
Chapter 12 Loch Maree and Gairloch district

By C. T. Clough, with notes by B. N. Peach, J. Horne, W. Gunn, and Greenly. The district described in this chapter is comprised in Sheets 81, 91, and 92 of the Geological Survey Map of Scotland on the scale of 1:63,360) one inch to a mile.

This district extends from the Fionn Loch, north of Loch Maree, to within three miles of Loch Torridon. Its northern limit is defined by a line running from the head of Gleann na Muice, by the northern slope of Beinn a Chaisgein Mor, and the north-west branch of Fionn Loch, to Loch an Eilein. Its southern boundary follows the Craig river to its source, and thence east to the south slopes of Ben Dearg. Its length from north to south is about 12 miles, and its greatest breadth about 9 miles.

Most of the rocks to be now described lie west of the ground affected by the post-Cambrian movements, and are included in two areas of approximately equal size, which are separated by a great fault that runs along the basin of Loch Maree and by the south-west side of Loch Ewe. The north-eastern portion may be called the Loch Maree-Carnmore area, and the south-western the Gairloch area. Along the margins of both of these areas the Lewisian gneiss is in most places covered unconformably by the Torridon Sandstone. The boundaries of the formations are of irregular shape, small inliers of gneiss are surrounded by Torridon Sandstone, while outliers of the Sandstone are found within the tracts of gneiss.

In the areas affected by the post-Cambrian movements the Lewisian gneiss reappears in several localities, the most important mass lying north of Kinlochewe. The Loch Maree-Carnmore area measures about ten miles in length and about five in breadth. The rocks are sometimes concealed under wide coverings of drift, particularly at the sides of Fionn Loch. The summits of A' Mhaighden, Beinn Lair, and Beinn a' Chaisgein Mor, all of which exceed 2800 feet in height, are covered with drift, though some of their sides form magnificent precipices. These hills lie in the eastern half of the district, and the general elevation decreases in a W.N.W. direction. The Gairloch area is generally rocky, the highest eminences lie towards its south-eastern borders, but no parts formed of Lewisian gneiss exceed 1400 feet in height.

The boundaries of the Lewisian gneiss in this district have been partly determined by lines of fault. The greatest of these dislocations, that of Loch Maree and Loch Ewe, forms the most striking topographical feature of the region. It might seem as if the Lewisian rocks on the north-east side of this fault had been shifted laterally in a south-east direction for a distance of about nine miles. As, however, the pre-Torridon land surface was singularly uneven on both sides of Loch Maree, and consisted of steep mountain-slopes with a pre-Torridon fault between, it is possible that the straight cliffs in which the Archaean rocks now end, both on the north-east side of the Gairloch area and the south-west side of the Loch Maree-Carnmore area, are of pre-Torridonian age, though there have certainly been movements along them in post-Torridonian times. The post-Torridonian fault near the head of Loch Maree seems to be a horizontal displacement along a vertical plane, the Fasagh N.N.E. fault being apparently shifted laterally to Grudie, a distance of nearly three miles in a north-west direction. The plane of this fault is nearly vertical, and a vertical downthrow could not account for its lateral shift.

Between Tollie farm and Loch an Iasgair, to the south-west of Loch Ewe, a fault, partly of pre-Torridon age, runs parallel to the Loch Maree dislocation, and towards the north-west forms the boundary between the gneiss and the Torridon Sandstone. Again, near Dubh Loch, four miles south-east of Gairloch, the most important of a series of north-east faults forms the boundary between the gneiss and the sandstone for more than a mile and a half, but is certainly in part of pre-Torridon age. Lastly, the north-eastern boundary of the gneiss area near Doire, on Loch Maree, and for a mile and a quarter north-west, is probably a post-Torridon fault.

One of the most interesting features in the geology of this district is the occurrence of a group of rocks which resemble altered sediments. They are found in each of the two areas, one prominent belt of them running along the southern edge of the Loch Maree-Carnmore area, and another broad band crossing the Gairloch area in a north-westerly direction. If these rocks are truly of sedimentary origin, they are probably as old as any examples of such deposits of which the stratigraphical position can be approximately determined in the British Isles.

The rocks which constitute the fundamental complex of the Lewisian gneiss cover the greater portion both of the Loch Maree-Carnmore and Gairloch areas. The basic dykes intrusive in that complex are in most places abundant. The acid intrusions are represented by pegmatites, and are here rare or thin except in the ground between Loch Tollie and Loch Doire na Herrie (three and a half miles E.S.E. of Gairloch), and also near the Dubh Loch of Carnmore.

Wide and comparatively gentle flexures, of pre-Torridon age, and with axial planes striking north-west, have folded the basic dykes in various places — for instance, south-east of Loch Tollie, south-east of Loch nam Buainichean, on Sron a' Choit, on the east side of Loch a' Ghobhainn, half a mile north-east of Folaiss, and near Carnmore. The broad flexure near Tollie is an anticline, with a general south-easterly pitch and a breadth of about two miles: the south-west limb dips steeply south-west or is vertical, while the north-east dips north-east at lower angles. The Carnmore fold is also an anticline of much the same breadth. Between these anticlines comes a compound syncline, which is seen between Beinn Airidh a' Char and Slioch. It is important to notice that these folds do not necessarily indicate the disposition of the rocks of the fundamental complex, for these rocks were in many cases already in a highly contorted condition before these later flexures were developed.

The plateau of Lewisian gneiss under or adjacent to the Torridon Sandstone is often stained red, as near Talladale (south side of Loch Maree), near Druim am Uamh (Gairloch), and on the west side of Meall Imireach (four miles W.N.W. of Poolewe). Dykes or veins of red sandstone or grit, from a quarter of an inch to several yards wide, cross the gneiss in many places. Examples of these may be seen in the Gairloch district by the side of the road half a mile west of the outlet of Loch Bad an Sgalaig, three-quarters of a mile E.S.E. of the outlet of Loch Braigh Horrisdale, on the west side of Meall Aundrary, close to the north side of Loch no' Feithe Mugaich, and on the flanks of Meall Each, near the head of Loch Maree. The material in the dykes is like that of the adjacent Torridon strata, but similar dykes also occur in the Torridon Sandstone.

Rocks of the Fundamental Complex

Ultra-basic rocks

These are in this district represented by hornblendite, biotite-hornblendite, peridotite or impure serpentine, and small bands and lenticles which consist almost wholly of biotite. Many thin bands and lenticles of hornblendite and biotite-hornblendite appear both in the early basic rocks and in the acid gneisses. Besides those in which the hornblende is black microscopically, others are almost entirely composed of needles of pale green actinolite. In some of the thicker black lenticles biotite occurs at the margin and hornblende in the interior.

A pale acid gneiss exposed in a burn about a quarter of a mile north-east of Carnmore Old House encloses various lenticles — the largest measuring ten yards in length — which consist in large part of pale-green actinolite. The outside of each is formed of a dark micaceous sheath, often about a foot wide, in which the biotite flakes are parallel to the adjacent side, while inside comes a rim, usually three or four inches wide, consisting chiefly of actinolite crystals with their long axes crossing it at right angles. In this rim also small spaces may be noticed, sometimes hexagonal in section and probably once occupied by garnet, but now with aggregates of brown and green mica. The interior parts of the lenticles consist of large crystals of green actinolite mixed with flakes of white talc (?). These lenticles are of particular interest because they contain scales of graphite more than a quarter of an inch long.

Other masses of ultra-basic rock of considerable size occur on the east side of Loch an Eilein, at the north limit of this district, on Croft Hill, south of Poolewe, and in the hornblende gneiss south of Tollie. These consist chiefly of hornblende rock, sometimes in association with biotite and thin strings of felspar and quartz.

Near the south-east corner of the Gairloch area patches of hornblendite or biotite-hornblendite were observed at the following localities: 1000 yards slightly south of west and half a mile E.S.E. of the west end of Lochan Druim na Fearna, rather more than a quarter of a mile S.S.W., and a third of a mile S.S.W. of Mullach nan Cadhaichean. The rock nearest the last-named locality is thrown into a series of small folds, in the cores of which most of the hornblende appears, while biotite is especially abundant in the limbs.

An exposure of serpentine, about 300 yards long, occurs about three-quarters of a mile south of the head of Loch na h'Oidhche (three and a half miles south of Slattadale, Loch Maree). It has been the source from which many boulders on the south side of Loch a' Bhealaich have been derived. This rock varies considerably in character, the surface tints being pale-grey, bluish-grey, green, or orange. The varieties that weather pale-grey contain many scales of talc (?), sometimes collected into veins, crystals of some ferriferous carbonate, and dark-grey or black fine-grained portions, forming hollows with a rusty surface, which are now composed of decomposition products of some earlier silicate. Some of the greener portions have a rough exterior, and contain stout crystals of decomposed enstatite (?). Most of the rock shows no foliation, but near the western end an obscure foliation dips at steep angles slightly west of south, and near the eastern limit E.N.E. About two-thirds of a mile south of Meall an Tuim Bhuidhe (five miles south of Shieldaig, Loch Gairloch) several lenticular masses of olivine-hornblende-peridotite have been noticed, which weather with an orange crust. In one of them the olivine is fresh and abundant and the hornblende colourless. Three-quarters of a mile northeast of Furnes (on the north side of Loch Maree) an outcrop occurs of an ultra-basic rock of variable composition, partly calcareous, and with portions softer than the finger nail. Some patches in it appear to be mainly composed of serpentine, but they also contain a cleavable mineral — presumably some rhombic pyroxene — from which the serpentine has been formed. Certain parts contain abundant flakes of chlorite and needles of tremolite, others consist almost entirely of crystals of dark-green hornblende. A few streaks of magnetite, about an inch thick, were noticed in one place.

Early basic rocks and hornblende gneisses

As a rule, the early basic rocks which form part of the Fundamental Complex are more variable in composition than the basic dykes, and contain more irregular streaks of quartz. In unsheared areas the margins of these basic masses and those of the basic dykes can be readily distinguished, the early basic rocks being so mixed with strings of acid gneiss that they can hardly be separated. This intermixture may perhaps be due, not so much to intrusion after the basic parts were solidified, as to segregation in a viscous magma and to movements in the partially differentiated mass.

Owing to their variability no satisfactory distinction can be drawn, in the field, between the hornblende-gneisses with, and those without quartz. Many of the early basic rocks are massive with only an occasional well-marked foliation. In these types the quartz occurs in thin opalescent strings, winding round eye-shaped masses of dark hornblendic rock, varying in length from a few inches to a few yards. The garnets in this series of rocks vary considerably in abundance and size, but here they are usually much smaller than those found in the Laxford and Kylesku district. Their presence cannot be taken as an indication that the rock in which they occur belongs to the early complex, for garnets abound in many of the basic dykes.

Rocks of the two groups characterised respectively by compact hornblende and a granular structure, and by hornblende in fibrous or other aggregates sometimes occur in the same area without a clear line of division between them. On the west side of Poolewe, and between Poolewe and Ob a' Choir'-uidhe (a bay in the west end of Loch Maree), where a large area of hornblende-gneiss is exposed, a specimen [\(S4187\)](#) [NG 886 762] obtained from near the south end of the mass is referred to the second group, while two others [\(S4992\)](#) [NG 846 811], [\(S4993\)](#) [NG 835 805], from near the north end, are assigned to the first. In the group with compact hornblende and granular structure, the hornblende is supposed by Mr Teall to be original, whereas in the group with aggregates of hornblende it is regarded as derived from an earlier pyroxene. It is possible that in some parts of one great igneous mass the predominant ferro-magnesian constituent may have been hornblende and in others pyroxene, and, after the alteration of the pyroxene, rocks of the two groups might be found in close association. It is necessary, however, to bear in mind that the hornblende in some of the foliated basic dykes is also of the compact type and indistinguishable from that in some of the gneisses. If the foliation in these dykes is a secondary structure produced after the solidification of the rock, the hornblende in them must also be of secondary origin.

As the granulitic hornblende-gneisses have been produced by shearing from the other hornblende-gneisses, it will be most convenient to describe them with their parent rocks. In the inlier the largest mass, rich in hornblende, stretches from near Doire, west end of Loch Maree, to Naast (two and a half miles beyond Poolewe) — a distance of six miles — and there are traces of it even as far as Inverasdale (west side of Loch Ewe). Its north-eastern boundary is formed by the great thrust or fault that skirts Loch Maree and Loch Ewe; its south-western margin is not well defined, but near Tollie the breadth of the belt from south-west to north-east is about two miles and a quarter. Near the south-western margin of the

basic mass the rock is rather evenly banded, dark hornblendic layers alternating with others of a paler tint. This type seems more common in the southwest limb of the Tollie anticline than anywhere else. On the south-west side of Loch Tollie the mass is more than half a mile broad.

The area embraced by the Tollie anticline is crossed by a series of pre-Torridonian faults and flinty crush-rocks that run in a general S.S.E. direction from about half-way between Loch Tollie and Tollie Bay. On one side of this series of dislocations the rocks somewhat differ from those on the other. On the east side, and particularly east of an imaginary line connecting Ob a' Choir'uidhe and Tollie Bay, a massive diorite is largely exposed, in which there is no clear plane-parallel-foliation, though a rodded or linearly-foliated structure can be recognised. The best sections may be seen on the headland, a mile W.N.W. of Ardlair, Loch Maree, and two-thirds of a mile west, and a mile north-west of this promontory. Most of the rock is paler than the basic dykes, and it contains many strings and rods of opalescent quartz. On the headland the felspar granules, many of which show distinct striation, are about the size of a mustard seed. The hornblende is often in grains of about the same size as the felspar, but rather less abundant. Where streaks of quartz occur, they generally lie close to others which consist almost entirely of hornblende. Where the rock is foliated, the paler folia are composed to a large extent of quartz, while the others are chiefly of hornblende. The folia often strike north-west, and are nearly vertical, but they are not generally granulitic. It is worthy of note that most of the basic dykes which traverse these early rocks have a similar trend and rarely display foliation. Some of them cut the foliation planes of the early basic material, and it is evident that the latter rock was foliated and often in a vertical position before the dykes were intruded.

