
Chapter 10 Kylesku to Loch Broom

By B. N. Peach and J. Horne, with notes by L. W. Hinman. The district described is comprised in Sheets 101, 102, 107, and 108 of the Geological Survey Map of Scotland on the scale of 1:65,360 (one inch to a mile).

This district extends from Kylesku and Loch a' Chairn Bhain in the north to the Coigach mountains north of Loch Broom in the south. Bounded on the east and south by the great escarpment of Torridon Sandstone that stretches from the hills beyond Quinaig, south by Canisp and Cùl Mòr to Coigach, the total area occupied by the Lewisian gneiss, west of the post-Cambrian displacements, amounts to about 120 square miles. Though outlying masses of Torridon Sandstone appear to the west of the main escarpment, as for instance at Stoer and on Suilven, the Lewisian gneiss is continuous between Loch a' Chairn Bhain and Loch Enard, south of Loch Inver.

This tract is characterised by a succession of bare domes and ridges of rock, enclosing numerous lochs and tarns, being remarkably destitute of drift save in the area north-west of Quinaig. Though drained by the Inver and the Kirkaig and their small affluents, it does not possess a well-defined valley system. In the neighbourhood of Stoer and south of Loch Inver, the undulating rocky plateau rises to a height of 500 feet. Eastwards, however, as we approach the Torridon escarpment the elevation gradually increases till it reaches 1000 feet on Suilven, 1500 feet on Canisp, and about 2000 feet on Quinaig. In this district there are relics of the pre-Torridonian topography which are so conspicuously developed in the region north of Loch Maree. The best example occurs on the north-west slope of Quinaig, where a pre-Torridon hill, about 700 feet high, projects through the lower and is overlapped by the higher members of the red sandstone series.

One of the prominent characteristics of the topography of the area west of the great escarpment is the number of straight features, often traceable for long distances, largely determined by normal faults, lines of thrust and the trend of intrusive dykes.

Within the belt affected by the post-Cambrian movements, the Lewisian gneiss reappears above the Glen Coul and Ben More thrust-planes, forming detached masses, which together cover an area of about 15 square miles. Here the average elevation is higher than in the undisturbed area to the west, and in the wild corries round Ben More the gneisses with their intrusive dykes give rise to gigantic cliffs, ranging in height from 500 to 1500 feet.

General sketch of the Lewisian rocks

In summarising the history of the Lewisian rocks in the district west of the escarpment of Torridon Sandstone, reference may be made, first, to the original members of the Fundamental Complex, second, to the sequence of dykes intrusive in that complex, and, third, to the series of pre-Torridonian movements which affected alike both dykes and gneiss.

Over a large part of the area between Loch a' Chairn Bhain and Enard Bay south of Loch Inver, the members of the Fundamental Complex still possess many of the characters of original igneous rocks, comprising ultra-basic, basic, and more acid types. Of these groups, the first, including pyroxenites and hornblendites, form here only an insignificant part of the series; the second, containing pyroxene granulites and garnet amphibolites, are much more largely represented; while the third, consisting of quartzose pyroxene gneisses, constitute the main portion of the unmodified gneiss of the region. Structurally they occur either as massive rudely-foliated igneous rocks, or as banded gneisses in which the constituents have a parallel or wavy arrangement. The ultra-basic rocks generally form lenticles traceable for no great distance, and the basic masses, though often in part free from banding, have frequently a rude foliation which usually coincides with that of the contiguous pyroxenic gneiss.

A noteworthy feature of the quartzose pyroxenic gneiss, conspicuously displayed on the south shore of Loch a' Chairn Bhain, on the sea-cliffs near Lochinver, and eastwards near Little Assynt, is the contortion and overfolding of the respective folia, which are truncated by planes oblique to the minute flexures. In 1888<ref>Report on the Recent Work of the Geological Survey in the North-West Highlands of Scotland, *Quart. Journ. Geol. Soc.*, vol. xliv., p. 389.</ref> these phenomena were ascribed to a gradual movement and piling up of the materials as the plutonic rocks underwent

enormous pressure when in a solid form. But the researches of Sir A. Geikie<ref>On the Banded Structure of some Tertiary Gabbros in the Isle of Skye. *Quart. Journ. Geol. Soc.*, vol. 1., p. 645.</ref> and Dr. Teall strongly support the conclusion that these structures must have been developed before the final consolidation of the rock masses.

Where not deformed by pre-Torridon movements the original gneisses of the complex are arranged in gentle anticlines and synclines, the axes of which usually run N.N.E. and S.S.W. or north-east and south-west, the outcrops of the successive bands forming parallel escarpments. After the development of the early foliation and the gentle folding, the original gneisses of this district were pierced by two sets of dyke intrusions. The earlier group, comprising rocks of basic and intermediate types, ranging from hyperite, gabbro, and diabase to biotite-diorite, is by far the most important and has the largest development. Crossing the plateau of Lewisian gneiss, generally in a W.N.W. direction, they clearly display their intrusive character in the unmodified areas. Those of the later group, including ultra-basic rocks (picrites), cut the earlier, and their trend is more nearly east and west. This slight change in the direction of the picrite dykes implies a corresponding change in the trend of the earth stresses that gave rise to these fissure eruptions.

After the eruption of these igneous materials, the area was subjected to mechanical movements, whose effects are conspicuously developed in this region. The members of the Fundamental Complex were folded on vertical axes which trend in certain definite directions irrespective of the gentle anticlines and synclines that preceded these movements. The folding was accompanied by disruption lines or thrust-planes which deflected, attenuated, and deformed the dykes and developed new structures in the gneiss. Within the zone of folding the reconstruction of the gneiss may be partial and may be confined to a modification of the constituent bands along the old foliation planes. Sometimes an incipient newer foliation is developed at an oblique angle to the older one, that is rudely parallel to the axial planes of flexure or to adjacent lines of movement. Sometimes the reconstruction of the gneiss is so complete that new divisional planes have been set up and the lithological character of the rock has been changed. Hence we find, within these belts of later flexure and shear-zones, granulitic gneisses with hornblende and biotite, while beyond these limits the quartzose pyroxenic gneisses with their ultra-basic and early basic masses are characteristically developed.

