former

covering of Torridon Sandstone. In the Achnahaird Bay inliers, which are small and irregular in outline, the strike of the foliation is fairly regular to north-west, the dip being sometimes as low as 30° or 40°.

Three of the inliers near Achiltibuie occur on the shore. The most northerly of them is composed of coarse grey hornblendic gneiss, the foliation of which dips northward. The ground here is crossed by several lines of fault and crush, embraces some small outliers of Torridon Sandstone, and is bounded on the south by Triassic conglomerate. The most interesting of the inliers is that which lies to the east of Achiltibuie. It forms a kind of dome-shaped mass of higher ground, against which the Torridon Sandstone was deposited, and consists internally of a denuded syncline of gneiss, partly overlapped by the Torridon Sandstone. The greater part of it seems to be occupied by a mass of dark green garnetiferous hornblendite, which forms the centre and highest part of the basin, while round this nucleus two bands of grey acid gneiss with hornblende crop out, concentric on the south and west, but apparently coalescing on the east side. The foliation of the gneiss and the hornblendite has a general dip inwards, at angles varying from 40° to 50° on the west, south, and east sides, rising to 60°, 70°, or more on the north. It thus appears that the ultra-basic core acts as a large eye, and the foliation in the gneiss is parallel to its edge. In the northern part of the outlier an epidiorite dyke appears to cut the foliation of both gneiss and hornblendite, but is only seen in three isolated exposures. The most prominent exposure of rock rises at a point 350 yards north-east of the Inn, where a vein or thin dyke of sandstone, one to two inches wide, doubtless connected with the Torridonian series, passes downwards into the gneiss at least 20 feet.

The gneiss of Meall nan Gabhar and the north end of Horse Island, as well as the rocky islets of the Carn nan Sgeir group, is a coarse grey acid rock, with occasional masses and lumps of hornblendic material. The strike of the foliation is generally from W.N.W. to north-west.

The most remarkable of the bands of fine flaggy micaceous granulitic gneiss, with vertical foliation, previously referred to (p. 173), as due to later shear movements, extends southeast, from a point on the shore about ½ mile to the north of Gruinard House, and can be followed inland in a south-easterly direction nearly to the edge of the Torridon Sandstone, northeast of Carn na Beiste, a distance of about two miles and a half. A similar band, in the same line and probably due to the same line of movement, occurs south of Craighour. Several basic dykes that have been isolated in this zone of movement have been sheared and converted into hornblende-schist.

About 30 yards north of the highest part of the Cadha Beag road a band of fine-grained gneiss, which strikes vertically north-west, can be traced in that direction for 200 yards or more. Another band of sheared gneiss, east of the Inverianie River, between Càrn Lochain Duibh and Lochan Guibhais (south-east of Little Gruinard), has likewise been much affected by subsequent movements. It has been shifted to and fro by several small faults, and the granulitic gneiss, together with its intrusive dykes, has been much folded after being sheared. These intense mechanical movements may account for the rapid thickening and thinning of the dykes in this tract and for their erratic courses. A further example of granulitisation may be cited from near Loch Ghiubhsachain (west of Loch na Sheallag), where some narrow vertical zones of a micaceous and schistose granulitic gneiss can be traced, characterised by white silvery micas. Where such a zone (as east of Beinn Dearg Bheag) passes through the basic gneiss a feathery hornblende-schist has been produced. A short distance further to the north-west, nearly one mile south-east of Guisachan, another zone appears in which the coarser gneiss has undoubtedly been sheared. Thin bands of gneiss rendered fissile in this way are not at all uncommon in the southern part of the Gruinard district, especially along the dykes which have been foliated in whole or in part.

These illustrations of the production of granulitic gneiss and hornblende-schist parallel or nearly so to the general north-west direction of the numerous dykes are precisely similar to those already described from the Scourie district and elsewhere. Of the other and probably later lines of movement in that district, which have had a nearly east course, and have powerfully affected the dykes along their course, examples have been obtained in the present district. One which occurs east of the Gruinard River, 100 yards south of Carn nam Buailtean, can be traced for more than half a mile in a westerly direction, crossing several dykes which are bent out of their course and foliated, just as at Scourie. The most marked effect of the movement is seen half a mile a little south of west from the last-named place, where a coarse massive dyke, some 50 yards wide with a northwesterly trend, has been bent so as to run east and west, and has been attenuated and converted into hornblende-schist.