Specimen [\(S4187\)](#) [NG 886 762], one of the rodded diorite-like rocks from the headland above referred to, shows no continuous parallel folia, but the hornblende and felspar have their long axes in one direction. In transverse sections no parallelism in the arrangement of the constituents can be perceived. The most conspicuous constituent under the microscope is a striated felspar, which occurs in irregular grains often of considerable size. The hornblende occurs in irregular patches, consisting of small grains and imperfect crystals associated with quartz.

About two-thirds of a mile south-east of the summit of Creag Mhor Thollie (two and a half miles S.S.E. of Poolewe), on an almost flat surface, many pieces of well-banded hornblende-gneiss may be observed within, or traversed by, a pale more acid gneiss which consists of felspar, hornblende, and occasional quartz. Some of the pieces in the flat surface are more than three feet long, and most of them have rather rounded outlines.

The folia in them are sometimes twisted and strike against one another. (Plate 10), (Plate 11) A similar brecciated structure also occurs in other parts of the same neighbourhood, and must have been in existence before the intrusion of the basic dykes.

In the early basic rocks, unusually acid and exceptionally basic parts are often found close together. Their association suggests that the banding and irregular mixing of the materials were produced while these were still in a viscous state. It is probable that the conditions under which the various parts of the earlier rocks were formed, or have at some time passed, differed from those which prevailed during, or subsequent to, the intrusion of the basic dykes.

The large basic mass two miles north of Loch Gairloch (Sheet 91), which forms Meall Glac na Daraich, is entirely isolated by unconformable Torridon Sandstone, and no outcrop of gneiss occurs within some miles of it. Consequently its relations to the rest of the gneiss are doubtful, but it probably belongs to the early basic group. In general, it consists of a coarse, massive, light-coloured diorite, [\(S4985\)](#) [NG 762 807] which shows little or no trace of foliation, but presents in places prominent divisional planes that dip south-east. A few narrow bands of fine-grained dark rock, [\(S4986\)](#) [NG 760 807], [\(S4987\)](#) [NG 761 806], [\(S4988\)](#) [NG 760 807], [\(S4989\)](#) [NG 761 804], which cross the coarser material in various places, are probably intrusive and rather of the nature of sills than of dykes. They seem mostly to trend north-west or W.N.W. and to dip southwest. Narrow zones of fairly well-foliated or sheared rock are found in a few places on the same hill, which run in the main in the same direction as the finer bands just described, and sometimes coincide with them.

In the promontory of Ard lalltaig, one mile south of Gairloch, a considerable amount of dark hornblendic rock is irregularly mixed with a more quartzose variety. In a central band, more than a quarter of a mile broad, the quartzose type contains broad streaks of opalescent quartz, many garnets, and large scattered crystals of hornblende. Small "augen" of felspar

are occasionally found. The dark and the pale parts sometimes occur in parallel folia, but more commonly the former appear as lumps round which the latter sweep. The central band is crossed by many thin zones of sheared granulitic gneiss, most of which are vertical and strike N.N.W. On either side of this band there are also sheared areas of some width. North-east of it, where the rocks are most deformed and finely granulitic, the gneisses are flaggy, vertical, and strike N.N.W., and are difficult to distinguish from the schists on their north-east side, which are supposed to represent altered sediments. Specimen ([S4342](#)) [NG 806 738] was taken as an example of one of the sheared zones within the central band. In the field, the obscure or irregularly arranged parts at the side of this zone are seen to be gradually dragged into parallelism, in a vertical position, so as to form the schistose material from which the specimen was taken. This specimen is a dark fine-grained rock which shows on the weathered face some white spots, about the size of peas, with curved tail-like processes. Under the microscope there can be seen various rounded grains of a mineral which is probably scapolite. The white spots are formed of more or less granulitic felspar, and the matrix consists of colourless microcrystalline material, with small flakes of pale-brown mica. In the section, ([S5128](#)) [NG 805 738], representing the massive rock at the side of the shear zone from which the scapolite schist was procured, no scapolite was found.

Excellent sections of early basic rocks occur about half a mile west, and half a mile south-west, of Mullach nan Cadhaichean. Some of the larger masses contain pieces of garnet varying in size from a pea to a hazel nut, and edged with rims composed of grains of white felspar.

North of Loch Maree, between Ben Slioch and the Folais Burn, hornblendic gneiss appears, and near the centre of the area various broad bands of hornblende-schist have been noted, the age of which is uncertain. An evenly banded variety with epidote often appears near the Letterewe limestone and on the north-east side of the thick hornblende-schist which accompanies this limestone.

Early basic rocks are also met with near the crag tops half a mile north-east of Carnmore, and on the west and north-west sides of Beinn a' Chaiagein Mor, to the north-east of Fionn Loch. Near the latter locality the basic material is much mixed with a pale-grey acid gneiss, either in broad masses or in thin irregular strings, which may cross the foliation of the basic rock. Large basic lumps are also enclosed in the acid gneiss. Most of the basic rock consists of hornblende-schist like that of the later dykes. The felspar is generally subordinate to the hornblende and in smaller grains. In some places the hornblende-schist and the acid gneiss are crossed by a second foliation which strikes W.N.W. parallel to the axial planes of various sharp folds. There seems no clear difference in structure between the hornblende-schist in which the hornblendes are parallel to the second foliation and that in which they are parallel to the broad banding.

Muscovite biotite gneisses

Perhaps the commonest rock in the early complex is a somewhat acid gneiss, carrying numerous flakes of black biotite and occasional muscovite. Oligoclase, microcline, and sometimes orthoclase, are also present, but the first-mentioned felspar generally occurs in excess, and occasionally to the exclusion of the others. Quartz is abundant and generally semi-opalescent. The structure is either granitic or granulitic. The types shade into one another, and the more granulitic are found in zones which have been sheared since the Intrusion of the basic dykes. Thin lenticles and inclusions of hornblendite, biotite-hornblendite, and hornblende-schist occur in abundance in certain places. This muscovite-biotite-gneiss often contains abundant "augen" composed of felspar, or of felspar with a small proportion of quartz. In three of the specimens that have been sliced the felspar in the "augen" is for the most part microcline or microperthite. In a fourth it is chiefly, if not entirely, oligoclase. The "augen" generally occur somewhat sporadically; in a few places, as, for instance, rather more than a third and nearly half a mile south of the foot of Loch Tollie, thin fairly well-defined bands contain them in special abundance. Thin strings of augen-gneiss occasionally penetrate the early basic rocks, isolating pieces of them and cutting the banding. On the other hand, augen-gneisses are cut by many basic dykes.

Muscovite-biotite-gneiss forms an extensive bare area on the north-east side of the thick hornblende-schist which runs through Meall Fuaraidh, Sithean Mor (east of Gairloch), and Meall Aundrary, between Gairloch and Loch Maree. South-west of the main zone of presumably Archaean sediments in Gairloch it is very prominent, and perhaps, as a rule, is there more rich in felspar eyes than on the north-east side. It occurs in Kerrysdale in association with altered

sediments, and sometimes mixed with them in thin parallel bands in a greatly sheared condition; also north-west of Dubh Loch (three and a half miles south-east of Gairloch), where it is traversed by thin bands of hornblende-schist, and again between Shieldaig and Braigh Horrisdale.

The north-west part of the tract of gneiss between Folaig and Slioch consists almost wholly of acid augen gneiss, over an area about a mile and a half long from north-west to south-east, and between half and two-thirds of a mile broad. The rock northeast of the Gleann Tulacha and Strathanmore (north-east of Loch Maree) altered sediments, and between Fionn Loch and the Torridon rocks on the west is chiefly biotite-gneiss with felspar augen". Similar material forms bare tracts near Germ Loch Mor, on the north-east side of Eilean Fraoch in Fionn Loch, and on the west slopes of Beinn a' Chaisgein Mor.

in many places the gneiss, whether with or without "augen", contains thin subparallel strips of redder tint than the rest, some coarser and others finer in grain than the gneiss in which they occur. Both coarse and fine varieties are well seen in the area about a mile and a third S.S.W. of Beinn Lair (two miles northeast of Letterewe, Loch Maree), where the fine strings generally stand out in relief and weather with smoother surfaces than the rest of the rock. All the strings are truncated by the basic dykes, and must be of older date. They are usually only about an inch thick, but in places so crowded that they form a considerable proportion of the whole rock. Apart from the redder streaks, an early banding, older than the basic dykes, is indicated in some places by variations in the amount of mica, or by thin parallel basic streaks and lenticles, but in many places little or no indication of this structure can be seen.

The matrix in which the "augen" are embedded has in most districts a pale-grey tint, but a red hue prevails for some distance off various lines of crush. In the sheared rocks the quartz chiefly occurs in long folia which frequently sweep round the "augen", but among the less sheared types this mineral projects in an irregular network on weathered faces, and is often opalescent. Most of the "augen" vary from the size of a small pea to that of a walnut, but a third of a mile south-west of Feachaisgean (Fionn Loch), an example of one was seen four inches long and three broad. In the fresh rock these eyes generally appear of a more pink colour than the small felspars, and in most of the larger specimens are composed of more than one felspar individual.

In certain sheared areas numerous thin thrust-like lines occasionally displace the early banding. Some of these perhaps existed before the dykes, though the rocks in which they occur have been subsequently altered in structure. In some exposures about a mile S.S.E. of Feachaisgean various sharp twists in the early banding are accompanied with lines of discordance. These lines are represented by streaks which are not more granulitic than the adjacent bands, and as there is no second foliation parallel to them, it seems probable that they were caused by movements which took place before consolidation.

Inclusions of hornblende-schist, or of dark well-foliated hornblende-gneiss, with the folia ending bluntly at the sides, have been noticed in many places, but more numerous than these are small lenticles and streaks of hornblende, biotite-hornblendite, and biotite rock. Round the margins of these lenticles an obscure banding is often indicated by dark micaceous layers, which are crossed by a second foliation, and probably existed before the intrusion of the basic dykes.

In a few places where the shearing has been intense, the felspar augen have been granulitised and pulled out into long streaks, but much more frequently the shearing has gone round these inclusions without much altering them. The exposures on the hillside a mile E.S.E. of Loch Braigh Horrisdale (south of Shieldaig on Loch Gairloch), show the augen gneiss comparatively unaltered. Here the basic dykes are foliated only in part, and show intrusive characters. Common planes of foliation of secondary origin often traverse both the dykes and the augen gneiss. These secondary planes generally strike north-west, and are parallel to the sides of the dykes, but they sometimes can be traced from the gneiss into the dykes. At the same place in two thin zones of the gneiss the early bands become suddenly vertical, or are sharply contorted along axial planes that strike W.N.W. In these zones the bands are considerably thinned, and the quartz and felspar granules in them become smaller and more elongated — all in one direction.

Rather more than a mile south-west of Loch Braigh Horrisdale a second foliation strikes in the unusual direction of about N.N.E., and thin zones of shearing run north and south. In the south part of the large inlier on the east side of Allt a' Ghiubhais an occasional second foliation strikes north-east. It is accompanied with contortions along axial planes in this

direction. At each of these localities the basic dykes run northwest, and the unusual trend of the second foliation cannot be due to folding of a second foliation which had originally a different direction. In the inlier, three-quarters of a mile east of Loch na h-Uamha (four miles S.S.W. of Shialdaig on Loch Gairloch), and in the area west and south of Meall an Tuim Bhuidhe (five miles south of Shialdaig), parts of the acid gneiss show no distinct early banding nor yet any second foliation, even though the adjoining basic dykes are foliated.

A little north-east of Lochan Druim na Fearna, some fine schists appear, which are supposed to have been formed in part from an acid augen-gneiss. They form a narrow valley which runs north-west from the side of Dubh Loch. Weathering with a yellow colour, they are very micaceous and fissile, and contain many small augen, often about half an inch broad, together with streaks of quartz and felspar. On the north-east side of the valley a much sheared augen-gneiss winds round a large piece of hornblende-gneiss. The latter does not show much alteration, the shearing movement having gone round it. The quartzo-felspathic matrix is finely granulitised, but the felspar-augen are not. Some of the fine granulitic schists with small felspar-augen are mixed with the mica schists at the south-west side of the main zone of the Archaean sediments of Gairloch, from which they can with difficulty be distinguished. Augen schists of this character are well seen in the banks of the Kerry about a quarter of a mile below the large waterfall.

Near the crushes on the north-east side of the thick hornblende-schist, about a mile and a half south-east of Loch Bad an Sgalaig (three miles S.S.E. of Gairloch), the shearing has sometimes gone so far as to transform the large felspar-augen into long lenticles composed of minute granules. These lenticles are red while the surrounding matrix, in consequence of its abundant biotite, appears dark grey. Many of the augen near the mylonised bands on the west side of the burn rather less than a mile north-east of Furnes have also been partially granulitised and deformed.

The gneisses in the narrow strip on the north-east side of Loch Maree, between the promontory near Regoilachy and Fasagh, are medium-grained and show a tolerably well-marked parallel structure of a flaky or lenticular type, but no well-defined banding. Near the loch the structures generally strike northwest and are vertical, but there is evidence everywhere of intense contortion. None of these gneisses are free from strain, though this feature is least marked in those by the loch. As they recede from the loch the gneisses become more and more crushed along lines of dislocation which are nearly vertical and strike north-west and W.N.W. These lines also traverse the basic dykes and frequently throw them, or even, near the northeast margin of the gneiss area, cut them up into small lenticles.

Most of the gneisses of Meall Riabhach and Smiorasair differ from those in the Regoilachy-Fasagh strip in being much more regularly banded. They are chiefly hard, grey, rather massive gneisses, with not much biotite, and with a lack of lenticular flaky or wavy structures. The gneiss is, as a rule, granitic rather than granulitic, but displays strong indications of cataclastic action in certain parts ([S4280](#)) [NH 008 665].