Coincident with these modifications of the gneiss, structural changes appear in the dykes. All the various stages between the massive basic dyke and hornblende-schist, so well developed in the Scourie district, and between the unaltered picrite and talcose-schist are here admirably displayed.

Finally, there is conclusive evidence that the eruption of the basic and ultra-basic dykes and the widespread series of movements that affected both the gneiss and dykes were completed before the deposition of the basal breccias of the overlying Torridon Sandstone.

Ultra-basic rocks

In the present district these rocks have only a limited development, seeing that they are restricted to small lenticles, bosses, or knots in the quartzose pyroxenic gneiss in the unmodified areas. The largest mass occurs on the north shore of Loch Dhrombaig, six and a half miles north of Lochinver, where it forms the margin of that loch for one-third of a mile, and stretches north-west in irregular tongues for half a mile. Its lithological characters are variable: in some portions, pyroxenic minerals predominate with more or less olivine; in others, hornblende is the chief constituent. Garnets are abundant in places. Specimens taken from a quarter of a mile west of the village of Drurabag (Slides Nos. [\(S3396\)](#) [NC 114 328], [\(S3403\)](#) [NC 118 330], [\(S3411\)](#) [NC 113 326], [\(S3415\)](#) [NC 118 330]) are referred by Dr. Teal to the olivine-hornblende-pyroxenite group (Group I. A).

Others taken from the western extension of the mass, at the sudden bend of the road, are described as garnet amphibolite (III. A) and hornblendite with pale-green hornblende (I. B). In this mass, which is more or less distinctly foliated, the direction of the foliation runs parallel to that of the surrounding gneiss. The irregular outlines of the mass suggest the folding of the gneisses at an early stage of the original complex.

Rocks allied to the banded pyroxenites occur at intervals over the rocky plateau between Quinaig and Steer, as, for instance, on the north arm of Gorm Loch Mor, on the west side of the northern arm of Loch Poll, and again between Loch Poll and Clashnessie Bay. In most of these examples they appear as thin foliated lenticles, banded with the grey

pyroxenic gneiss. One instance on the north margin of Loch na Bruthaich (one mile north-east of Clashnessie) is a hornblendite with pale-coloured hornblende in aggregates. (I. B., No. [S3402](#) [NC 073 315])

An important mass of hornblendite, about a quarter of a mile long, occurs on Fairait Mhor, two and a half miles W.N.W. of Lochinver, where it has been quarried for millstones. The rock is almost flat and intercalated in and folded with the pyroxenic gneiss. Like other lenticles of the same material, this mass is cut by one of the north-west basic dykes and traversed by shear-zones. Again, one mile south of Lochinver and a quarter of a mile south of Loch na Doire Daraich, a sheet of ultra-basic rock, about 50 feet thick, forms a crag near the hill-top. It belongs to the pyroxenite group, and is there interbanded with the grey pyroxenic and hornblendic gneisses, both rocks having a common dip. At the extreme north-west end of Suilven a band of soft ultra-basic rock, in which lies a chain of lochans, is traceable, and again at the southern limit of this district, at the eastern end of Loch an Gainmheach, south-west of Cùl Mòr, two irregularly-shaped masses of ultra-basic rock show more or less alteration into serpentine. On the islands half-way down Loch Assynt and at Kylesku Ferry, lenticles of ultra-basic rock appear; in the latter case they have been referred to olivine-hornblende pyroxenites and hornblende pyroxenites (Group I. A). Other examples might be quoted which have been recorded on the six-inch maps, but these are sufficient to show that, while these rocks form an insignificant part of the complex, they occur at intervals throughout this district.

In addition to these larger bands and lenticles, innumerable lumps and knots occur in the grey gneiss, from a few feet to a few inches in diameter, consisting mainly of hornblendite, which are analogous to the basic knots in the granite of Criffel, in Galloway, and may probably have had a similar origin.

Early basic rocks

The members of this group have a much larger development, and are represented by hypersthene-augite plagioclase rocks (II. A1), by augite-plagioclase rocks (II. A2), by garnet amphibolite (III. A1c), and pyroxene granulite. The distribution and relations of some of the more prominent masses may here be indicated.

About two miles south-west of the village of Lochinver, on the promontory of Baddinaban, a grey basic mass may be seen, having an even texture with dark streaks full of small garnets, which are sometimes crowded together. It is well exposed on the cliffs on the south side of Strathan Bay and at the little boat harbour at Baddinaban, where it is rudely banded and in general appearance resembles a massive igneous rock. It is traversed by several of the north-west basic dykes, the latter having chilled margins along their course. In this eruptive mass Dr Teall has identified two types of rocks, (1) dark medium-grained, containing hypersthene, augite, and plagioclase, with and without garnets, the variety without garnet being a typical example of the Baltimore gabbros; [S3392](#) [NC 08 21] and (2) augite-plagioclase rocks without hypersthene [S3406](#) [NC 08 21]. It is noteworthy that the grey acid pyroxenic gneiss traverses this basic rock in anastomosing veins, without chilled margins, which become banded and interlaced with the basic material.