## **Intrusive dykes of pre-Torridonian age**

Three different varieties of intrusive dykes make their appearance in the Lewisian gneiss of the Gruinard district. Of these the most important and numerous consist of epidiorite, either massive or in the form of hornblende-schist. A second type is represented by a considerable number of soft green dykes, somewhat irregular in character and containing abundant mica.

These are for the most part older than the epidiorite dykes. In the field they weather somewhat like ultra-basic rocks, and appear to be less acid than the ordinary basic type. The third type is ultra-basic in composition, of which only a single example has been met with near the southern borders of this district, unless we include in this class a hornblende-dyke, with very little felspar, which occurs to the south of Lochan Dubh (two and a half miles S.S.E. of Little Gruinard).

(I) The ordinary basic dykes, as will be seen from the map, though numerous, are not evenly distributed over the district.

Between the north-east termination of the Fionn Loch and Beinn a' Chaisgein Beag they occupy nearly as much ground as the gneiss, while, on the other hand, there are belts, such as the ground immediately south-west from Creag na Sgoinne (five miles south-east of Little Gruinard) where few are to be seen. It must be remembered, however, that some of the areas, where few dykes appear on the map, are obscured by drift.

The individual dykes vary much in width. While some are too small to be shown on the map, others measure upwards of 100 yards across. Some irregular examples in the area north-east of Creag Mheall Beag reach to between 130 and 170 yards in width. South of Lochan Dubh two dykes have each a breadth of about 130 yards, and, after decreasing in size to the eastward, they again swell out, and unite into one great mass measuring more than 200 yards across. As in other districts the dykes often project at the surface and form prominent features, while they occasionally weather into hollows or slacks, as near Loch an Iasgair, three and a half miles S.S.W. of Little Gruinard.

Adjacent dykes which run nearly in the same direction are often found to coalesce. The reverse process also occurs, a single intrusion splitting up into several separate dykes, as may be seen near the north end of the Fionn Loch, east of Loch Toll a' Mhadaidh, and immediately south-east of Guisachan (four miles south-east of Little Gruinard). In these cases the dykes are all presumably of the same age, but in a few cases two sets of dykes appear, one of which is of earlier date than the other. West of Carn na Beiste what appears at first sight to be a large dyke giving off smaller branches is found, on examination, to be a case of a large dyke of later date crossing several smaller and earlier intrusions. Again, on the north side of Loch a' Mhadaidh Mor, a striking example appears of the intersection of several north-west dykes by a large east and west dyke of later date.

The intrusive character of the dykes is best exhibited in the neighbourhood of some of the larger basic and ultra-basic masses, such as those at the Cadha Beag and near Beinn Dearg Bheag, where the dykes cut the foliation of the gneiss nearly at right angles.

In the northern part of the district, for a width of five miles or more, all the dykes are massive epidiorites, except in those few narrow zones of shearing movement previously described, where they have been converted into hornblende-schist. In this area the dykes are vertical. South, however, of the quartz-hornblende zone they often occur wholly or partly in the form of hornblende-schist, and have a hade to the north-east of about 40°–50°, nearly parallel to the prominent foliation in the gneiss, as may be clearly seen between Loch na Moine Bulge and Loch Fada, S.S.W. of Little Gruinard.

Between Loch Ghiubhsachain and Loch na Sheallag, the basic dykes, with the usual north-west trend, occur in belts or sheaves. On the south-west of Creag Mheall Mhor smaller dykes are in two cases seen to coalesce upwards and form one large intrusion. The chilled edges of these dykes, now converted into fine-grained hornblende-schist, can be distinctly traced through the basic masses, even when these most resemble the average texture of the dyke. The large dyke east of Loch Toll a' Mhadaidh is completely foliated throughout — a change not usually to be seen in the larger dykes of this area, and all the more noticeable here as the surrounding gneiss does not seem to show any sign of later movement.

A remarkable dyke in the Beinn Dearg belt south-east of Loch Ghiubhsachain ([S4666](#)) [NH 010 812], which differs decidedly from its neighbours, though it appears to unite with them, is more basic in composition even than the "green" dykes; yet its marginal parts appear to be ordinary hornblende-schist.