In some places within the plicated area near the Dubh Loch of Carnmore (south-east end of Fionn Loch), as, for instance, near the centre of the anticline, no distinct first nor second foliation can be traced. A little south-west of the centre, on the northeast sides of Gleann Tulacha and Lochan Fada, the gneiss is less massive and shows a foliation that dips S.S.W., often at angles between 30° and 60°, while on the north-east side the general dip is steep, often about 70°, in a north-east direction. An earlier broad banding is, however, not unfrequently observed which is crossed by this second foliation, and it must be remembered that the anticlinal arrangement refers only to the dykes, and the various older structures are now difficult to trace.

While most of the Carnmore gneiss is more granitic than granulitic in texture, it includes a zone in which the foliation is finer than usual, and wherein the structure may be partially granulitic. This zone keeps at the side of the folded and foliated basic dyke which crosses the stream a third of a mile east of Fuar Loch Mor, and can be traced more than five miles. It contains more quartz veins than the adjacent gneiss, and shows various thin thrust-like lines parallel to the dyke. The zone probably acquired its finely foliated character in consequence of movements which took place near the side of the dyke before it was folded into its present form.

Where the felspar "augen" are absent the gneisses near Carnmore bear a resemblance to some of those near Laxford and also to the less fissile rocks in the plicated tract south-east of Loch Tollie, but the rodded structure is not so apparent as in the latter tract. The Loch Tollie and Carnmore areas resemble the ground near Laxford in containing pegmatites

later than the foliation of the basic dykes, and the gneisses there have probably at some pre-Torridonian period been covered by a greater thickness of rock than those in adjacent tracts.

The biotite gneiss west of Fionn Loch near the north limit of the district is generally- coarse-grained, grey in colour or sometimes pinkish, and with rude or irregular foliation. A low anticline — no doubt a continuation of that at Carnmore — crosses this area in a nearly east and west direction from a little southwest of Eilean Fraoch towards the south end of Loch Ghiuragarstidh (two miles east of Poolewe). The northern dip of the foliation from this central line is at first about 30° or 40°, but it increases in a northward direction, so that near the northern boundary of the area it becomes nearly vertical. The southerly dip from the anticlinal axis is S.S.W. at angles of 30° or 40°. Near Kernsary a number of minor folds are accompanied by thrust-lines along which the rock is finer in grain and more evenly foliated, generally with abundant white mica on the foliation-planes. The gneiss on the north and north-west sides of the Beinn Airidh a' Char (three and a half miles N.N.W. of Letterewe, Loch Maree) hornblende-schist is generally fine in grain and well foliated, often displaying much white mica on the foliation-planes. Some of the specimens which have been sliced show marked signs of cataclastic structure, while others are granulitic.

Basic dykes

Well developed in this district, these dykes display the characteristic features which have been already described in the districts further to the north. In those areas where they have been least altered they strike towards north-west and are nearly vertical, as may be typically seen in the examples on the headland a mile W.N.W. of Ardlair, on the hill-slopes west and south of Meall an Tuim Bhuidhe, and near Braigh Horrisdale. In such situations they partially reveal their original structure and composition. In only two instances, however, both of which came from the headland on Loch Maree nearly opposite Ardlair, has any original pyroxene been detected. A minor amount of alteration is shown where they have passed into epidiorite, but the great majority of them have been so thoroughly altered as to have become hornblende-schist. Occasionally the original igneous structure has not been effaced, as in the case of a dyke near Sithean Mor (2¼ miles south of Gairloch), which has preserved an unusually perfect ophitic grouping of its constituents, and in this respect the dyke resembles many of the Central Highland sills more than the dykes of Scourie<ref>This dyke is mentioned again in this chapter.</ref>.

Near Meall an Tuim Bhuidhe two dykes have been noted, each almost free from foliation, and presenting large scattered aggregates of felspar in a black fine-grained crystalline matrix. One of them is well seen about half a mile, and the other about 1500 yards, S.S.W. of the hill top. Under the microscope [\(S4193\)](#) [NG 813 640] the edges of the aggregates are seen to be frequently indented by small crystals of hornblende, and to blend with the general mass of the rock, which is a granulitic aggregate of hornblende and felspar. The felspar appears to be an oligoclase-andesine, and contains small inclusions of hornblende.

But even where the material of the dykes has become distinctly schistose, the forms of some of the original minerals may occasionally be detected. Thus, between Loch Garbhaig, north of Ben Slioch, Loch Maree, and the north and south burn, rather more than a mile west of that loch, various bands of hornblende-schist contain somewhat idiomorphic porphyritic forms composed of granules of felspar. One of these bands, about 1000 yards W.N.W. of the outlet of the loch, is composed of different layers that vary slightly in character; some of them show the porphyritic forms, often about half an inch long, so crowded together as to equal in bulk the rest of the rock, while in other layers these inclusions are rare or absent. Again, about 1000 yards north-east by north of Furnes, a hornblende-schist appears, parts of which are full of porphyritic forms of felspar giving lath-shaped and squarish sections. Near the sides of the schist, and along certain bands in the interior of the dyke, these felspars have been sheared, and are represented by thin parallel streaks.

The basic dykes vary in breadth from a few inches to 100 yards or more. The same dyke may likewise differ considerably in width at various parts of its course. Thus, three-quarters of a mile north-west of the outlet of Loch Braigh Horrisdale a dyke has a breadth of about 110 yards, but a quarter of a mile further north-west it measures only 40 yards.

In two of the unfoliated dykes, one, already referred to, on the headland W.N.W. of Ardlair, and the other 200 yards south-east of the top of Sithean Mor, 2¼ miles south of Gairloch, two distinct types of material have been observed which may belong to successive intrusions. In each case the coarser rock appears to be the older, but it may perhaps not have

thoroughly cooled when the other material was injected; for in the last-mentioned dyke coarse veins, like the segregation veins of an igneous magma, cross both varieties of rock.

The dyke just referred to shows no foliation in the centre where it is an ophitic-dolerite, yet contains several fine-grained bands, a yard or two broad, that display sharp junctions with the coarse rock. Some of these were traced 20 or 30 yards nearly parallel to the sides of the dyke mass in which they occur. The fine-grained type is composed of the same materials, but shows a micro-porphyratic structure.

In most of the foliated dykes the foliation is parallel to the sides of the dykes. The margins are more closely foliated than the interiors, and in the broad dykes are often finely schistose, while the central portion may remain, wholly or in part, in a massive condition. Not unfrequently closely foliated parts wind round large eye-shaped masses of less foliated, or even massive, rock. A dyke half a mile south-east of Sithean Mor ($2\frac{1}{4}$ miles south of Gairloch) exhibits a string of such masses, about a yard broad and from two to four yards long, connected together by narrow constrictions and having their long axes parallel to the trend of the dyke.

That the foliation in the dykes in the Loch Maree district is in most cases parallel to their margins, and most perfectly developed near the sides, is no doubt due to the fact that most of the movements which gave rise to the foliation have, in this district, proceeded along the lines of the dykes. These movements have often had less influence on the contiguous gneiss than on the dykes, many of which are well foliated, while the adjoining gneiss shows comparatively little alteration.

Few bands of hornblende-schist, which can be proved to represent dykes, show so close a foliation as that frequently observable in the thick hornblende-schists associated with the altered sediments in the Lewisian gneiss. There can be little doubt, however, that some of the very finely-foliated thin bands on An Ard (Gairloch), and between there and Loch Kerry, represent dykes, for they are flanked by gneiss on either side. The intensity of shearing which has produced the very close foliation has probably sufficed to destroy the evidence of the intrusive character of many of the bands.

Where the dykes are foliated throughout in directions transverse to their course, the foliation in them corresponds with a second foliation in the gneiss, or with an early banding which has been thinned and modified. In the latter case, the modified banding represents both the first and second foliation. In a section nearly a mile slightly north of west of Mullach nan Cadhaichean, the foliation in a dyke is transverse to the side, and the second foliation in the gneiss is parallel to the axial planes of some small folds which are seen in the gneiss, but which do not seem to affect the margins of the dyke. As the foliation planes in the dyke are continuations of the second foliation planes in the gneiss, the foliation in the dyke must have been produced at the same time as these folds, though no indications of folding are to be observed on the sides of the dykes. The foliation which has been produced simultaneously in both gneiss and dykes is in some districts so strong that it obscures the early broad bands which existed in the gneiss before the dykes were intruded. These early bands have also been dragged so that their outcrops are almost parallel to the dykes.

Although the mechanical deformation which the dykes have thus undergone has to a large extent destroyed the evidence of their intrusive character, abundant satisfactory proofs of their original injection into the surrounding rocks have been obtained in many areas, particularly near Loch Braigh Horridail, and Meall an Tuim Bhuidhe. Near Lochan Druim na Fearna various bands of hornblende-schist can be traced for a mile or more keeping so nearly parallel to the limestone that their original dyke-like character might well be doubted, were it not for the phenomena seen a little further south-west, where, after passing many parallel bands of similar schist separated by thin strips of gneiss, we reach, near Mullach nan Cadhaichean, a series of hornblendic bands which are generally less sheared than those near the limestone and display repeated evidence of intrusion.

On the north-east side of the thick hornblende-schist near Loch Bad an Sgalaig, Loch Airidh a' Phuill, and near Meall Airidh Mhic Criadh, between Loch Gairloch and Loch Maree, the parallelism of the foliation planes in the dykes and gneiss is marked. The rocks at the last locality lie in the steep southwest limb of an anticline of later date than the basic dykes, and during the folding they have been sheared and partly dragged into parallelism. The central parts of the same arch contain bands of hornblende-schist which are, as a rule, rather coarser in grain than those on the Meall, and often possess a linear instead of a plane-parallel foliation. Between the hornblende-schist bands in the centre of the fold and those on the Meall many others occur. Although at no place is there any sudden change in character, yet in the centre of

the anticline, where it may be supposed that there has been less alteration by dragging and shearing than in the south-west limb, nearly every hornblende-schist shows clear indications of intrusion.

Some of the hornblende-schists in the gneiss area between Folais and Slioch (north-east of Loch Maree) show their original intrusive character. This is best seen about half a mile southwest and half a mile south of the outlet of Loch Garbhaig. The dykes are distinctly folded and lie near the axial plane of the great syncline of Folais and Beinn Airidh a' Char. The sides of some of them strike steadily north-east for several hundred yards and are inclined at gentle angles.

Over a large part of the ground west of Fionn Loch gently-inclined bands of hornblende-schist are certainly intrusive in the gneiss. On the north side of the anticline in that area the Meall na Meine basic band, which is 300 yards wide near the Ordnance station, chiefly consists, both here and to the west, of a massive, coarse diorite or epidiorite with little foliation extent along its southern edge. The rock dips north with the gneiss, and is grey in colour with white felspar. Further east it is sheared almost throughout, becomes a much narrower band, and before reaching Fionn Loch disappears. The mass forming Meall Dhuireadh Airde appears to dip north-east and to underlie that of Meall na Meine, yet it maybe the same rock repeated by an isoclinal fold. A marked line of shear intervenes between it and the similar mass that comes on a quarter of a mile south-east, which may be again the same band. This outcrop has an irregular outline, but in the main runs in a southerly direction, dipping at a comparatively low angle and spreading out on the dip slope. It distinctly crosses the strike of the gneiss foliation.

A broad band of the same kind of rock, with a southerly dip, runs east towards Fionn Loch, and this is probably connected with the mass north-east of Kernsary (two and a half miles south-east of Poolewe). At Loch nan Carn it has a breadth of at least 250 yards, and it dips S.S.W. at 30° or 40° nearly coincident with the adjacent gneiss, though it clearly crosses the foliation of that rock. South of Kernsary a coarse massive epidiorite, partly foliated, trends in a N.N.E. direction. Its west boundary is fairly regular, but from its east side project two spurs which may be due to folds. It is more than 200 yards wide at its south end, but narrows considerably in a northerly direction. Its relation to the ordinary dykes is doubtful.

After their intrusion many of the dykes underwent a process of shearing by which intense foliation was produced. In certain cases folding took place later than the production of the first foliation. In some areas the dykes have been thrown into sharp folds with axial planes striking north-west, almost parallel to the original direction of intrusion, so that the dykes in the limbs of fold do not differ much in direction from those which have not been plicated. Near the centres of other more gentle folds, the divergence from the original directions is conspicuous, and, for distances of a quarter of a mile or more, dykes strike north-east and dip at low angles, so as to look like sheets rather than dykes.

If vertical dykes are affected by folds the axes of which are horizontal, it appears that the sides of the dykes will remain vertical, though different points in the margins must receive an upward or downward motion, and the horizontal distance between points which are not in the same vertical line must be decreased. Similar movements will affect the whole of the interior parts of the dykes, and hence a foliation may be produced throughout the rock. In other cases, as, for instance, near the top of Meall Airidh Mhic Criadh and nearly a third of a mile north-west of Loch Doire na Herrie, the sides of a dyke are clearly plicated, and the foliation in the dyke is parallel to the axial planes of flexure and the second foliation in the adjoining gneiss. In these cases the pitch or inclination of the axes of fold is steep.

In a nearly horizontal exposure, about 250 yards south-east of the outlet of Loch nam Buainichean (two and three-quarter miles E.S.E. of Gairloch), a dyke can be seen to have been first foliated parallel to the side, and for a short distance inwards from the margin, and then subsequently plicated and further foliated in a direction parallel to the axial planes of fold. The foliation planes parallel to the side are folded, and crossed by strain slips parallel to the axial planes of fold.

It is noteworthy that nearly all if not the whole of the foliated dykes which occur in the areas S.E. of Loch Tollie, between Folais and Slioch, near the Dubh Loch of Carnmore, near the Sron Choit (one mile west of Talladale), N.N.E. of Beinn Bhreac (six miles S.S.E. of Shieldaig on Loch Gairloch), and east of Loch a' Ghobhainn (two miles north-east of Beinn Bhreac) must have been foliated throughout before they were plicated, for their foliation planes share in the folding of the dyke outcrops.