About four miles north-west of Lochinver and one-third of a mile south of Loch a' Ghleannan Shalaich, another prominent area of early basic material appears, embracing different types of rock. Its long axis, measuring about half a mile in length, runs north-east and south-west, and varies in breadth from 100 to 400 yards. At the south-east end it is rudely foliated, the strike of the foliation being north-east and south-west in common with that of the surrounding pyroxenic gneiss. Specimens taken from this mass are referred to two groups — garnet-amphibolite (III. A1c), and hornblendite (I. B2). On its north-west and south-east sides, it is truncated by the north-west basic dykes, the boundaries between the two being clearly defined. About one-third of a mile south-west of this place and to the north of Loch Beannach, several masses of garnet-amphibolite are banded with the grey pyroxenic gneiss and share in its folds. They are rudely foliated, the strike being north-west and south-east. Again, about five miles N.N.W. of Lochinver and one mile south of Clashnessie, between Loch nan Lub and Loch-na-h-Uidhe-Doimhne, an area of early basic material extends for half a mile and forms several rocky hills. Some parts of it are devoid of foliation, others show a rude banding. It is an epidote amphibolite (III. A1a) [S3409](#) [NC 064 294]. An interesting feature here is the plexus of acid veins; composed of granulitised andesine felspar, that traverse the basic rock. As the mass lies between two prominent shear-zones and is itself traversed by lines of movement, the granulitisation of the andesine and the saussuritic aggregates referred to by Dr. Teall may with much probability be regarded as of secondary origin.

The remaining area of rocks of this group lies about five miles south of Lochinver, between Loch Skinaskink and the western sea-board. Here a large crude mass showing little foliation is in the main a hornblende-plagioclase-rock, occasionally garnetiferous. It is traversed by numerous veins of quartzose pyroxene-gneiss, which near the margin of the basic rock become so abundant that both merge into the surrounding gneiss complex. From the evidence here adduced it is apparent that, like the smaller lenticles of ultra-basic material, these early basic masses are older than the quartzose pyroxenic gneiss, and that both rocks share in the rude foliation which preceded the eruption of the basic dykes.

Pyroxene-gneiss

In this district, as elsewhere, the dominant member of the Fundamental Complex in the unmodified areas is the pyroxene-gneiss of Dr. Teall's classification (II. B). In addition to the pyroxene, this type contains hornblende and biotite as original constituents. The characteristic features of the group are the abundance of blue or semi-opalescent quartz (see Chapter 4 for explanation of this tint) and the carious weathering of the surface due to the decomposition of the felspar and ferromagnesian constituents and the projecting network of quartz. A gradation can frequently be traced from a type rich in ferromagnesian minerals to a variety composed mainly of quartzo-felspathic material. Throughout the district, the pyroxene-gneiss with hornblende and biotite passes imperceptibly into grey hornblende gneiss with biotite, in which both the hornblende and biotite occur as aggregates. The quartz of this hornblende gneiss contains the same hair-like inclusions (Chapter 4), and the felspar is likewise identical. The secondary hornblende replaces the augite in such an irregular manner that the rock may pass, in a short distance, from a pyroxenic to a hornblendic gneiss.

The pyroxene-gneiss may be examined in the shore sections east and west of Kylesku, on the south side of Loch Glencoul and Loch a' Chairn Bhain, and on the coast north and south of Lochinver. Inland it spreads over wide tracts from Drumbag south by Little Assynt and the Kirkaig river to Loch Skinaskink, presenting throughout in the unmodified areas the same general characters. In places, as, for instance, near Little Assynt and along the south shore of the upper part of Loch Assynt, the rocks are so massive as to present only a slight parallel arrangement of the constituents. At the latter locality they have locally undergone alteration due to decomposition, and have a waxy appearance owing to the development of secondary epidote. In other areas, the banding is more or less marked, and the outcrops of the successive bands make characteristic features on the hill slopes, as on the rocky platform west of the Torridon escarpment of Quinaig and on the plateau near Suilven. The maps (107 and 101) show the disposition of the flexures of these original gneisses and the considerable variation of the strike owing to undulation. Yet the long axes of the folds frequently run in a N.N.E. or north-east direction. The subsequent modifications of the members of the Fundamental Complex in strike, dip, and petrographical characters as displayed in this district will be described in connection with the pre-Torridonian movements.

Pre-Torridonian dykes intrusive in the Fundamental Complex

In no portion of the whole region of North-West Scotland are these dykes more conspicuously developed than in the district now under description. Their abundance and general distribution are well illustrated on the one-inch maps (Sheets 101, 107). They present here the usual petrographical types, which may be classified as (1) an ultra-basic group, comprising picrites; (2) a basic group, which is the most abundant, and includes olivine-norite, hyperite, gabbro, diabase, enstatite-diabase, and hornblende-enstatite-diabase; (3) intermediate rocks comprising biotite-diorites. The trend of the basic series is generally W.N.W., that of the ultra-basic more nearly east and west, and that of the intermediate north-east, and in one instance W.N.W.

The descriptions already given of the general features of the basic dykes between Scourie and Kylesku are applicable to this district. The uprising of the igneous materials along vertical or highly-inclined fissures transverse to the early foliation of the gneiss, the frequent brecciation of the walls of the fissures, the branching and reuniting along their course, the intersection of one dyke by another of much the same mineral composition, the presence of close-grained or "chilled" margins, the contrast in texture between the interior and sides of the larger intrusions, and in some instances the mineral banding due to original segregation — all these features are displayed in the district between Kylesku and the Coigach mountains.

The dykes vary much in breadth and visible length. The broadest example appears south of the Kirkaig, and at certain points in its course is 200 yards wide. Others vary from 20 to 50 yards in breadth. The remarkable persistence of these dykes is a striking feature in this district. The larger examples have been traced for twelve miles across the plateau of Lewisian Gneiss from the base of the Torridon escarpment to the western seaboard.