A large dyke of an unusual type occurs on the west side of the Little Gruinard River, crossing the southern part of Loch Fada, and extending E.S.E. past Lochain Cnapach. It is traceable for at least two miles, and throughout the whole of its course is a coarse-grained rock, often foliated throughout. It appears to be much more acid than the ordinary epidiorite dykes, as very few of these contain free quartz. Specimens of this dyke from a place 500 yards south-west of Loch nan Eun consist of rudely foliated hornblende and felspar, with quartz, biotite, and garnet.

Masses of epidiorite which, although few of them can be traced continuously as dykes, are probably of an intrusive character, occur in the moved gneiss above the thrust-plane in the neighbourhood of Ullapool, . along the Ullapool River below Loch Achall, at Corry Point, and on the other side of Loch Broom near Loggie. Four specimens of dykes or dyke-like masses from the thrust gneiss area on the Ullapool River below Loch Achall ([\(S2089\)](#) [NH 23 94], [\(S3067\)](#) [NH 152 954], [\(S3068\)](#) [NH 147 953], [\(S4880\)](#) [NO 408 792]) are described as epidiorites. The rock is dark and compact and traversed by thin veins of epidosite. An epidiorite, more dyke-like in form than that described above, occurs on the north side of the river close to the main thrust. It will be referred to in connection with the earth-movements. (Chapter 36)

A little north-east of Beinn a' Chaisgein Mor a set of foliated dykes contain extremely abundant inclusions of a pale-grey quartzose gneiss. These inclusions are generally persistent and often so abundant that the dykes containing them can be readily distinguished in the field from the neighbouring intrusions and can be followed over the ground. From the evidence obtained in the field, it seems probable that the dykes in the area northeast of Beinn a' Chaisgein Mor are not all of the same age, those with inclusions appearing in most cases to be earlier than the neighbouring dykes without inclusions; though at one place on the west side of a small burn, two-thirds of a mile north of the top of Beinn a' Chaisgein Mor, an apparent exception is found where a dyke with inclusions occurs within, and is presumably later than another coarser dyke of hornblende-biotite-schist. About half a mile south of Lochan na Bearta, a group of four parallel dykes with inclusions is crossed by other dykes of hornblende-schist which contain no inclusions. A good example of one of these dykes, in which the lenticular inclusions of quartzose gneiss form perhaps half the mass of the dyke, may be seen 300 yards W.N.W. of the north end of Lochan Cnapach. Here the gneiss inclusions appear to have their longer axes more nearly parallel to the direction of dip than to that of the strike of the foliation planes, which resemble in character and composition the gneiss of the surrounding area. The foliation in the quartzose gneiss is often seen to be abruptly truncated at the sides of the inclusions.

Some thin dykes, in which there are indications of porphyritic felspars, occur rather more than a third of a mile north-east of Lochan Cnapach, and half a mile south of west of the outlet of Lochan na Bearta. Dykes with a foliation crossing them in a direction parallel to the modified early banding of the contiguous gneiss are seen in the area surrounding Lochan na Bearta. In some cases the foliation at the margins is nearly parallel to the sides of the dyke, but changes its direction towards the inside. In the dyke-rocks near Lochan na Bearta the stretching lines are generally diagonal to the direction of dip of the planes on which they occur and their upper ends are on the south-east side, but the amount of variation from the direction of dip varies in different places.

A short distance south-east of the outlet of Lochan na Bearta, dykes, now in the form of hornblende-schist, appear to have been folded along axial planes striking north-west, nearly parallel to the general direction of the dykes of the region. At one place the hornblende-schist is associated with a band of mylonised and crushed rock, which also strikes north-west. Other examples of folded dykes are to be seen between the Inverianie and Gruinard Rivers, quarter of a mile east of Carn an Lochain Duibh and a little more than half a mile south of Creag Mheall Beag.