In several places it would seem that the more gentle folds which plicate the outcrops were preceded by others-which folded them more sharply. Thus, on the east side of Loch Garbhaig, south-west of Talladale, the great fold which folds the outcrops has an axial plane that strikes slightly west of north, and its axis is almost vertical. In two or three places on the east limb the dyke rocks are arranged in such a way as to suggest that they have also been sharply folded along axial planes which now strike N.N.E.

In the more sheared areas it is occasionally difficult to decide whether the irregularity of form of some intrusions is due to folding or not. About a third of a mile north-east from the south end of Lochan Sgeireach, in an area in which the dykes are almost free from foliation, two dykes unite, and in the space between them a third appears which gradually dies out as it approaches the place of union of the other two. Similar arrangements are also seen about 700 yards east and half a mile north of Loch nam Buainichean, and in other places. In the dykes cited from Loch nam Buainichean the appearances are no doubt due to folding.

The hornblende-crystals always lie parallel to the foliation planes of the foliated dykes, and they have usually a general direction — the direction of stretching — on these planes. Some of these directions are shown by signs on the published one-inch map (91) which only indicate their horizontal projections. To find the actual trend in space note has to be taken also of the dip of the planes on which the indications are seen, which may be assumed to be the same as that shown by the nearest of the dip signs on the map.

In the south-west limb of the Loch Tollie anticline the variations in direction of the stretching lines are considerable. When the lines appear diagonal, their upper ends are sometimes on the south-west and sometimes on the north-east side, but in various places, for instance, about 700 yards E.S.E., and half a mile south-east, of the head of Loch Tollie, and rather more than half a mile north-east of Meall an Spardain, the lines are nearly horizontal and parallel to the strike. In the north-east limb of the anticline the lines generally appear diagonal, and with their upper ends on the north-west side. Near Meall Lochan Chleirich (one mile west of Slattadale, Loch Maree) the stretching lines are more nearly with the direction of the foliation dip than with the strike, and their upper ends are on the south-east side. They are in some places affected by minute folds, the axes of which cross them nearly at right angles.

In the foliated dykes three-quarters of a mile N.N.W., and a mile and a third north-west, of Carnmore Old House the stretching lines are 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. In the dykes two-thirds of a mile north-east of Strathanmore, and about 1000 yards south-east of the foot of the Dubh Loch of Carnmore, the stretching lines appear diagonal and their upper ends are on the north-west side.

In the most finely foliated dykes the hornblende crystals are thin and needle-like, but in others they present stout or stumpy forms. In specimen [\(S4434\)](#) [NG 856 766], obtained 1100 yards north of Meall an Spardain (two and a half miles south of Poolewe), from a dyke which is now composed of a rodded or linearly foliated hornblende-schist, the hornblende is compact and indistinguishable under the microscope from that which occurs in the typical granular hornblende-gneisses.

Flakes of biotite are common on the foliation planes of the best-foliated dykes near Beall Airidh Mhic Criadh, south-west of Loch Tollie, Poolewe, in the area between Folais and Slioch, and near Strathanmore (Fionn Loch). Near Carnmore several thin bands of hornblende-schist are much more micaceous than others near them. One of these, about three feet thick, makes a conspicuous recess in the crags rather more than a quarter of a mile north-east of the Old House. Other thin bands of a similar kind occur on the north-east side of the N.N.E. fault rather more than two-thirds of a mile north-west of the Old House, about 1500 yards slightly west of south of the outlet of Lochan na Bearta (three miles east of Fionn Loch), and 300 yards W.N.W. of Meall Lochan a' Chleirich (one mile west of Slattadale, Loch Maree).

Some of the foliated dykes which contain conspicuous flakes of biotite, or chlorite, may have originally differed slightly in composition from the others. But the unusual abundance of these flakes may possibly be due to the greater intensity of the shearing which the dykes have undergone. Satisfactory evidence has been obtained in several places that after dykes had been converted, wholly or partially, into hornblende-schist, renewed movements took place which transformed the dyke-rock, whether it was previously foliated or not, into a shivery micaceous or chloritic schist. An example of this

change has been found near the top of Sithean Mor, south of the village of Gairloch, where a massive epidiorite has become a shivery micaceous hornblende-schist with foliation-planes parallel to a line of thrust.

Again, about half a mile north of Meall an Spardain, a coarse almost vertical N.N.E. pegmatite, a foot or two thick, which crosses a broad hornblende-schist, is sheared parallel to its own sides, and the hornblende-schist near it is also in some places Converted, for a thickness of a few inches, into a fissile chloritic schist, the foliation planes of which are often crumpled, though their general direction is parallel to that of the pegmatite.

About 700 yards E.S.E. of the head of the Dubh Loch of Carnmore a quartz vein, from 12 to 20 feet thick, appears within a thick hornblende-schist which represents a foliated and folded dyke. The schist dips north-east at gentle angles. The vein lies nearer the base of the schist than the top, and is almost parallel to the base. Above it comes hornblende-schist of the common type, but the schist below is biotite-actinolite-schist, the foliation planes of which dip steeply south. The quartz-vein probably marks a line of movement, the foliation-planes of the schists at either side of it striking against one another. The vein contains scattered hornblende crystals, streaks of biotite-actinolite-schist, and irregular patches, as much as a foot thick, of a coarsely crystallised carbonate which contains some diopside.

Some of the foliated dykes contain grains of magnetite of the size of small peas, as may be seen in the crag about a mile slightly north of west of Loch Garbhaig, north of Slioch. These grains are generally elongated in one direction, and are often bounded in part by grains of quartz. In a hornblende-schist, on the west side of the burn rather more than two-thirds of a mile north-east of Furnes, magnetite specks are so abundant that hand-specimens affect the compass.

Garnets, sometimes as large as peas, have been abundantly developed in some of the foliated dykes. They never show good idiomorphic outlines, and most of them are edged with a thin rim of small granules of felspar. They are also often accompanied by small white spots, which seem entirely composed of such granules. Both the garnets and the white spots are particularly common in the dykes which lie between lines connecting Loch Shildaig, south of Gairloch, and Busbheinn, on the north-east side, and Port Henderson and Beinn Bhreac, on the south-west.

The garnetiferous hornblende-schists are often divided into parallel layers, some of which are much richer in garnets and white spots than others. These sometimes agree in direction with the side of the dyke and the planes of foliation, and sometimes are oblique to the margins. About 1500 yards S.S.W. of the inlet into Loch Gaineamhach (three and a half miles S.S.E. of Shildaig on Loch Gairloch) a folded dyke contains much Crumpled bands in which white-edged garnets are specially abundant. This crumpling no doubt took place during the plication of the dyke. The bands are crossed by a foliation that strikes north-west parallel to the axial planes of fold. About 700 yards S.S.W. of Mullach nan Cadhaichean (two and a quarter miles S.S.E. of Shildaig on Loch Gairloch) the white spots and garnets have in certain places been deformed and affected by a foliation, but in most of the hornblende-schists such is not the case. It is probable, therefore, that the shearing and foliation which sometimes affect the garnets . are later than the foliation found in most of the dykes. A broad dyke about 700 yards E.S.E. of the outlet of Loch Braigh Horrisdale, which is closely foliated at the sides, but almost free from foliation in the central half, displays abundant white-edged gamete and white spots in the foliated parts, but none could be found in. the middle portion. The formation of the garnets probably accompanied the development of the foliation. No garnets with white rims have been noticed in any dyke which is quite free from foliation. There are garnets in an unfoliated dyke in the headland a mile W.N.W. of Ardlair (north-west end of Loch Maree), but these have no white rim.

The best examples of "rodded" or linearly foliated dykes occur between Tollie Bay and Ob a' Choir-uidhe (a bay at the west end of Loch Maree), and on the north-west side of Doire: especially clear are those which successively appear a third of a mile east, rather more than a quarter of a mile south-east, and three quarters of a mile slightly east of south from the summit of Creag Mhor Thollie. In the exposures of these dykes, which happen to cross the direction of rodding almost at right angles, no plane-foliation is observable, the ends of rod-like parts being only exposed. It is not known that the dykes in the area between Tollie Bay and Ob a' Choir-uidhe have been folded, but those near Doire have certainly been.

Some of the sheared dykes N.N.W. from the outlet of Loch Braigh Horrisdale include veins with greenish-grey crystals of one of the minerals of the epidote-zoisite group. At a place half a mile N.N.W. of the loch the veins are half an inch thick,

and cross the dyke almost at right angles.

Ultra-basic dyke

Only one ultra-basic dyke, composed of hornblende, has been noticed in this district. It is seen rather more than a mile and a quarter W.N.W. of Ardlair. In the published one-inch map (91) it has been coloured like the basic dykes. It runs northwest parallel to broad dykes of epidiorite, is a few yards thick, and has only been traced about 100 yards. It is not foliated, and its intrusive character is quite clear.

Syenite dyke

About a third of a mile south-east of Carnmore Old House a thin dyke may be seen, from five to eight feet thick, extremely coarse in texture, and chiefly composed of hornblende and microcline. Some parts of it are massive, others, particularly near the south-east side, are foliated parallel to the margin. The dyke can be traced 160 yards in a N.N.E. direction with occasional twists. It shows a rather low

inclination towards S.E. The hornblende crystals in this dyke are sometimes three-quarters of an inch long, appear dark-green macroscopically, and contain inclusions consisting of granular aggregates of reddish microcline. The felspar is generally subordinate to the hornblende in amount. The dyke contains some thin veins of still coarser grain than the general mass,

Pegmatites

Pegmatites of later age than the basic dykes are abundant in two areas in the Loch Maree district, one near Loch Tollie and the other near Carnmore. The former stretches from Naast, on the south-west shore of Loch Ewe, to Loch Doire na Herrie, four miles S.S.E. of Poolewe, and the latter from the sides of the Dubh Loch for about three-quarters of a mile. They appear in the gneiss of the Fundamental Complex, in the dykes and in the altered sediments. As they are harder than most of the rocks in which they occur, they form prominent exposures or crags in the partly drift-covered areas. Most of them are irregular in direction and small projections and branches appear at their margins. In both the Loch Tollie and Carnmore areas the most general trend is perhaps towards north-west, irrespective of the foliation of the rocks which they traverse. In the crags 1500 yards south of Carnmore, where the strike of the gneiss varies between east and north-east, the transgression of the pegmatites across the foliation is remarkably clear.

The common constituents of these pegmatites are plagioclase, orthoclase, and microcline felspar, biotite, muscovite, and quartz, but the proportions of these minerals vary considerably in different exposures. For example, biotite is sometimes largely developed, as in a pegmatite a third of a mile south-west of the summit of Creag Mhor Thollie, where the flakes are several inches long, and in another instance, three-quarters of a mile S.S.W. of Tollie Farm, similar scales exceed four inches. In other places this mineral is scarce or absent altogether. The white mica (muscovite) sometimes reaches larger dimensions. In the crags north-east of Carnmore it often occurs in idiomorphic crystals from one to three inches long and from a quarter to one inch thick in a direction across the basal cleavage. In the tumbled blocks from a white pegmatite a mile and 200 yards west of south of Carnmore, some of the crystals are ten inches long and three or four broad. The larger crystals are often cleaved transversely to the basal plane. The folia are generally somewhat bent and occasionally sharply twisted.

Most of the pegmatites in the Carnmore and Coppachy areas (north-east of Loch Maree) contain more white felspar than red. In the tract north-east of Carnmore the white felspar is sometimes enclosed within the red. Intergrowths of two felspars are common in these rocks as, for example, north-east and a mile and 200 yards west of south of Carnmore. A specimen tumbled from a vein at the last-mentioned locality consists of large crystals of orthoclase, intergrown with plagioclase. Another, from a pegmatite more than a third of a mile north-east of Carnmore Old House, consists of a large individual of microcline containing muscovite and quartz. Graphic intergrowths of quartz and felspar appear in pegmatites in the crags 1500 yards south and north and north-east of Carnmore and on the north-east side of Lochan Fada. In a vein, about three inches wide, in the crag about 1500 yards south of Carnmore the outer parts are composed solely of

quartz, while the inner consist of quartz and felspar.

Both in the Loch Tollie and Carnmore areas the rocks in which the pegmatites are found are near the centres of anticlines, and may have been covered by considerable thicknesses of material at the time of the introduction of these acid veins. Many pegmatites cross dykes of hornblende-schist, though themselves free from foliation, or only partly sheared, along lines formed since the foliation of these intrusions.

No thick massive pegmatite which shows clear evidence of folding has been detected, but the movements which plicated the various mylonised rocks between Folaiss and Slioch probably took place after the introduction of the pegmatites, as mylonised pegmatites adjoin the folded bands. Zones of mylonised pegmatite are common, but, excepting in the tract just mentioned, are rarely more than a foot or two thick. The pegmatites near Coppachy have more often been mylonised than the adjacent rocks, and the mylonised examples contain numerous eye-shaped pieces of pink or white felspar, some of them as large as a hen's egg, in which one cleavage plane crosses the entire breadth. Felspar crystals of such a size are rare in any of the Archaean rocks, except in the pegmatites. Most of the pieces have rounded outlines and look like corroded phenocrysts embedded in a fine-grained streaky pale-grey or greenish-grey felsitic matrix. The subparallel streaks of which the matrix is composed vary in translucency, and are often so thin that thirty can be counted in a thickness of half an inch. They wind round the sides of the felspar "augen", and are sometimes also sharply folded. On the surfaces of the streaks small flakes of a nearly colourless mica may usually be observed. Many of those flakes are from 1–10 to 1–20 inch in length, and considerably twisted. They occur sporadically, and perhaps they have been derived from larger flakes which existed in the pegmatites before they were mylonised. In the thin slice of a specimen ([S4775](#)) [NG 986 692], from a mylonised pegmatite half a mile north-east of Coppachy, the microscope discloses many minute scales of white mica which have probably been formed during the shearing. In the same slice some of the felspar "augen" show twin lamellae which have been bent and twisted.