Certain typical examples of the various groups may now be indicated. A dyke of special interest may first be noticed, as it furnishes a link between the basic and ultra-basic types. It occurs on the north shore of Loch Assynt, at Rudha na Doire Cuilinn, four miles W.N.W. of Inchnadamff, and is described by Dr. Teall as an olivine norite ([S2319](#)) [NC 20 25]. The relations of this dyke to the normal types of the basic intrusions is not there apparent — a point of some interest, in view of the fact that the latter are cut by the ultra-basic group. About two miles west of Tomore Lodge, Loch Assynt, on the west side of Loch an Ruighean, an allied type is represented in a dyke of hyperite.

An interesting feature of the basic group in the Assynt region is the occurrence of varietal types in the same intrusion. For example, the dyke that runs by the side of the road north of Loch Assynt, in the direction of Tomore Lodge, and crosses the small promontories north-west of Ruadha an Doire Cuilinn, shows marked variation. A series of specimens ([S3040](#)) [NC 1 2], ([S3041](#)) [NC 1 2], ([S3042](#)) [NC 1 2], ([S3043](#)) [NC 1 2], ([S3044](#)) [NC 1 2], ([S3045](#)) [NC 1 2] indicate that it ranges from a hyperite and enstatite-diabase in the centre to an epidiorite or epidote-amphibolite at the margin where there are signs of deformation. Another example of rapid variation is furnished by the conspicuous dyke, 50–70 yards in breadth, that follows the southern shore of Loch Glencoul for three-quarters of a mile east of the mouth of the Unapool Burn.

10Y' A series of specimens ([S8600](#)) [NC 247 314], ([S8601](#)) [NC 247 314], ([S8602](#)) [NC 24 31], ([S8603](#)) [NC 24 31], ([S8604](#)) [NC 27 30], ([S8605](#)) [NC 270 240] from Cona Craig, a hillock formed by the intrusion near its eastern end, and taken at various distances from its edges, include rocks described as diabase, gabbro, and epidote-amphibolite.

The dykes of epidiorite or hornblende-plagioclase-rocks are separable into two groups, according to the presence or absence of igneous structure. An example of the igneous structure, with lath-shaped interstitial feldspars, occurs in the dyke that runs immediately below the road and close to the shore of Loch Assynt, about four miles west of Inchnadamff. The typical rocks of the group in which igneous structure is not apparent are essentially composed of plagioclase and hornblende, with some quartz. These include a large number of the dykes in this region.

A typical instance of segregation before the solidification of these basic intrusions is afforded by the massive dyke, to which reference has already been made, near the river Kirkaig. Emerging from beneath the Torridon Sandstone at the base of the north slope of Cùl Mòr, it has been traced along the south side of Loch Veyatie, by the south of the Fionn Loch, thence across the Kirkaig a little above the waterfalls, till it passes out to sea at Kirkaig Point. The rock is an enstatite-diabase, merging, in places, into an epidiorite at the edge. The centre of the dyke shows knots and strings of acid material, which, under the .01 microscope ([S3905](#)) [NC 109 186], ([S3906](#)) [NC 109 185], ([S3907](#)) [NC 109 186], ([S3908](#)) [NC 109 186]), are found to be composed of alkali-feldspar, plagioclase, quartz, biotite, hornblende, and epidote, forming a hornblende-granite. Here there is a repetition of the phenomenon which is such an invariable feature of the Fundamental Complex traversed by this dyke. Another example of differentiation with rude mineral banding is found in the dyke between Canisp and Cama Loch, a quarter of a mile north-west of Loch a' Chroisg, which is a hornblende-diabase, passing into epidote-amphibolite. The rude banding is due to the parallel arrangement of the feldspathic and ferro-magnesian constituents, similar to that in the pyroxene-hornblende-gneiss of the older complex. The central portion is more acid than the outer parts. In places the rock is sheared and becomes a schistose epidiorite. The thin basic dykes which abound in the region do not show the variation in character here referred to. For the most part they consist of fine-grained epidiorite.

Only three examples of the intermediate group of intrusions, consisting of biotite-diorite, have been mapped in this district. One, which varies from 33 to 70 yards in width, occurs at Allt a'Mhuillinn, close to the road, about two miles south-west of Loch Inver, and stretches from Loch Bad na Muirichinn to the sea at Baddinaban. Its course is about north-west and southeast, it intersects one of the normal basic dykes, and displays lustre-mottling as a conspicuous feature in the field. The two other dykes, only a few feet in breadth, have been met with north of Little Assynt, one east of Loch Beannach, the other east of Loch an Ruighean. Their direction — north-east and southwest — is exceptional, and

they are traceable only for short distances. They are characterised by large feldspars — oligoclaseandesine — set in a compact dark matrix.

The ultra-basic dykes, composed of olivine and augite with some reddish-brown biotite, are of special interest. Like the members of the basic group, they rise along well-defined fissures with more or less vertical walls, which are slightly oblique to the trend of the older lines of eruption, as their course is more nearly east and west. Owing to their ultra-basic character they frequently decompose and give rise to long narrow slacks or clefts forming marked features in the landscape. In some rare cases they reach as much as 100 yards in breadth.

There is ample evidence that the picrite dykes are later than the basic series, for in many places the intersections are exposed. The relations between the two, however, are somewhat peculiar. In the accompanying (Figure 7), which is a transcript of part of the six-inch map of an area near Sron a' Bhuic on the plateau midway between the foot of Loch Assynt and the west end of Suilven, the intersections are well displayed. It will be seen that, in the case of the more southerly of the two ultra-basic 'dykes in this diagram, tongues of picrite run along the outer margins of the older epidiorite intrusion and then die out. At the point of crossing the width of picrite is sometimes narrower than the normal breadth of that intrusion on either side of the epidiorite. In other cases both the gneiss and the basic dykes have more or less vertical walls, up which the ultra-basic material has arisen.