(2) The green dykes are most numerous to the south of Creag Mheall Beag and Loch a' Mhadaidh Mor, where they form prominent features in the landscape. Some of them are coarse-grained and contain large plates of biotite, in others the biotite is less prominent. It will be seen from the map that the course of these dykes is much more irregular, and in a direction more approaching to east and west than that of the epidiorite dykes, and that they are crossed by the latter in several places. The same group of dykes is continued in the ground between the Little Gruinard River and the outlet of Loch na Sheallag. A thick cluster of them occurs about a mile north of Loch Ghiubhsachain, where they have a north-west trend. They are here soft, olive-green rocks, showing plates of green mica, which is especially conspicuous in the coarser parts, and also in segregation spots. Specimens from the margin and centre of a dyke north of Beinn Dearg Bheag are doubtfully referred to the class of amphibolites ([\(S4662\)](#) [NH 022 825], [\(S4663\)](#) [NH 022 825]).

The dykes of this type are coarse and quite unfoliated in the centre, and not very schistose even at the margins. They have good chilled edges, and also show clear intrusive junctions, proving that they are real dykes and not of the nature of basic knots. They are excessively variable in width, and in this respect are much unlike the ordinary or epidiorite dykes. They are traversed by basic dykes of epidiorite, which present chilled margins where they cut the older intrusions.

(3) Half a mile south of the outlet of Lochan na Bearta a dark-green, foliated, ultra-basic dyke has been traced for about three-quarters of a mile. For most part of its course it closely follows the north-east side of a thick dyke of hornblende-schist, but diverges near its south-east end. The rock being of a more perishable character than the contiguous schists has given rise to a rather conspicuous slack or valley-feature. There is evidence that this intrusion is later in age than the contiguous hornblende-schist. The amount of felspar in the rock is variable, but in the specimen, which has been microscopically examined, it is so small that it seems best to include the dyke in the hornblende series.

As supplementary to the description of the gneiss of the Gruinard district, there falls to be described the peculiar belt of rocks which stretches from Loch na'h Uidhe (one and a half miles S.S.W. of Little Gruinard) to Loch Ghiubhsachain. Its most north-westerly exposure lies close to the north-east end of Loch na'h Uidhe, where bands of quartz-schist and mica-schist may be observed. One of the specimens collected here, an epidotic quartz-hornblende-schist ([S5505](#)) [NG 93 87], is a light grey compact rock, traversed by narrow bands containing hornblende. Another specimen ([S5508](#)) [NG 93 87], besides abundant epidote, presents also hornblende, biotite (scarce and mostly represented now by chlorite), felspar, and quartz. A third specimen shows much biotite, together with hornblende, felspar, quartz, and iron ores. A fourth variety ([S5507](#)) [NG 93 87] contains the same materials as the last, with the addition of garnet, but has quite a different appearance, With more or less rounded patches of garnet projecting as knots on a weathered surface. All the specimens of rocks here referred to may be regarded as varieties of hornblende-schist, though the one first mentioned is much more acid than the others, and is practically a quartz-schist. The garnetiferous hornblende-biotite-schist has the appearance of a sheared basic rock, but whether it belongs to the basic portion of the original complex or to a dyke cannot be definitely stated, though the former supposition seems the more probable. Some general considerations as to the origin and mutual relations of these rocks will be given in the sequel.

No further exposure of these rocks occurs till the Little. Gruinard River is crossed, where, at a point half a mile west of 2) Lochan Dubh, a very acid type of rock ([S5504](#)) [NG 948 864] crops out, having a greasy lustre and sub-conchoidal fracture. It is almost entirely composed of irregular grains of quartz, with a few small and usually imperfect prisms of hornblende, the quartz-grains showing signs of strain under crossed nicols. This quartz-schist forms a band which lies between two large epidiorite dykes, in which position it may be traced almost continuously for nearly two miles. Half a mile south of Lochan Dubh a fine section exhibits clearly the relations of the schist and the dykes. On the south side of the larger dyke the banded quartz-schist dips N.N.E. at angles of 55°–60°, its foliation being clearly cut by the edge of the epidiorite which dips in the same direction at 75°. A continuous band of schist follows the south side of the dykes for more than half a mile. Next to this band lies a coarse crude gneiss with basic eyes, and beyond it, and nearly 100 yards south of the quartz-schist, bands of finely-sheared gneiss and hornblende-schist appear, which seem to be connected in some way with the quartz-hornblende-rock. A lenticular mass of unsheared gneiss, about 250 yards in length, occurs to the eastward in the heart of the dykes, which here apparently coalesce.