The greenish fine-grained rock, about 50 yards north-east of the mica-schist zone on the south-east side of Smiorasair (near the head of Loch Maree), probably a mylonised pegmatite, is hard, very fresh, weathering only in a narrow dirty white film, and sharply jointed. Its fracture is conchoidal. Microscopic examination shows ([S4277](#)) the matrix to be crypto-crystalline and the grains in it to be composed of felspar and epidote. The felspars sometimes show plagioclase striation and give definite extinction. An analysis of the rock by Mr. Barrow gave the following result

Silica	72.9
Alumina	13.85
Ferric oxide	1.85
Lime	1.17
Magnesia	0.72
Potash	5.21
Soda -	2.49
Loss on ignition	1.5
	99.69

The broad pegmatite 200 yards south-west of Meall an Doirein (three and a quarter miles south of Poolewe) is sheared along a zone, several feet wide, which is nearly vertical and strikes parallel to the adjoining gneiss. The unsheared parts of the pegmatite consist of large crystals of red felspar and quartz, with little or no mica. In the sheared zone most of the felspar is granulitised, almost white in colour, and arranged in thin streaks parallel to the sides of the zone, but there are also eye-shaped pieces of felspar, an inch or two wide, which still retain the original red colour and the old cleavage planes. The quartz has also become finely granulitic, and has been pulled into streaks parallel with those of the felspar.

Subsequently to the first shearing of the pegmatites movements of later but still pre-Torridon age have in some places produced compact flinty rocks, such as appear about 350 yards east of Meall an Doirein.

Rocks presumably of sedimentary origin associated with the Lewisian Gneiss

General relations and distribution

It was the general belief of the old observers that the Lewisian Gneiss, like the primitive gneiss everywhere, is as a whole of sedimentary origin. In later years, when the igneous character of many of these rocks had been recognised, Dr. Hicks^{<ref>On the Pre-Cambrian Rocks of West and Central Ross-shire. *Geol Mag.*, 1880, p. 104.</ref>} maintained that some of the schists near Gairloch and Loch Maree were metamorphosed sediments. In the detailed mapping of the region the Geological Survey has endeavoured to separate certain bands which would by general consent be classed as probably altered sediments, but it is possible that future investigation may indicate that other zones not here included may also be of sedimentary origin. A satisfactory separation of those schists and gneisses which have the most sedimentary aspect from the other foliated rocks which seem to be of igneous origin — the ortho-gneisses — seems at present impossible. Many of the supposed sediments have ill-defined margins, and both they and the adjoining gneisses have been much sheared and crushed. It is noteworthy that one of the commonest of what are taken to be sediments is a flaggy brown mica-schist, resembling granulitic bands which in Sutherland have in many places been formed along pre-Torridon shear-lines from more massive gneisses.

There is no proof of the intrusion of the gneissose rocks of the Fundamental Complex into the supposed sediments, nor yet of the unconformability of the latter on the former. In certain places bands of marble and of kyanite-gneiss lie within gneisses of common type in the complex, and pass gradually into them. It is suggested that these gneisses may be in part of sedimentary origin, and may belong to a formation of the same age as the limestone. The bands of kyanite-gneiss and one of the marbles lie at some distance from the most-sheared areas, and in districts where the intrusive characters of many of the basic dykes remain distinct.

The evidences of shearing and crushing, in and near to most of the sedimentary zones, are generally greater than in the adjacent rocks. Great intrusions of igneous material, most of them now in the form of hornblende-schist, appear also to have been injected along the margins. Most of the rocks which have been mapped as altered sediments present smooth features in the landscape and show comparatively few rock-exposures. They contrast strongly with the bare hummocky areas of gneiss at their sides, and with the crags of hornblende-schist associated with them.^{<ref>Near Scourie and Loch Inver, however, equally smooth features characterise some of the pre-Torridonian sheared rocks which have been formed from massive gneiss.</ref>}

In Gairloch the chief belt of these altered sediments extends for seven or eight miles in a south-east and north-west direction, from a mile and a quarter south-east of Loch Bad an Sgalaig to the coast east of An Dun and the road between Strath and Poolewe, and there are traces of it about two miles further northwest. Its width is about a mile and a quarter, half of which is occupied by bands of hornblende-schist or hornblende chlorite-schist. Consisting for the most part of a fine-grained brown mica-schist, it contains also various bands of limestone, graphite-schist, and quartz-schist or quartz-magnetite-schist.

There are other detached smaller bands, one of which strikes south-east from Loch Kerry (at head of Loch Gairloch), reaches the river Kerry about half a mile S.S.E. of Kerrysdale, and can be traced thence nearly to the foot of the Dubh Loch. The distance between it and the Bad an Sgalaig belt diminishes in a south-east direction, and on the south-east side of the fault near the Dubh Loch it is possible that the two are united. (See Sheet 91) Another band composed of brown mica-schist occurs about 170 yards south of the Free Church Manse at Gairloch. On the south-east side of Shildaig a band of micaceous or chloritic schist, 120 yards broad at its greatest width, often calcareous and with outcrops of marble, emerges from beneath the Torridon rocks. The marble bands north and south-east of Lochan Druim na Fearnna are probably continuations of those near Shildaig. Near these bands thin outcrops of granular quartz-rock can be seen. Again, bands of marble make their appearance near the north-west side of Am Feur Loch, nearly a mile and a half E.S.E. of the outlet of Loch Bad an Sgalaig, on either side of the bay near Gairloch Bridge, 160 yards above the foot of the Kerry, and at a few others places.

Along the north-east side of the Loch Bad an Sgalaig belt a series of nearly vertical pre-Torridonian flinty crush-rocks is exposed, separated in places by thin strips of gneiss from the altered sediments, or the adjacent broad band of hornblende-schist. Possibly other thrusts may have preceded the flinty crushes, and may exist where the latter are not seen. The thin bands of hornblende-schist in the gneiss on the north-east side of the broad band seem to have been folded along axial planes that make a slight angle with the outcrop of the thick hornblende-schist. It seems as if the latter were bounded on its north-east side by a great line of discordance.

Some difficulties present themselves if we suppose the altered sediments of the Bad an Sgalaig belt to lie in a complex syncline with gneiss on either side. No thick hornblende-schist appears at the south-west margin like that at the north-east, while all the bands of graphite-schist lie nearer to the south-western than to the north-eastern boundary. Near Bad an Sgalaig four outcrops of hornblende-schist appear in the south-western half of the band, but only one in the north-eastern (Sheet 91). These difficulties can, however, perhaps be explained by supposing, (1) that the hornblende-schist does not keep strictly to the bedding planes, (2) that some beds have been cut out in certain places by crush lines running parallel with the strike, (3) that thrusts have affected the great north-east limb of the supposed syncline, and (4) that the number and depth of the minor folds in the syncline vary in different parts.

A gneiss with felspar augen — a common type in the early complex — prevails on the south-western side of the Bad an Sgalaig belt of sediments. In several places near the same margin a fine flaggy augen-schist, which lies close to, and sometimes is mixed with, the mica-schists, might conceivably represent sheared pebbly sediments, but is more probably a sheared form of massive augen-gneiss like that a little further south-west.

That the Loch Kerry band of sediments is perhaps bounded by thrust lines on both sides is suggested by the following considerations. Some hornblende-schists in the gneiss on the northeastern margin do not seem to be affected by a large fold which plicates part of the sediments. The evidence for a line of discordance on the south-west side is stronger. On the hill a mile S.S.E. of Kerrysdale a thick band of hornblende-schist, with nearly vertical pitch, is folded along an axial plane striking north-west and south-east, the nose of the fold pointing northwest. The rocks on the north-east side of the hornblende-schist, and some thin partings in this schist, are the presumably sedimentary mica-schists and graphite-schist, which ought to appear on the south-west limb of the fold. But those in the latter position form a valley, are extremely sheared, and differ from the mica-schists on the other side in containing many small augers of felspar, and alternations of siliceous and dark hornblendic bands which perhaps represent sheared forms of gneiss.

In (Plate 30), Section A, an attempt is made to represent what appears to be the probable relations of the chief groups of rock in the Gairloch area as they occur along a line of traverse from near Shildaig in a north-easterly direction to near the foot of Loch Maree.

The altered sediments on the north-east side of Loch Maree closely resemble those of Gairloch, with which they were probably once continuous. Like them, they are associated with broad outcrops of hornblende-schist, and consist for the most part of mica-schist, graphite-schist, and limestone, with bands which may represent altered quartzite and chert. The broadest development of these rocks stretches from Letterewe to Fasagh, and may be called the Furnes belt. Its length from north-west to south-east is about five miles, and its greatest breadth, including various outcrops of hornblende-schist, nearly three-quarters of a mile. Another, which may be called the Gleann Tulacha belt, can be traced from Lochan Fada along Gleann Tulacha to near Strathanmore, and thence round the north and west sides of Beinn Airidh a' Char till it approaches the side of Loch Maree, rather more than half a mile north-west of Ardlair. In some parts of Gleann Tulacha it may perhaps be a quarter of a mile wide, but to a large extent it is covered with drift.

Between the Furnes and Gleann Tulacha belts several minor bands can be followed north-west from the west part of Loch Garbhaig. One is visible on the south-east side of Beinn Airidh a' Char, and a second in a north and south burn from two-thirds of a mile north to 150 yards west of Folais. Both of these bands are affected by a common system of folds along axial planes striking north-west and south-east. For convenience of description these may be referred to as the Beinn Airidh a' Char and Folais bands. The latter contains the Letterewe limestone, formerly quarried near Folais, and traceable for several miles. A large fault runs from the foot of Loch Garbhaig to the side of Loch Maree a mile north-east of Reigoilachy, on either side of which the arrangement of the rocks is different. On the north-west side the Folais and Furnes bands are separated by a broad outcrop of hornblende-schist, and no similar outcrop appears on the north-east side of the Letterewe limestone. On the south-east side of the fault, broad bands of hornblende-schist appear on both sides of the Folais band, and a zone of mica-schist which occurs near the limestone can be traced south-east until it coalesces with the Furnes mica-schist.

Another thin band crops out in the burn a little east of Meall Each, south-east of Slioch, which probably represents one of the belts near Loch Garbhaig, but it is separated from them by a cover of Torridon Sandstone.

A key to part of the structure of the south-western portion of the Furnes band is given at Regoilachy burn. All the way between Fasagh and that stream, in spite of frequent contortions, the hornblende-schists and the altered sediments seem in most places to be vertical. But, at the great crag overlooking the south side of the burn, the hornblende-schist is seen to be in a sharp synclinal fold, and the mica-schists pass, with many contortions, underneath it. The apparent verticality in this district is produced by intense and rapid puckering within the large folds, so that across the crest of an anticline, or the centre of a syncline, the prominent inclination appears vertical on both sides. The graphitic and other schists north-west of Smiorasair probably on the whole dip nearly with the slope of the hill, so that a small change of dip, or of the declivity of the hill, suffices to alter the form of their outcrop.

The tectonic relations of the altered sediments to the northeast of Loch Maree are far from clear. The Gleann Tulacha, the Beinn Airidh a' Char, and the Folaiss bands, as well as the hornblende-schists which separate them, are certainly all folded into a complex syncline, the north-east limbs of which generally dip south-west, while the south-west limbs are themselves plicated, sometimes dipping north-east and at other times southwest. The hornblende-schist between the Furnes and the Folaiss bands is separated from the hornblende-schist which overlies the Gleann Tulacha belt by the Beinn Airidh a' Char sediments. Hence these bands of hornblende-schist cannot be the same, nor can the Furnes band be the same as that of Gleann Tulacha, unless the rocks were already folded before the development of the compound syncline, which is not an improbable supposition.

An attempt is made in (Plate 30), Section B, to show what are supposed to be the general tectonic relations of the rocks between Loch Maree and Beinn a' Chasgein Mor. The section is drawn several miles south-east of the north-western apex of the compound syncline, and does not show the evidence that favours the supposition of the existence of an earlier fold.

The thick hornblende-schists north-east of Loch Maree seem to have been foliated before the mylonising movements, for many pieces enclosed within the mylonites are indistinguishable from these schists. There may have been two periods of flexure later than the foliation of the hornblende-schists, and separated from one another by an interval during which certain rocks were mylonised. It also seems probable that the movements which plicated the mylonites in the Folaiss area were later than the broad flexure that affected the basic dykes near Carnmore, for the pegmatites and mylonites near the latter place seem to have been unaffected by folding.

Near the foot of the burn half a mile east of Isle Maree, and again on the hillside a mile and 350 yards S.S.E. of the top of Beinn Airidh a' Char, the hornblende-schist which there lies below the mica-schist approaches close to the hornblende-schist that lies above and on the east side of that zone. The two bands may conceivably belong to one sheet which has been plicated at different times, first so as to include the mica-schist between the two limbs of an acute fold, and thereafter to plicate the limbs of this early flexure and the mica-schist between them. On this supposition, the places where the upper and lower bands of hornblende-schist approach each other are near the axis of the early fold. In some parts of the hornblende-schist, particularly in the area between a mile and a mile and a third N.N.W. of Folaiss, the foliation-planes are twisted by flexures with axial planes striking north and south, both limbs having east. Such plications are of the type which would account for the two bands of hornblende-schist being portions of one folded sheet.

It is not improbable that the Gleann Tulacha belt of sediments may be separated from the gneiss beyond by a line of thrust, for the north-east side of the Beinn Lair hornblende-schist and the Gleann Tulacha sediments, appear to cross the direction of some basic dykes in the gneiss further north-east. Some thin mylonised bands run with the Gleann Tulacha sediments, but they have not been seen north-west of Meall Mheinnidh, and perhaps some earlier line of thrust keeps along the junction of the sediments and the gneiss.