Regarding the distribution of these picrite dykes, a glance at Sheets 101 and 107 will show that they are mainly restricted to a belt of ground, about three miles broad between Loch Inver on the west and the lower end of Loch Assynt on the east. Outside these limits they are of rare occurrence.

The dyke which has been taken as the typical example of the group occurs one mile north-east of Little Assynt on the west shore of Loch Assynt, and about half a mile above the foot of that loch. It is there 15 yards broad. Westwards across the plateau of pyroxene-gneiss it can be traced at intervals to Loch Beannach, near which it bifurcates and is truncated by a N.N.E. fault. In the field its conspicuous feature is the occurrence of large individuals of a green pyroxene in a dark fine-grained matrix. (See Chapter 7)

A similar dyke crosses the promontory on the south side of Loch Assynt, and can be traced east to Easter Tobeg. It reappears on the promontory of Torr an Eilein, where lustre mottling is very apparent. Like the type just described, this intrusion contains large green pyroxenes and the chief constituents are alike, but Dr. Teall regards it as occupying a position intermediate between peridotite and olivine-gabbro ([\(S3307\)](#) [NC 160 255], [\(S8123\)](#) [NC 169 249]).

Two parallel ultra-basic intrusions, one of which may be a continuation of the Torr an Eilein dyke, can be traced for two miles across the strip of gneiss that lies between Beinn Garbh and the upper part of Loch Assynt. These dykes are composed of a hard greenish-black rock belonging to the picrite group, with no recognisable feldspar, but showing conspicuous lustre-mottling. Both exhibit the more common type of alteration into serpentine.

South of these examples a remarkable group of dykes can be traced from the Torridon Sandstone escarpment between Canisp and Beinn Gharbh, across the Lewisian gneiss, to the coast at Achmelvich Bay north of Loch Inver, and to Clachtoll, near Stoer. Two members of this group have been specially studied on account of modifications developed by pre-Torridonian movements, to which reference will be made in the sequel (p. 170). The more northerly crosses the river Inver at Inveruplan, and forms the hollow along which the road runs at Brackloch. The southern one traverses the Inver a quarter of a mile further south and appears at the roadside at Loch an Eun, about one mile north-east of Lochinver. Westwards these two dykes unite near Riecairn, a mile and a half N.N.W. of Lochinver, and the western prolongation is visible in many places at the roadside between Riecairn and Clachtoll.

Near the southern limit of the district an ultra-basic dyke forms a well-marked cleft in Allt Gleannan t-Srathain, northwest of Loch Skinaskink. In the northern part only a single example has been found. It runs along the course of the stream that flows W.N.W. through Gleann Ardbhair (about one mile south-west of Loch a' Chairn Bhain) into Loch Ardbhair. Here also, owing to the softer character of the rock, the dyke has given rise to a long deep hollow.

Pre-Torridonian movements

Throughout the district now under description abundant evidence has been obtained of the earth-stresses to which the Lewisian rocks were subjected, and which resulted in the violent folding of the members of the Fundamental Complex in definite lines of disruption or thrust-planes and in well-marked zones or belts of secondary foliation, whereby considerable changes in petrographical character were superinduced upon the gneiss and its dykes. Inasmuch as many of the phenomena characteristic of these pre-Torridonian movements, which have been described in detail in the section relating to the district between Laxford and Kylesku, are repeated in the ground to the south, it will be sufficient to give here merely an outline of the direction and character of these movements and the modifications of the rock-types resulting from their operation.

Three distinct lines can be followed along which the movements have taken place — (1) W.N.W. and E.S.E., that is more or less parallel with the basic dykes; (2) nearly east and west; and (3) in certain exceptional cases north-east and south-west. The distribution of these shear zones may be readily grasped by referring to Sheets 107 and 101, from which it will be seen that they are specially numerous in certain areas.

Examples of the first system — those that more or less coincide with the trend of the dykes — are well developed along a belt that stretches from the valley between Canisp and Suilven, W.N.W. by Druim Suardalain, and the river Inver, between Brackloch and Loch Inver, thence to Achmelvich Bay south of Clachtoll. They likewise traverse the plateau along the valley of the Kirkaig, W.N.W. by the Fionn Loch to the coast at Strathan south-west of Loch Inver. Some with a similar trend have been mapped, south of Allt Gleannan t-Srathain, north-east of Loch Skinaskink. Those which run nearly east and west are numerous along the western part of the plateau between Achmelvich Bay, north-west of Loch Inver, and Clashnessie Bay, N.N.E. of Stoer. Eastwards many of them seem to die out or disappear, while others coalesce and are traceable for miles. Perhaps the best examples of this system form the group that extends from Clachtoll east by Loch Crocach, thence by the north slopes of Cnoc an Dubharlainn to Loch a' Ghleannain Shalaich and onwards in the direction of Tomore Lodge by Loch Assynt. The lines of movement trending north-east and south-west are rare, but some examples occur to the south-east of Loch Crocach, near Loch Skinaskink, and at other localities. The planes of disruption are generally more or less vertical, but in exceptional instances are nearly horizontal.

In this district the effects of these movements upon the rocks have been similar to those above described from the Laxford and Kylesku ground. It will not, therefore, be necessary to repeat details already given. It may suffice to select a few typical examples of the modifications, which are here displayed. We may consider first the modifications superinduced upon the gneiss, and secondly those exhibited by the dykes.