A fault or crush along the valley of Uisge Toll a' Mhadaidh shifts the dykes and associated rocks to the southward. On its east side a trace of garnetiferous schist can be observed in the dyke, and, beyond on the north side of the dyke a quartzose and granulitic epidote-hornblende-schist ([S5501](#)) [NG 985 855]. Several specimens ([S5495](#)) [NG 98 84], ([S5496](#)) [NG 98 84], ([S5498](#)) [NG 98 84], ([S5499](#)) [NG 98 84], which have been examined from a hill named Creag Mheall Meadhonach on the six-inch map, situated about a mile and a quarter S.S.E. of Creag Mheall Beag, may, as a whole, be referred to the quartz-hornblende group, though some of the hands differ from the typical representatives of that group in that they contain more or less felspar. Beyond the place just mentioned the schistose rocks are exposed at a few places along the same line as far as the north end of Loch Ghiubhsachain, and they reappear 600 yards north-east of the south end of that sheet of water. Near the head of a small burn that flows off the north-eastern slope of Creag na Sgoinne into Allt Loch Ghiubhsachain, the quartzose bands are well developed along the north side of a dyke of hornblende-schist. From their contact with that schist a specimen was taken of a black rock with a peculiar resinous lustre ([S4695](#)) [NG 998 842], and consisting mainly of a crystalline aggregate of quartz-grains, most of which give undulose extinction, and through which lie scattered prisms of actinolitic hornblende. The dyke clearly crosses the

foliation of the quartzose bands.

The width of the quartzose zone which has now been traced is very variable. Sometimes the zone is apparently arranged in several parallel bands at considerable distances from one another. In other cases the rocks are separated by large intrusive dykes, which then form a great part of the total width of the zone.

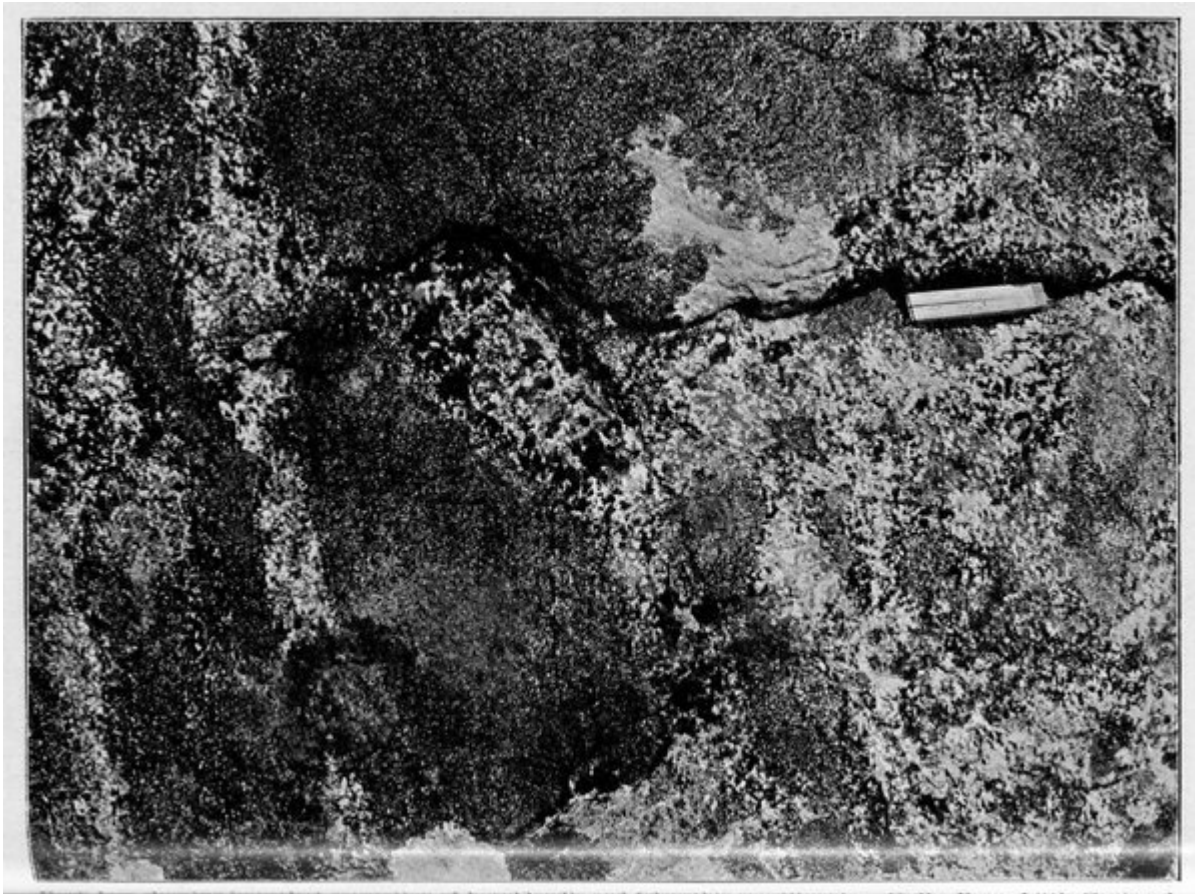
These fine-grained, granular quartzose bands, associated with fine schists, differ in a marked degree from the ordinary gneiss of the district, and their field-relations are peculiar and often puzzling. Though their appearance, especially that of the finer biotite-schists, is sometimes suggestive of a sedimentary origin, they are not here, as in the Loch Maree area, associated with limestones, but often seem to merge into ordinary quartz-veins. At Creag Mheall Meadhonach the hornblende-schist and fine-grained gneiss adjoining are in many places penetrated by quartz-veins, and also by quartz-rock and quartz-schist, which appear to have been formed by the coalescence of quartz-veins and subsequent shearing. Further, at the head of the burn which flows off the north-east slope of Creag na Sgoinne, above referred to, the quartz-bands seem to merge into thin quartz-veins that traverse the gneiss in all directions, so that in some places the quartz-bands appear to be quartz-veins traversing the gneiss. Although nearly one-half of the specimens which have been sliced and examined may be called quartz-hornblende-rocks, they differ much in composition, and the most siliceous varieties ([S5495](#) [NG 98 84], [S5496](#) [NG 98 84], [S5504](#) [NG 948 864] are almost pure quartz. Epidote is found in five of the specimens, sometimes in the quartz-schist, and at other times in the peculiar gneissose rocks ([S5501](#) [NG 985 855] and [S5508](#) [NG 93 87], in which it is an important mineral. Five of the specimens are garnetiferous hornblende-schists, which certainly appear to be sheared basic portions of the Fundamental Complex. In Chapter 6., page 79, where this group of rocks is discussed from a petrographical point of view, their possible sedimentary origin is doubtfully referred to.