In the section rather less than a mile above the head of Lochan Fada a pale-grey rock, a few feet thick ([S4408](#)) [NG 986 737], comes between the Gleann Tulacha sediments and the gneiss on the north-east side. It differs from the gneiss in colour and in containing few or no parallel quartz-streaks, but conspicuous long prisms of hornblende. The quartz and feldspar grains show cataclastic characters, but many of the hornblende prisms have idiomorphic terminations, are unstrained, and contain grains of the quartz and feldspar. In the field it seemed as if this pale rock might possibly belong to the altered sediments, the hornblende having been developed by metamorphic action. The constituents are, however, the same as those in the red gneiss, with the exception of hornblende and possibly of orthite. Perhaps the pale rock should

be regarded as a sheared form of the adjoining gneiss, though the foliation-dips in the coarse gneiss on the north-east side of the glen are much the same as those in the sediments. The boundary between the pale rock and the red gneiss is not sharp, but a specimen ([S4407](#)) [NG 986 737] of the latter, taken at a distance of two or three feet from the pale rock, is granular rather than granulitic in structure. -t

A quarter of a mile south of Furnes, and between Regoilachy and Fasagh, the mica-schists are separated from the loch-side by gneiss with many bands of hornblende-schist, most of which certainly represent basic dykes. The line between the gneiss and the mica-schists is a pre-Torridonian dislocation. Between Regoilachy and Fasagh the gneiss and the dykes become more and more crushed as they are traced away from the loch in a north-east direction towards the mica-schists. The gneiss is first crossed by many strings of a compact purplish-brown flinty, or felsitic-looking, material. Then the external aspect becomes affected, the rock weathers white, and the flinty material becomes general. The dykes are similarly affected but to a less extent. Both in the gneiss and dykes the flinty rock can often be seen to follow the planes of dislocation. The fault which bounds the gneiss on the north-east side has probably an upthrow to the south-west, but whether the crush phenomena observed in the gneiss are due to this line of movement is doubtful. Perhaps it is a later dislocation along an old line of weakness. The section in (Figure 10), which has been drawn from information supplied by Mr. Greenly, shows the general structure from Loch Maree, 600 yards south-east of Regoilachy, to the south-west slope of Slioch. About 600 yards south-east of Smiorasair burn, at a place where a marked feature appears at the northeast margin of the lochside gneiss, the gneiss seems to pass into the flaggy brown mica-schist, and the latter might be held to have been formed from the former by mechanical metamorphism. But perhaps a portion of the schist has been caught on the upthrow side of part of the fault, and has been so crushed with the gneiss that the rocks cannot now be distinguished.

In the centre of the syncline embracing the Folais and other bands of sediment massive pinkish gneisses are intersected with many bands of hornblende-schist, some of which are certainly altered basic dykes. These may be called the Leth Chreag<ref>Leth Chreag is the name of a crag in which this gneiss and the hornblende schists are unusually well seen. It is not named in the one-inch map, but it lies about a mile W.N.W. of Loch Garbhaig and trends N.N.E.</ref> gneiss. In their present position these gneisses usually overlie the Folais and other sediments over an area four miles long by three-quarters of a mile broad, but this is not always so, there being some places where the south-west limb of the syncline is vertical or dips south-west. It is not certain that this super- position was originally brought about by thrusting, for the present synclinal arrangement of the rock-masses is later than most of the mylonising, and it cannot be determined how the mylonites were inclined before the syncline was formed. Possibly they were nearly vertical. Nor can the amount of movement be estimated which has taken place along the mylonites that now underlie the Leth Chreag gneiss, seeing that before the movement the sediments and associated rocks may have been folded, so as to be flanked by the more massive gneissose rocks on either side.

The various members of the series of presumably altered sedimentary deposits and their associated rocks in the district of Loch Maree and Gairloch will now be described in the following order: (1) Mica-schists; (2) Mica-actinolite-schists; (3) Graphite-schists; (4) Granular-quartz-rock; (5) Quartz magnetite-schists and Quartz-schists; (6) Quartz-hornblende-schists; (7) Limestones; (8) Calcareous Biotite-hornblende-schists; (9) Kyanite-gneiss (10) Cumingtonite-garnet-schist; (11) Chlorite-schists; (12) Hornblende-schist and hornblende-chlorite-schist; (13) Hornblende-schists with brown mica and pyrites; (14) Actinolite-schists without either quartz or felspar.

(1) Mica-schists

A flaggy brown mica-schist is the most common type of the altered sediments, and is especially abundant in the Gairloch area. It has a close resemblance to a mica-schist near Findlater Castle, Banffshire, but, unlike it, does not in most parts contain actinolite. Owing to the presence of small specks and streaks of pyrites, it often weathers with a rusty surface. Its foliation planes are coated with small flakes of white, black, or bronze-brown mica, and it splits readily along the filiation, but the cross fracture is rather conchoidal. Good exposures of this schist may be seen by the road half a mile south of Meall Aundrarry, on the south side of A' Chosag, and in the burn at the side of the wood west of An Groban, all situated to the east and south-east of Gairloch. These several outcrops lie in the same broad band which stretches from the Torridonian rocks on the north slopes of Bus-bheinn to the road between Strath and Poolewe. The width of this band is in many places nearly half a mile, but it diminishes on the north-west side of Loch Mhuilinn. On the south-west side of this

broad band, and separated from it by hornblende-schist, various thinner bands have been observed.

On the north-east side of Loch Maree the mica-schists are much mixed with thin graphitic-schists. They also contain in many places large crystals of dark actinolite — a mineral which appears to come in sporadically. Those schists in which it is specially abundant are described in the sequel (Sec. 2, p. 224). Near the path between Letterewe, and Fasagh a band of mica-schist extends about five miles in a north-west direction. North and north-west of this band various much-folded zones of mica-schist appear at the sides of or between outcrops of fine hornblende-schist, like that forming the bulk of Beinn Lair. One of these bands strikes north from about half a mile east of Isle Maree for about a mile and a half. Another occurs in Gleann Tulacha, below the Beinn Lair hornblende-schist. Other outcrops are found near the top of Beinn Airidh a' Char, between the heads of the two burns which run westward from this hill, and north of the limestone quarry on Am Marcach.

In Gleann Tulacha a dark-brown foliated rock is seen on either side of the limestone in a little burn two-thirds of a mile above the head of Lochan Fada, on the north-east side of the limestone in a section rather less than a mile above the head, and in other places. It is more massive and felspathic than the common type of mica-schist in Gairloch, and contains epidote crystals, some of which are half an inch long. Biotite generally considerably preponderates over white mica, but large plates of the latter mineral sometimes lie across the foliation-planes. Calcite occurs in some bands as an essential ingredient in close association with the granulitic feldspar and quartz. Small grains of black iron-ore and scattered prisms of tourmaline can often be seen with the unaided eye. In specimen [\(S4413\)](#) [NG 986 737], from 1540 yards W.N.W. of Lochan Fada, part of the feldspar is microcline.

Scattered crystals of hornblende may occasionally be observed. In the section rather less than a mile above Lochan Fada the mica-schist is mixed irregularly with a coarse gneissose rock containing large crystals of green actinolite, epidote, pink and white feldspar, and some quartz, the dark and the pale constituents being sometimes separated in subparallel folia. The actinolites, in the dark parts are sometimes grouped in radiate forms as much as an inch in breadth. These two types of brown mica-schist and coarser gneissose rock are often arranged in parallel bands. The schist sometimes shows a structure resembling bedding, which is crossed by a foliation in the same direction as the banding in the coarse rock. In some places the junctions between the two rocks are much complicated, and parts of the brown rock appear to be included in the other.

The more siliceous mica-schists weather with a pale-grey crust, and often project somewhat from the other mica-schists with which they are associated. When broken across the foliation they show a conchoidal fracture which sometimes presents a vitreous lustre. In Gairloch they never form broad outcrops, and in the mapping of the ground they have not there been separated from the other mica-schists. They may be seen on the west side of the Kerry slightly west of south of Kerrysdale, 200 yards south of Lochan Dubh nan Cailleach (in bands six or seven feet thick), and about 700 yards E.S.E. of Kerrysdale. In the area north-east of Loch Maree siliceous mica-schists are more common. A broad band of them runs close to the path from near Letterewe to near Regoilachy; other exposures are met with east of Furnes and near Coppachy.

A specimen [\(S4196\)](#) [NG 842 721] of the hard mica-schist from the roadside a quarter of a mile south of Meall Aundrory (two and a half miles south-east of Gairloch) was found, under the microscope, to be essentially composed of a fine-grained mosaic of water-clear grains and minute flakes of pale-brown mica, with iron-ore and tourmaline (scarce and in fragments) as accessories. Another specimen [\(S4787\)](#) [NG 965 700] obtained half a mile north-west of Inishglass (on the north side of Loch Maree) contains a number of small pink garnets which are just large enough to be discerned by the eye and lens. Garnets also occur in the thin bands of mica-schist interbanded with graphite-schist on the hillside nearly a mile south-west of Beinn Lair.

The more micaceous mica-schists never spread over large areas either in the Gairloch area or in that to the north-east of Loch Maree, and they have not been mapped separately from the others. Half a mile slightly east of south of the foot of the Dubh Loch, Gairloch, the shore of the lake exposes bands composed of crumpled folia of brown and white mica, with idiomorphic garnets, interstratified with more siliceous schists. On the shore of Loch Maree, 150 yards slightly west of south of Inishglass, garnets are also specially abundant in the more micaceous schists. The thin band of altered sediments in the burn east of Meall Each includes a silvery garnetiferous mica-schist, only a few feet thick, which is

described by Dr. Teall as a type specimen.

No clastic grains have been detected in any of the mica-schists. In some places, as, for instance, on the shore of Loch Maree, 150 yards slightly west of south of Inishglass, the foliation planes of the schists display many thin quartz-veins in which a white felspar occurs in scattered eyes, which are often thicker than the quartzose parts of the veins in which they occur. Thus, in one of the veins that has an average width of three-quarters of an inch, an eye of felspar was noticed an inch and a half broad. Many of these eyes have only short extensions of quartz at their sides, and might on cursory examination be mistaken for clastic grains. Most of them show one cleavage-plane extending across their whole breadth. The mica-schists have been repeatedly folded. Owing to their fineness of grain, it is difficult to discern to what extent they have also been affected by cataclastic or mylonising action. Microscopic examination shows, however, that in many places the granulitic constituents have been strained and crushed, or broken down into streaks of finer granules. Mylonised structures, where not seen in the schists themselves, are sometimes visible in thin pegmatites within the schists. Examples of such sheared pegmatites have been observed near the thick hornblende-schist a quarter of a mile north-east of Furnes (on the north side of Loch Maree), about 700 yards slightly east of north of Coppachy, and in various places rather more than two-thirds of a mile slightly south of west, and again 1500 yards S.S.E. of Coppachy.

Some of the brown flaggy schists on the south-east side of Beinn Airidh a' Char should probably be regarded as mylonites into the composition of which mica-schist and also other rocks have entered. In a section near the south-west edge of the thick hornblende-schist a mile south-east of the hill-top, the brown schist contains lenticles and eyes of finely foliated hornblende-schist like that of the thick band. Many of the lenticles are two or three feet long, and the folia in them end abruptly at the margins of the lenticles, while the planes of the brown rock wind round the margins.

Mica-schists are occasionally crossed by flinty or halleffinta-like streaks which seem to be due to intense crushing. Examples may be seen about 200 yards east of Regoilachy, about 1500 yards S.S.E., and half a mile north, of Coppachy, and in a band rather more than a mile slightly west of south of Beinn Lair.

(2) Mica-actinolite-schists

Mica-schists with long needles of actinolite are not uncommon. The brown mica and actinolite are frequently accompanied by large garnets, thin calcareous streaks, and specks of pyrites which give a rusty colour to the weathered surface of the rocks. Thin bands of such schist may be seen in Gairloch at the following places: near the south-west side of the thick hornblende-schist nearly half a mile south-east of Loch Bad an Sgalaig; at the north-east side of the thick hornblende-schist half a mile south-east of the outlet of the Dubh Loch; about 700 yards S.S.W. of Lochan nam Breac; at the north-east side of the thick hornblende-schist 100 yards west of Am Fear Loch, and along the strike north-west. In the area north-east of Loch Maree schists of this type form a considerable proportion of the bands of micaceous-schist which run from near the top of Beinn Airidh a' Char towards the west end of Loch Garbhaig. Examples may also be seen in the burn that flows into Loch Maree about half a mile east of Isle Maree, at the edge of the thick hornblende-schist rather more than two-thirds of a mile slightly south of east of Furnes, in Gleann Tulacha, 350 yards S.S.E. of Strathanmore, about half a mile slightly east of north of Ardlair, and east of Am Marcach.

While in some of these schists the hornblendes are small and sparsely scattered through the micaceous matrix, in others only a few yards distant these minerals may be half an inch broad and two inches long and may preponderate over the matrix, sometimes combining in radiate shapes, with arms nearly parallel to the foliation of the rock and the flakes of brown mica. Macroscopically they are dark-green or black, but in thin slices often nearly colourless, and crowded with small inclusions of granulitic materials. Most of the garnets have rounded edges, or they occur in lumps with their long axes parallel to the foliation. In the band three-quarters of a mile south-west of Beinn Lair, the larger garnets have rounded outlines and coats of biotite, while the smaller have no such coats and are idiomorphic.

These forms of mica-schist include calcareous portions which vary from the thinnest streaks to bands a foot or two thick, and often cross the foliation planes of the rock, or enclose rounded pieces of the schist. In a band within the thick hornblende-schist half a mile south-west of Meall Mheinnidh, north of Letterewe, the transgression of the calcareous streaks and the inclusion of hornblendic parts is well seen. Some of the hornblendic lenticles appear to have been derived from a rock which was first sharply folded and then broken along the limbs of flexure. A considerable proportion

of the calcareous matter would therefore appear to have been introduced into its present position either at the time of, or subsequently to, various thrusts and mylonising movements. Some lime may perhaps have been liberated by chemical changes taking place during these movements, for instance, by the conversion of part of the hornblende into biotite. But these rocks were probably originally calcareous, and most of the substance of the calcareous streaks may have been derived from other parts of the bands. The ready solubility of calcite would enable it to travel from one part of the rock to another, and to collect in the lines of thrust.