(1) Modifications of the gneiss — The system of east and west lines of displacement has here, as elsewhere, given rise to narrow and well-defined shear-zones. A typical illustration of this modification may be seen west of Loch a' Ghleannain Shalaich, two miles W.N.W. of Tomore Lodge, Loch Assynt, where several parallel lines of disruption may be traced, showing newer foliation. One of these varies from 50 to 70 yards in breadth. The strike of the foliation of the pyroxenicgneiss is north-east and south-west or north-west and south-east, but on approaching this thrust-plane the gneiss is folded and dragged into parallelism with the line of movement — that is, nearly east and west. Coincident with this folding and deflection of the original gneiss, important modifications have been effected in its constituent minerals along the old foliation-planes. The opalescence of the quartz has disappeared, biotite has been developed, and the felspars have been granulitised. Within the narrow shear-zone the reconstruction of the rock is complete, and it appears as a fine granulitic micaceous gneiss whose foliation planes dip at high angles towards the south. Occasionally a lenticle or phacoid of the modified pyroxene hornblende gneiss appears within the narrow belt of reconstructed gneiss showing the intermediate stage of change. Other similar instances of metamorphism might be quoted from this district along the east and west Tines of displacement.

The most prominent belt of modified and reconstructed gneiss connected with the W.N.W. lines extends from the south slope of Canisp, through the Canisp deer forest, and across the Inver above Loch Inver Bridge to Achmelvich Bay. At certain places, as above Loch Inver Bridge, the boundary line is well defined between the adjacent pyroxene-hornblende-gneiss and the flaggy hornblende-biotite-gneiss. Along this line the flaggy gneisses have been folded on vertical axes, the planes of foliation being nearly vertical. A rude anticlinal arrangement is occasionally observable beyond Loch Inver Bridge, the planes being vertical in the centre and dipping away on either side. On the line of this belt of secondary foliation at the shore beyond Achmelvich Bay a fine section is exposed on the seacliff within a

space of 50 yards, showing the relation of these shear-planes to the pyroxene-hornblende-gneiss, as represented in the accompanying figure. It will be seen that, between the lines of disruption, the folia of the older gneiss are sharply contorted and dragged into parallelism with the disruption planes. In these intervening bands a partial modification of the constituents has taken place, but within the shear-zones the reconstruction is complete. Here the same phenomena are observable as those already described; the granules of quartz lose their opalescence, are elongated and become granitic, biotite is developed from the hornblende, and the feldspars are granitised. The rock becomes a granitic gneiss, wherein the foliation planes dip at high angles to the S.S.W.

On the promontory east of Camas nan Bad (two miles northeast of Drumbag) two narrow shear-zones run north-west and south-east through a mass of pyroxene-gneiss, the strike of the old foliation planes being oblique to the lines of shear and the dip being at low angles. Under the microscope, a specimen ([S3401](#)) [NC 2 2] shows that the reconstructed rock is a biotite-gneiss, in which the biotite occurs in aggregates (IV, 2).

In some localities, as between Stoer and Clashnessie Bay, the reconstruction of the gneiss has taken place along nearly horizontal planes and without any apparent deflection of the associated dykes. In such cases there may have been interstitial movement of the constituents and recrystallisation under compression.

In the north-western part of the district between Drumbag, Gleannan Salach, and Loch Poll, the prevailing type of rock is a flaggy well-banded hornblende-gneiss, which seems to have undergone a certain amount of reconstruction. Though there are many local flexures, the general strike is approximately north-west. These flaggy gneisses are particularly well developed in Oldany Island, where excellent sections are exposed on the coast. Along the west side they have a fairly uniform strike, and for a distance of nearly a mile are vertical or nearly so. They often contain biotite in addition to the hornblende, and at several places thin intercalations appear in which that mineral is the chief ferromagnesian constituent. On the west side of the inlet of Baile na Cille, the rocks include a large proportion of feldspar, and are sometimes epidotic, with abundant semi-opalescent quartz. The strike of the gneiss on the north and east sides of the island is more irregular, and the rocks are often folded and crumpled. The contortion of these banded gneisses is most intense on the promontory of Cnoc a' Mhoil Bhain and the islands that surround it, and also on the cliff face along the west side of Eilean nan Gobhar, which lies to the S.S.W. of Eilean nan Tian. In this section the folds of the banded gneiss and basic rock are distinctly cut off by a set of planes that cross the cliff face at various angles and have all the appearance of thrust-planes.

Apart from the bands of wholly reconstructed micaceous gneiss developed along the lines of pre-Torridonian movement, there are, in several parts of the district, belts of flaggy granitic gneiss, which owe their present structures to a certain amount of modification of the rocks of the early complex. Rocks of this type are developed along the shores of the upper part of the hamlet of Nedd (one mile E.S.E. of Drumbag), where the flaggy well-foliated gneisses dip W.N.W. at 15° – 25° . The mica is orientated along the divisional planes, while occasional lines of striping can be observed. A belt of similar rocks extends E.N.E. from Glenleraig and past Loch nan Claidhmhnean (two and a half miles east of Drumbag), biotite being abundant in the gneiss to the east of that loch. Again, at the village of the Stoer, on the cliff east of the Torridon Sandstone strata, a belt of similar flaggy gneisses with biotite on the divisional planes, strikes nearly east and west in accordance with the direction of the shear-zones in that area. Their general inclination is south at angles from 50° – 60° . On either side of this belt the hornblende-gneiss appears in a partly modified form, but still shows the original foliation-planes.

South of Clachtoll, in the direction of Riecairn, excellent examples may be noticed of the development of incipient newer foliation at an oblique angle to the older one. This change is best seen where the original banding is well defined and where the folia have undergone rapid crumpling and contortion. In such cases, the biotite-flakes are arranged in lines parallel to the axial planes of folding, and where the puckering is fan-shaped there is a corresponding disposition of the biotite. This double foliation is well displayed on some of the cliff-faces by the roadside north of Riecairn, where the gneiss is contorted close to disruption lines.

(2) Modifications of the dykes — The alteration of the dykes in the present district so closely resembles the changes already noticed in Chapter 9. that it will suffice to select a few typical examples characteristic of the whole series.