Whatever may have been their origin, it is clear that a band of various schistose rocks, with a definite north-west strike, existed here before the intrusion of the large epidiorite dykes, and that this band is flanked and surrounded by gneiss which retains its original coarse structure. The dykes themselves have locally been altogether or partially converted into hornblende-schists, so that it would seem that the older rocks have been, at least twice, subjected to great mechanical movement. This metamorphism probably accounts to some extent at least for the peculiar character of some of the phenomena observed.

## Pre-Torridonian movements

Numerous examples of the effects of these movements have been observed in this district, but few of them require particular notice. The faults and crushes usually form distinct topographical features similar to those already noticed in other parts of the Report. An important crush-line, already alluded to, follows the course of Uisge Toll a' Mhadaidh. On its western side the large dykes are considerably shifted to the north. Its effects may be traced for about a mile to the north of Loch a' Mhadaidh Mor. The displacement of basic gneiss, etc., by the fault in this part of its course, has already been noticed. Another powerful crush coincides with the course of the lower part of the Inverianie River, and is well seen for more than than 200 yards on the east side, about a mile up the river. Above this point the fault divides, one branch following the course of the stream, the other passing off to the eastward towards Lochan Guibhais. Other faults and crushes are numerous near the lower part of the Inverianie River, especially on its eastern side. The most important of these crosses that river in a S.S.W. direction not far from its mouth, and is continued as far as the Little Gruinard River, its course for nearly the whole distance being marked by a conspicuous scar or feature.

A flinty crush, running E.N.E., forms a fine crag half a mile N.N.W. of Cern na Beiste, east of the Gruinard River. Two other features parallel to it but nearer Carn na Beiste have probably a similar origin. Near Lochan na Bearta (three miles east of Fionn Loch) and on the western side of Loch Ghiubhsachan, a good many lines of compact, crushed or partially mylonised rock, accompanied by sharp contortion, have been observed. The material in most of them is of a deeper-red colour than that of the surrounding gneiss, but it sometimes resembles black hällflinta. The general trend of these lines of movement is W.N.W., nearly parallel to that of the basic dykes.