In a specimen ([S4761](#)) [NG 956 733] taken from about 1500 yards slightly west of south of the lochan on Meall Mheinnidh, the schist has been considerably sheared. It contains some large grains of hornblende and of garnet round which the thin laminae of the matrix sweep. The hornblende fragments show strain shadows, and one of them in the thin slice is crossed by microscopic faults. Some of the garnet pieces are full of cracks which do not go into the matrix and which were probably produced during the mylonisation. In slice ([S4766](#)) [NG 935 735], made from a rock two-thirds of a mile slightly east of north of Isle Maree, the grains of water-clear material enclosed in the pieces of hornblende are generally larger than those in the matrix, which may be accounted for on the supposition that they were protected by the enclosing hornblende from the crushing movements. In a schist ([S4411](#)) [NG 999 735] observed about 300 yards north-west of the head of Lochan Fada many needles of pale-brown tourmaline can be seen under the microscope, some of them broken and slightly faulted. A few quartz-tourmaline veins have been noticed in the schists on the north-east side of Loch Maree.

(3) Graphite-schists

These form thin bands from a few inches to rarely more than a few feet in thickness, much intermixed with mica-schist or mica-actinolite-schists. The graphite never occurs in distinct scales, but in irregular clots, shreds, and small particles which sometimes exist as inclusions in the other minerals in the schist. In some places these inclusions prove not only that the graphitic rocks existed as schists, but also that these schists had been much contorted and crushed before the formation of the minerals which contain the graphite. One of the common enclosing minerals is actinolite in feathery and radiate forms. The graphite-schist, for instance, which crops out about 1500 yards S.S.E. of Beinn Lair is hard, has a sharp metallic ring when struck, and contains folia particularly rich in graphite, some of which is traceable through the actinolites ([S4427](#)) [NG 975 717].

At a locality nearly a mile south-west of the same mountain a dozen alternating laminae of more or less graphitic schist are sometimes visible within a breadth of half an inch. The extreme thinness of these laminae, however, may perhaps be due to their having been dragged out in the limbs of a fold. Near Inishglass (on the north side of Loch Maree) and Kerrysdale most of the bands of graphite-schist vary in thickness from a few inches to a few feet: most of the intermixed mica-schists are rather hard and siliceous.

In many of the exposures of graphite-schist numerous slightly-curved surfaces may be seen, perhaps crush-surfaces, which blacken the fingers readily. In some sections, for instance, in the burn a quarter of a mile north-east of Furnes, the graphite-schist is so full of movement lines that no clean fracture can be procured, and yet the schists near it are but little crushed.

The graphitic-schists and some of the mica-schists with which they are so closely intermingled often weather with a rusty colour in consequence of disseminated pyrites. In dry weather the surfaces of these schists are also frequently coated with a thin efflorescence of sulphates. Nearly all the rusty schists between Letterewe and Smiorasair, north-east of Loch Maree, contain graphitic bands, and chiefly lie between hard siliceous mica-schists on the south-west side and a thick hornblende-schist on the north-east. Including thinner hornblende-schists they form an outcrop which varies in width from about 300 yards to a quarter of a mile. Bands of graphite-schist also occur north-west from Loch Garbhaig; 1500 yards S.S.W. of Beinn Lair; at the base of the thick hornblende-schist northwest of Meall Mheinnidh; in Gleann Tulacha; and at other localities.

In Gairloch most of the exposures of graphite-schist lie between the two thick bands of hornblende-schist which run south-east from near Gairloch Bridge and Flowerdale House. Others appear at the side of the new road nearly three-quarters of a mile west of the outlet of Loch Bad an Sgalaig, nearly half a mile S.S.W. of this outlet, rather more

than a mile S.S.W. of Kerrysdale, and in a burn a mile and 300 yards south-west of Kerrysdale<ref>For further remarks on the distribution of graphite schist in the Gairloch area, see p. 216. </ref>.

In a pyritous graphitic rock 230 yards above the foot of the little stream which flows into the Kerry nearly a mile S.S.W. of Kerrysdale, thin veins of biotite-felspar material appear to have been introduced into the rock after it had been brecciated, and the graphite occurs partly as fine dust included in the biotite.

The graphite-schist a mile and 300 yards W.N.W. of the head of Lochan Fada contains a white mica which must have been developed after the parallel arrangement of the chief graphitic portions. In a section ([S4421](#)) [NG 982 741] there are also veins and patches of felspar; often twinned, and a mineral, supposed by Dr. Teall to be probably andalusite, which is of later origin than the present distribution of the graphite.

(4) Granular Quartz-rock

Near Lochan Druim na Fearria in the Gairloch area some bands of a granular quartz-rock, pale-pink in colour and somewhat resembling quartzite, have been observed. One of these bands, which appears nearly half a mile slightly east of north of the outlet of the lochan, is about 16 yards broad, and is flanked on the north-east side by thin streaks of similar rock mixed with limestone. Another band, a third of a mile north-east of the outlet, is also rather calcareous in places. The best exposures of this type of rock are to be seen on the south-east of the loch. Each band is there mainly composed of thin parallel laminae, from half an inch to an inch thick, on the surfaces of which lie scattered flakes of a dark-green mica or chlorite. Some of the bands contain eye-shaped masses, several yards broad, of a dark hornblendic rock, like parts of the adjoining gneiss, round which the laminae of quartz-rock sweep. If the quartz-rock is an altered sediment, it would appear to have at one time been made to flow across the folia of the pieces of hornblendic rock. In slice ([S5122](#)) [NG 836 700] the junctions of the grains of quartz and felspar are stated by Dr. Teall to be sutural, but this may be due to secondary enlargement of clastic grains.

In the area north-east of Loch Maree similar bands of quartz-rock have been observed on the north side of Amhainn na Furneis, particularly about three-quarters of a mile E.N.E. of Inishglass, and in some scars three-quarters of a mile E.N.E. of Furnes. Bands and lumps of dark hornblendic rock are there also intimately mixed with the quartz-rock, the laminae of which can be seen in several places to cross the folia of these included masses.

(5) Quartz-magnetite-schists and Quartz-schists

A quartz-magnetite-schist, mixed with limestone and calcareous chlorite-schist, is seen in various places at the north-east side of the thick hornblende-schist which runs north-west from a point 300 yards south-west of the outlet of Loch Bad an Sgalaig in the Gairloch district. The best exposures are by the old road near the southwest corner of the Meall Aundrary wood, and between that place and a third of a mile west of the north corner of the wood. Some varieties of this schist consist of alternating pale and dark layers, the former containing a great proportion of quartz and having a somewhat vitreous lustre, while the dark layers present streaks and irregular grains of magnetite mixed with a little quartz, and affect the compass. The hornblende-schist which runs south-east from Kerrysdale includes various bands of quartz-schist, one of which, rather more than two-thirds of a mile south-east of Kerrysdale, is black and contains sufficient magnetite to affect the compass. Other thin bands of black, or of banded pale-grey and black, quartz-schist may be observed in the following places in the Gairloch district: 250 yards E.N.E. of Kerrysdale; about 700 yards south-east of Gairloch Bridge; nearly a third of a mile north-east, and a third of a mile E.N.E., of the Gairloch Hotel; a third of a mile east of this hotel, and in the apex of a large fold of the rocks about a mile south of Kerrysdale.

Half a mile south-west of Meall Aundrary (two and a half miles south-east of Gairloch), between hornblende-schists, various bands of quartz-schist display a conchoidal fracture, and as some of them contain hornblende they cannot be easily separated from the hornblende-schists of igneous origin.

In the district north-east of Loch Maree most of the quartzschists, whether with or without magnetite, appear to have been mylonised. They are more compact and more finely banded than those in the Gairloch district, and have a considerable resemblance to banded cherts. The quartz-schists in both districts may possibly represent altered cherts, but the present resemblance of certain portions of them to cherts is perhaps rather the result of deformation. In some exposures

north-east of Loch Maree more than 30 thin laminae may be counted in the thickness of a quarter of an inch. Each of them was not improbably broader originally but has been dragged out and thinned. Most of the outcrops of quartz-schist are only a few feet wide, and the rocks are so much contorted, and perhaps also displaced by thrusts, as to be difficult to trace.

In the inlier of Lewisian rocks on the eastern shoulder of Slioch, near the head of Loch Maree, a thin wedge of altered sediments, exposed in Abhuinn an Fhasaigh, includes, among other rocks, a granulitic quartz-magnetite-schist ([S4320](#)) [NH 022 673] which is of special interest, as it contains a mineral supposed by Dr. Teall to be possibly sillimanite. If this supposition be well-founded it would suggest that the rock may have suffered from contact metamorphism, perhaps induced by the igneous rock which is now represented by the overlying thick hornblende-schist (part of the Ben Lair schist).

Quartz-schists with dark-grey or black streaks and resinous lustre are seen at the following places: on the hillside 350 yards north-east of the outlet of Loch Garbhaig; a third of a mile E.S.E. of Letterewe; nearly a third of a mile E.N.E. of Inishglass; a third of a mile N.N.W., and 350 yards slightly west of south of Coppachy; and behind the rock called Torr an Fhithich<ref>An analysis and description of the Torr an Fhithich rock is given on p. 80.</ref> about half a mile north-west of Smiorasair. At the second, third, fifth, and last-named localities the quartz-schist contains small pieces of actinolite-schist and of hornblende, and is closely associated with actinolite-mica-schist. At the second, fifth, and last places the dark colour is known to be due to magnetite. In the fourth the schist is mixed with thin calcareous streaks, and the different folia sometimes strike at one another — presumably at opposite sides of thin dislocations.

Some of the quartz-schists here described may possibly have been produced by the shearing of quartz-veins. The hornblende-schist a mile N.N.E. of Isle Maree is traversed by a folded quartz-schist, about 12 feet thick, containing a good deal of pyrites. At its marginal junction with this schist the hornblende-schist is occasionally replaced by chlorite-schist, and thin bands of similar quartz-schist cross the foliation of the hornblende-schist in a vein-like manner.

(6) Quartz-hornblende-schists

A few bands of quartz-hornblende-schist have been noticed in the broad mass of hornblende-schist on Beinn Lair. About half a mile south-east of the hill-top two such bands, two feet and five feet thick respectively, are separated by 16 feet of fine hornblende-schist, from which they are sharply defined. They both contain Crystals of dark-green actinolite, some of which measure three or four inches in length and half an inch in breadth, and coalesce into radiate forms. Idiomorphic garnets, half an inch broad, occasionally occur, particularly in the more micaceous portions of the rock. The quartz, usually subordinate in amount to the actinolite, occurs in granulitic streaks edging that mineral. In a thin slice ([S5109](#)) [NG 987 726] examined under the microscope the actinolites are seen to contain many inclusions of quartz. A band of similar schist, about 20 yards wide, may be seen a little more than two-thirds of a mile south-east of the top of Beinn Lair.

(7) Limestones

The limestones are for the most part composed of granules of white calcite together with flakes of mica and with needles of pale-green tremolite, which often form radiate groups. Some varieties, however, contain a considerable proportion of chlorite and seem to pass into chlorite-schists. The limestones are rarely more than a few feet in thickness. The different bands will here be described seriatim, first in the Gairloch and then in the Loch Maree area.

a. Gairloch area — Shildaig

A limestone striking W.N.W. was formerly quarried in the wood a quarter of a mile E.S.E. of Shildaig. The exposure visible in the quarry is about twelve yards wide, but the bed is evidently much folded and mixed with less calcareous parts, like the calcareous schists on its south-east side. The purer bands consist of coarse white marble with thin green serpentinous patches. About 40 yards W.N.W. of the road the marble contains, near the middle, a pegmatite five or six yards thick. By the road- 170 yards north-east of this outcrop a band appears, about a foot thick, with abundant fibres of pale-green actinolite: the carbonate portions of the limestone are of a deep brownish-red colour, probably in consequence of staining from Torridonian breccias. In the wood two-thirds of a mile E.S.E. of Shildaig four or five bands of marble can be traced, which perhaps all belong to the bed quarried nearer Shildaig. One contains many parallel

fibres of pale-green tremolite, flakes of pale-brown mica and chlorite (?). The calcareous matrix is partly white and partly red, the latter colour being especially common near joints.

On the north-east side of the Torridonian rocks near Lochan Druim na Fearn limestone occurs at several places, and has been quarried at one of these. In an exposure about 700 yards slightly east of north of the outlet of the lochan the limestone is mixed with granular quartz-rock. On the south-east side of the lakelet two bands of limestone crop out, one of which consists of two portions separated by a calcareous hornblende-biotite-gneiss four or five yards wide: the total thickness, including the biotite-gneiss, is about eleven yards.

[\(S3746\)](#) [NG 851 718], [\(S3751\)](#) [NG 840 720]

The Am Feur Loch — The limestone [\(S4186\)](#) [NG 856 722] 260 yards northeast of Am Feur Loch (three miles south-east of Gairloch) gives the name to the hill, Meall an Tuill-aoil = hill of the quarry- holes of limestone). It is divided into two bands by a calcareous hornblende-biotite-gneiss [\(S4185\)](#) [NG 855 721]. The north-easterly band, about 15 feet thick in one place, has been quarried along its outcrop for 70 yards. Both bands are fine grained, of a white or pale-cream colour on fresh fracture, and contain small parallel flakes of a colourless mica and greenish fibres of tremolite. Two sets of planes may be observed in the rock, both nearly parallel to the strike. In one of these the planes are smooth, almost free from mica, and occur at intervals of about half an inch. In the other they lie at greater intervals, and are rougher and more micaceous. In the former case the planes seem to represent thin crush-lines or joints, and to be later than the others. Perhaps they are of the same age as the lines of flinty crush near the north-east side of the thick hornblende-schist of An Groban and Sithean Mor. The north-east side of the double limestone is flanked by a sheared micaceous gneiss. On the south-west side no rock is seen for some distance. Mr Barrow has made the following analysis of a specimen of the south-west portion, from which it appears that the rock is a slightly ferriferous dolomite:

CaO	32.7 per cent
MgO	16.2 per cent
FeO	1.3 per cent

The limestone is not seen further north-west, nor nearer in a south-east direction than a mile and 300 yards. This may be due to faulting along the flinty crushes already alluded to. In the exposure to the south-east the limestone makes an outcrop about ten yards broad. It there contains tremolite, brown mica, some soft serpentinous parts and thin bands of a calcareous biotite-hornblende-gneiss which resembles the rock at the sides.