The promontory, Rudha nam Fias, at the mouth of Loch Chair. Bhain, is traversed by three lines of shear, which appear to be branches of the disruption line that passes eastwards beyond that sea loch and Loch Glendhu. They are marked by the usual narrow bands of sheared gneiss, in which the foliation is parallel to the line of movement, with a southerly dip at high angles, in contrast to the gneiss on either side. The epidiorite dyke that appears on the shore three-quarters of a mile north of Kerracher Bay, as it approaches the crush-line, rapidly diminishes in breadth, and is deflected towards that line. This attenuation is accompanied by the usual crushing, shearing, and conversion of the rock into hornblende-schist, the foliation being more or less parallel to the plane of thrust. A short distance further west, the line of movement deflects another thinner dyke, and at this point both intrusions appear to be disrupted and displaced for a distance of several hundred yards. Crushed dyke-material is seen again on the further side of a normal fault that shifts the shear-line a few yards to the north, and the dyke finally resumes its normal course as it passes into the sea on the west side of the promontory.

This example clearly illustrates the deflection, thinning, and conversion of the epidiorite into hornblende-schist, and further, the westerly movement of all the materials on the north side of the disruption line. Many similar instances might be adduced in connection with the numerous shear-lines on the plateau between Drumbag and Little Assynt.

In addition to these modifications of the basic intrusions, it may frequently be observed, within these east and west shear-lines, that the dyke is wrenched into a series of isolated lenticles or "phacoidal" masses imbedded in a zone of reconstructed granulitic gneiss. Perhaps the best illustration of this phenomenon in the present district is to be found along the prominent line of disruption west of Loch a' Ghleannain Shalaich, two miles W.N.W. of Toraore Lodge, Loch Assynt, already referred to. Following this shear-zone westwards for about three-quarters of a mile from the south-east branch of that loch, the observer may note that a thin basic dyke, which enters that zone from the north, is disrupted and severed into seven detached lenticles of hornblende-schist, from 30 to 130 yards in length, all arranged parallel to the line of the thrust and to the foliation planes of the reconstructed micaceous gneiss by which they are surrounded.

The W.N.W. movements frequently only partially affect the dykes that rim in the same direction. The margins of the intrusions have been rendered schistose while their central parts and the adjacent gneiss remain comparatively unaffected. Such marginal strips of schist are a common feature among the basic dykes. Between this stage and the conversion of the whole dyke into hornblende-schist a lenticular or phacoidal structure is sometimes met with, when isolated portions of crushed basic rock are surrounded by wisps and bands of hornblende-schist.

This feature is exhibited in the dykes in Canisp forest, about 2½ miles south of Little Assynt. Again, when the lines of shear in this direction coalesce, then the basic dykes are entirely converted into hornblende-schist, sometimes with a platy parallel foliation and abundant biotite on the divisional planes. These phenomena are admirably displayed along the belt extending from Canisp by Lochinver Bridge to Achmelvich Bay.

The evidence of the conversion of parts of the ultra-basic dykes into schists by the W.N.W. movements is no less clear. In the case of the picrite dyke that crosses the Inver at Brackloch and Inveruplan, the rock at the former locality is only slightly more altered than the typical example near Little Assynt, being still massive and containing olivine, hornblende, chlorite, and carbonates. At Loch nan Eun (a mile west of Brackloch), where the west branch of this dyke is affected by a shear-line, only a few grains of olivine are left, while the amount of chlorite and hornblende is increased. Further west, at a point 2½ miles north-west of Loch Inver and 4½ miles by road, the prolongation of the Brackloch dyke, is converted into a schist with chlorite, hornblende, and knots of siderite. Still westwards, on the seacoast, 3½ miles north-west of Loch Inver, and 300 yards south of the road to Stoer, a picrite dyke is found which appears to be a branch of the Brackloch intrusion. At its northern edge it is massive, but part of it is affected by shearing. A series of specimens ([\(S2938\)](#) [NC 048 263], [\(S2939\)](#) [NC 048 263], [\(S2940\)](#) [NC 048 263], [\(S2941\)](#) [NC 048 263], [\(S2942\)](#) [NC 048 263], [\(S2943\)](#) [NC 048 263]), when examined under the microscope, show progressive alteration into a perfect schist composed of chlorite, pale hornblende, and talc.

Apart from these main directions of movement, there is still another group trending north-east and south-west which has led to the reconstruction of both the basic dykes and gneiss. In the neighbourhood of Clashnessie Bay north of Stoer, a belt has been observed where the strike of the newer foliation is north-east and south-west, and where the interstitial movement of the constituents has been along nearly horizontal planes, without much, if any, disruption of the dykes.

These phenomena are well seen about a third of a mile south-west from the bridge across Clashnessie Burn, where the foliation of the hornblende-schist dips gently south-east — that is nearly at right angles to the course of the dyke. In connection with the deformation of the dykes, it may be mentioned that quartz-veins frequently appear in the bands of hornblende-schist.

This district furnishes abundant evidence that the pre-Torridonian movements which led to the reconstruction of the gneiss and dykes were completed before the deposition of the Torridon Sandstone. For example, at Steer, where there is an important outlier of that formation, the numerous shear-zones can be traced up to its margin, while pebbles of the deformed gneiss and of hornblende-schist occur in the bands of conglomerate which there appear. In like manner the lines of disruption can be followed up to the base of the Torridon Sandstone on Canisp, but they do not enter the sandstone. They likewise pass under the escarpment of Cambrian quartzite between Canisp and Suilven. Pebbles of the reconstructed granulitic gneiss and of hornblende-schist are found in the basal Torridon breccias in Canisp and at the east end of the Suilven outlier.

Inliers of Lewisian gneiss above the Glencoul and Ben More thrust-planes

Detached masses of Lewisian Gneiss appear in the areas affected by the post-Cambrian movements. Of these masses, the largest occur on Ben More, Assynt, and Sgonnan Mor, S.S.E. of Braebag, above the Ben More thrust-planes. Smaller areas are found in Was Bheinn and Beinn an Fhurain, north and east of Inchnadamff, on the hill between Ledbeg and Cama Loch, and at other places.