*(Plate 6) Rock face showing imperfect separation of hornblendic and felspathic constituents, Cadha Beag, Little Guinard, Ross-shire*



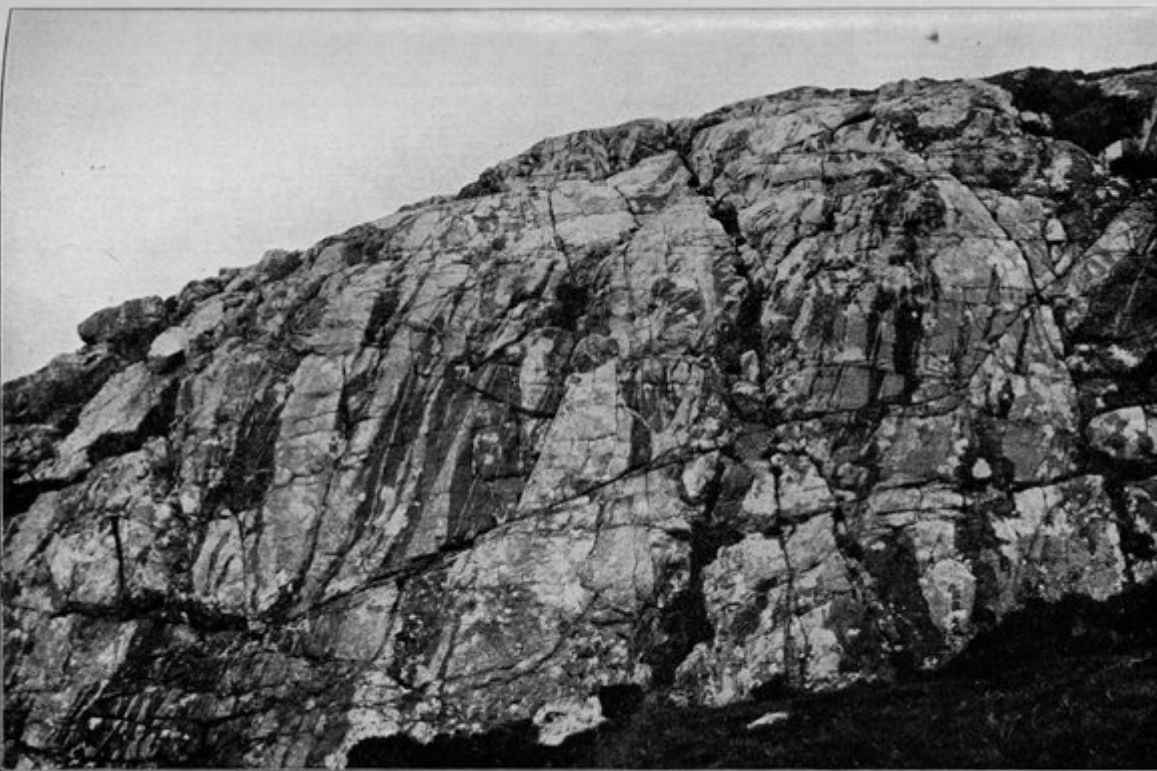
Lumps of basic rock mainly composed of hornblende, separated by quartzo-felspathic material.  
Cadha Beag, Little Guinard, Ross-shire.

*(Plate 7) Lumps of basic rock, mainly composed of hornblende, separated by quartzo-felspathic material; Cadha Beag, Little Guinard, Ross-shire.*



Basic Hornblende-Gneiss traversed by quartzo-felspathic veins. Cadha Beag, Little Gruinard, Ross-shire.

*(Plate 8) Basic hornblende-gneiss traversed by quartzo-felspathic veins; Cadha Beag, Little Gruinard, Ross-shire. B60.*



Felspathic Gneiss with streaks and lenticles of basic (hornblende) rock. Cliff face about 20 feet high.

*(Plate 13) Felspathic gneiss with streaks and lenticles of basic (hornblende) rock; Meall Buidhe, Cadha Beag, Little Gruinard, Ross-shire. B54-B55*