All these various masses include certain well-marked types, which are characteristic of the Fundamental Complex, between Scourie and Kylesku and in the Loch Inver region. These comprise ultra-basic rocks (pyroxenites and hornblendites), grey pyroxene-gneiss, and hornblende-gneiss with blue quartz. The general strike of the Lewisian gneisses in the Ben More inliers is N 1st W and S S E , and the early foliation is quite apparent; indeed, the old structures of the early basic masses can be readily recognised in all the corries on the north-east face of Ben More, in Corrie Mhadaidh, north-west of Ben More, and on Sgonnan Mor.

A remarkable feature is the abundance of basic dykes that traverse the gneiss and still preserve their north-west trend, though the detached and moved masses in which they occur over-

lie the Glencoul and Ben More thrust-planes. These dykes are well exposed on the gigantic cliffs and on the rocky floors of the great corries of Ben More. Most of the dykes consist of massive epidiorite, in some cases reaching 100 yards in breadth, and usually showing strips of hornblende-schist along their margins.

Dykes of picrite also occur, as, for instance, on the plateau west of Dhu Loch Beag, about three miles up the Oykel valley from Kinlochailsh, and again on the south-west face of Sgonnan Mor, close by the unconformable base line of the Torridon Sandstone.

Along its line of junction with the Torridon and Cambrian strata, the Lewisian gneiss has been sheared, rendered schistose and reconstructed, the planes of schistosity being parallel with the post-Cambrian thrust-planes.

Brief reference may be made to the normal faults that traverse the Lewisian gneiss west of the post-Cambrian displacements which give rise to many of the linear features in that plateau. On referring to Sheets 107 and 101, it will be seen that they belong mainly to one system, trending in a north-east and south-west direction. The existence of these faults has been proved in many cases by the slight change in the outcrops of the dykes and sometimes by the brecciation and discolouration of the gneiss. Other lines of displacement run in a W.N.W. and north-west direction.. The chain of lochs and hollows that extends from Loch Assynt by Gleannan Salach to Loch Poll affords an excellent example of the influence of the W.N.W. dislocations upon the topographical features of the country.

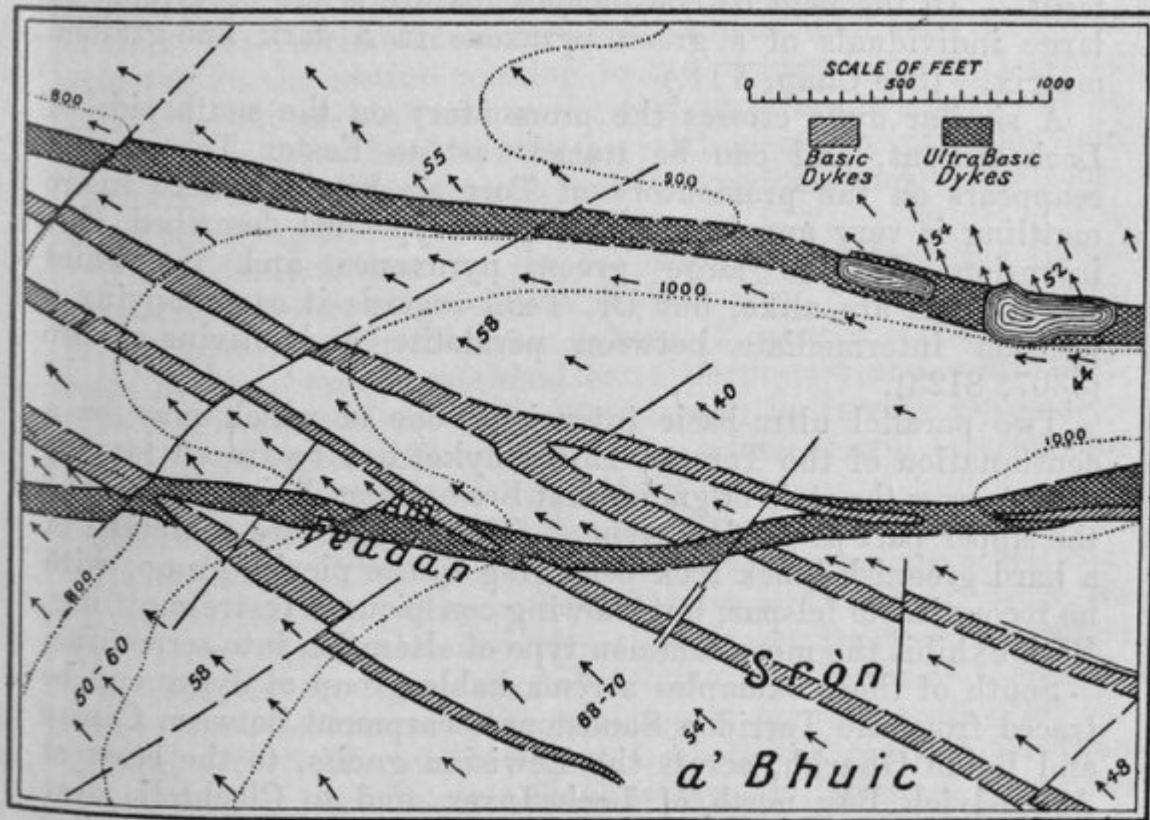


FIG. 7.—Intersection of the older epidiorite dykes by the later picrite intrusions on Sron a Bhuic, two miles south of the foot of Loch Assynt.

(Figure 7) Intersection of the older epidiorite dykes by the later picrite intrusions on Sron a Bhuic, two miles south of the foot of Loch Assynt.