Magnetite Limestone — About 150 yards east of the outlet of Lochan Dubh nam Biast<ref>This is the long narrow loch east of Loch nam Buainichean.</ref>, and more than three-quarters of a mile from any other rock which has been mapped as a sediment, a limestone containing magnetite makes its appearance. [\(S4179\)](#) [NG 866 732], [\(S4180\)](#) [NG 866 732], [\(S4181\)](#) [NG 866 732]?. The greatest breadth of good limestone is about six feet, but there are also other impure calcareous rocks at the side. The carbonate portions weather with a yellow or leaden colour, but in fresh fracture are white or pale pink. They are mixed irregularly with pieces of magnetite, hornblende, epidote, and chalcopyrite, but subparallel zones occur in which the carbonate, the hornblende, and the magnetite are predominant in turn. The carbonate sometimes contains a large proportion of magnetite, which also occasionally constitutes the greater part of streaks five or six inches thick. The hornblende is dark- green or black macroscopically, and occurs both in sheaves several inches long and in small prisms. The epidote is in small green prisms. The chalcopyrite only occurs in small scattered grains. In a slice [\(S4178\)](#) [NG 866 732], of a specimen which is poor in carbonates, the microscope shows that felspar, frequently in a granulitic condition, also forms an important constituent of the rock.

At the edge of this band a hornblende-epidote-rock, which shows no clear foliation, varies in thickness from two inches to a foot. Six or seven yards from the limestone the common red gneiss of the adjacent country comes in, showing subparallel quartz-streaks. The ground between this gneiss and the hornblende-epidote-rock is occupied by material intermediate in character between these two types, showing fewer quartz-streaks than the red gneiss but a good many lenticles rich in hornblende and epidote.

Bad an Sgalaig — The limestone which runs northwestwards from a point 300 yards south-west of the outlet of Loch Bad an Sgalaig, along the north-east side of a thick hornblende-schist, is usually mixed with calcareous chloritic schist and quartz-magnetite-schist, and in this mingled condition forms a zone which can be followed for three miles, though for not much more than half this distance are the outcrops of limestone sufficiently thick to be mapped. This failure may be accounted for partly by folding, partly by faulting, and partly by variation in the original character of the rock. Flinty crush-rocks run along the zone for considerable distances.

Limestone in thin bands and streaks mixed with chloritic schist is exposed in the burn 700 yards east of Kerrysdale, but has only been seen in two places further north-west. Along the strike in a south-easterly direction it is more often visible, the positions in which it seems the thickest being now at one side of the chlorite-schist and now at the other. About a quarter of a mile west of the outlet of Loch Bad an Sgalaig a limestone outcrop has a width of two or three yards, and this is perhaps as wide as any.

Copper-bearing Limestone — On the south side of the old road, nearly a mile and 300 yards south-east of Kerrysdale, a much contorted brown-weathering limestone crops out. It is mixed with talcose streaks and siliceous layers which contain a good deal of pyrite and some chalcopyrite. Its apparent thickness is ten feet, but the calcareous portions of the band are probably less in amount than those of the other constituents taken together. None of the pyritous layers exceeds two or three inches in thickness.

An Ard and Kerry Glen — Outcrops of limestone, generally of an impure character, have been observed at various places between Gairloch and Dubh Loch. Most of these lie a little south-west of the mica-schists supposed to be of sedimentary origin, and they are bounded by augen-schists which probably represent sheared forms of augen-gneiss.

On the south side of the bay south of An Ard two calcareous bands can be seen, each about four feet thick, while a third, about two feet, appears twenty yards to the south-west of these. The two-foot band is represented again on either side of An Ard. It always has the augenschist on both sides, and itself contains some small eyes.

The gorge of the Kerry, 180 yards above the foot of the river, exposes a limestone, two feet thick, 50 yards south-west of the mica-schists. On the north-east side the augen-schist appears, and on the south-west hornblende-schist with augenschist beyond. Less pure calcareous bands also occur close to the edge of the mica-schists, likewise on the south side of Loch Kerry.

At the side of the new road between Kerrysdale and Loch Bad an Sgalaig several calcareous bands, which may be seen a little south-west of the junction of the mica-schists and the augenschists, all contain much Mica, some of them consisting chiefly of mica, or of chlorite, with actinolite in feathery forms. A specimen [\(S4348\)](#) [NG 829 720] examined in a thin slice under the microscope is found to consist essentially of granulitic quartz, brown mica, and calcite. The calcite grains interlock with those of the granulitic constituents.

b. Area North-East of Loch Maree

The Letterewe limestone is the best known of the limestones<ref>At is indicated in Macculloch's Geological Map of Scotland, and described by Sir R. I. Murchison and Sir A. Geikie in their paper On the Altered Rocks of the Western Islands of Scotland, and the North-Western and Central Highlands, *Quart. Journ. Geol. Soc.*, vol. xvii., p. 171.</ref>, and perhaps also the thickest. On the west side of the burn 200 yards north-west of the ruined house of Folais it was formerly extensively quarried, and a tramway descended from the quarry to the shore of Loch Maree. The limestone with the calcareous beds that accompany it appears repeatedly in the burn north of the quarry for about 700 yards, the exposures being separated by outcrops of finely foliated hornblende-schist which closely resembles that of Beinn Lair. Here the rocks occupy the apex of a compound syncline, the axial planes of which strike north-west. In some of the exposures the thickness is about 20 feet. South-east of Folais, in the south-western limb of the syncline, the limestone and calcareous beds can be traced nearly three miles. Yet they form here only a thin outcrop, and they are much interrupted at the south-east end by lines of movement. From the outcrop in the burn two-thirds of a mile north of Folais the horizon continues nearly a mile south-east along the north-east limb of the syncline, but the sections are poor.

The limestone of the quarry is compact and creamy and contains lumps of green actinolite. Some bands in it include more biotite, chlorite, and hornblende than carbonate, and display also thin streaks of white talc (?). Some of the actinolite lumps are two or three inches in diameter, and all have smooth rounded surfaces, coated with flakes of biotite, chlorite, or white mica. In cross section some of them show centres from which the actinolite crystals have grown out in diverging rays, while many others are broken by small faults.

A soft greenish rock, which appears to be a calcareous mylonite in a line of movement, is seen between the thick limestone and the hornblende-schist on the east side of the burn near the tramway end. It traverses contorted bands of the massive limestone. It is finely striped, and the long axes of included fragments of other material are parallel to the banding. Its inclusions consist of, eye-shaped lumps of limestone, rounded pieces of actinolite fibres (like those in the thick limestone), and of quartz-tourmaline vein-stuff, together with scattered prisms of tourmaline.

All the impure calcareous rocks which accompany the thick limestone seem to be mylonised, but they are not all of the type of the green rock just described. The mylonised rock close to the north edge of the calcareous zone in the burn two-thirds of a mile slightly west of north of Folais includes many small pieces of finely foliated hornblende-schist resembling the hornblende-schist a little higher up the burn. Other contorted strips of similar schist also appear, varying in length from a few inches to a few yards, the ends of which are cut sharply by the fine laminae of the matrix. At this locality no lumps of radiate actinolite were observed. The lenticles and pieces of hornblende-schist are most abundant close to the thick hornblende-schist which bounds the mylonised rock. Hence it is probable that the finely foliated hornblende-schists which adjoin the mylonised rock have contributed material towards its formation. The line of junction between the two is in many places a crush line, at the side of which the foliation planes of the hornblende-schist have been truncated. In the burn two-thirds of a mile slightly west of north of Folais, besides the pieces of hornblende-schist, fragments of a slightly calcareous dark-grey mica-schist, very rich in biotite, appear in the crushed material. These become more numerous a little further away from the hornblende-schist, and sometimes form thin strips two or three feet long and several inches broad. A little lower down, the section exposes a calcareous mylonised rock with broken pieces of epidote, and trains of minute granules of that mineral which sometimes wind round the larger epidotes. In a thin slice prepared from a specimen of the rock ([S4426](#)) [NG 952 717] one of the longer prismatic epidotes is broken across and faulted, but without any indication of crushing later than the formation of the matrix. This matrix is itself a crush-rock, and the epidote has evidently been broken during the progress of the crushing. Many of the epidotes contain inclusions and bays of water-clear granules of larger size than most of those in the matrix, and these granules have perhaps been protected from the mylonising movements by the epidote around them. The mylonised matrix is fine-grained, and seems to consist largely of minute scales of mica and of microcrystalline quartz and felspar.

The calcareous zone continues to be traceable for some distance in a more or less mylonised condition in both the large limbs of the syncline. Some of the interruptions in its course, and its cessation in the south-east portions of the limbs, may be attributable to lines of movement. The limestone as exposed in the south-west limb of the fold about 700 yards N.N.E. of Coppachy contains small flakes of colourless mica, streaks of a greenish-grey serpentinous substance, and some brick-red bands coloured by small specks of ferrite, which are sometimes arranged in a kind of network. Thin slices of these bands examined by Dr. G. J. Hinde were not considered by him to be of organic origin. On either side of the limestone, and partly folded with it, a massive gneissose rock appears which contains a good deal of hornblende, and about two-thirds of a mile east of Inishglass includes calcareous bands near the limestone.

A limestone, cryptocrystalline and pyritous in places, and accompanied by calcareous biotite-schists, is exposed at several places near hornblende-schist close to Regoilachy and also about a third of a mile W.N.W. of Smiorasair. Most of its outcrops are mere lenticles, but near the last-named exposure the limestone can be traced for a quarter of a mile through several sharp folds. The accompanying calcareous schists contain larger flakes of biotite than the mica-schists.

Gleann Tulacha — Although the Gleann Tulacha and the Letterewe limestones may possibly represent the same bed in different limbs of fold, they nevertheless differ considerably in appearance. Most of their differences may not improbably be due to the amount of deformation which the Letterewe limestone has undergone. A good exposure of the Gleann Tulacha limestone may be seen on the hillside rather less than a mile W.N.W. of the head of Lochan Fada. The fresh rock is there almost pure white on a fresh fracture, but the weathered surface has a brownish hue and is crowded with projecting fibres of pale-green tremolite, arranged in fan or radiate forms. Individual fibres of the mineral penetrate far into

the substance of the matrix and show no signs of crushing. Those of longest dimensions lie in parallel planes and give rise to a banded appearance. In a thin slice prepared from a specimen of the rock ([S4417](#)) [NG 986 737] a few pieces of a biaxial untwinned mineral, probably feldspar, are disclosed by the microscope. About 300 yards W.N.W. of the good section near Lochan Fada, above referred to, a boulder of limestone has been observed to be crowded with prisms of pale-green augite, but this mineral has not been observed in the limestone in situ.

Lower down the glen similar limestone crops out near bands of a contorted pale-pink, quartzite-like rock, which shows on its foliation-planes a good deal of mica and small eyes of feldspar.

A specimen ([S4420](#)) [NG 999 735] of the pink rock was found to consist of irregular fragments of feldspar (microcline in part), imbedded in a mylonised matrix of quartz and feldspar, with carbonates and white mica as accessories. The parent rock may possibly have been a gneiss, like parts of the rock which appears on the northeast side of the glen. Near the head of Gleann Tulacha several other outcrops of limestone have been noticed. One of these, about half a mile slightly east of north of Beinn Lair, is five or six yards wide, and has a garnet-actinolite-mica-schist on its southern side. The north side is probably flanked by a little graphite-schist followed successively by (1) actinolite-mica-schist, (2) the mylonised pink rock, and (3) the gneiss.

On the north-east side of Meall Mheinnidh four bands of limestone or calcareous rock can be observed within 100 yards of the Ileum Lair hornblende-schist. The two highest bands belong to one bed repeated by a crush that runs nearly parallel to the strike: the bottom band contains streaks and lenticles of marble imbedded in a chloritic or micaceous schist which overlies gneiss. Along the north margin of the hornblende-schist of Beinn Airidh a' Char the limestone appears at intervals, near Strathanmore and in a burn W.N.W. of the top of that hill. In one of the exposures in that stream the limestone contains reddish streaks and patches ([S3471](#)) [NC 225 461] which owe their colour to the presence of an abundance of beautiful crystals of yellowish-brown rutile. A plagioclase feldspar and quartz are also present.

About 50 yards north-east of the junction of the burns one mile north of Ardlair, an old quarry supplies an exposure of the limestone, which is there mottled green and pink, and includes calcite, tremolite, phlogopite, haematite, and chlorite. The mica-plates have often been bent and twisted, and the other minerals show signs of mechanical disturbance. On the line of strike 150 yards to the south-east the limestone is again visible as an almost pure white saccharoid dolomite, bounded on the north-east by hornblende-schist which seems brought against it along a line of fault. An analysis (see p. 82) shows it to contain over 96 per cent. of mixed carbonates of lime and magnesia. In the stream to the southward the limestone may be noticed in four or five places about half a mile south-east of the junction of the burns, but owing to folds and crushes no continuous section can be seen. The highest outcrop, more than half a mile from the foot of the burn, consists of a compact, banded, white and dark-grey limestone, composed of carbonates and chlorite, with here and there a grain of plagioclase intergrown with the carbonate, and some micro-crystalline aggregates of quartz. An analysis of the calcareous portion of a specimen ([S5480](#)) [NG 905 766] shows it to contain not much more than one-half as much magnesia as the specimen last referred to. The banding in the rock, strongly suggestive of stratification, is due to the concentration of silica along certain lines. The original rock was probably a cherty carbonate.

A quarry has been opened to the west of Am Marcach, near Loch Maree, in alight-coloured micaceous and siliceous dolomite, west of which the limestone, bending sharply round, trends S.S.E. It has a high dip towards W.S.W., and is in some places vertical. Nearly half a mile W.N.W. of the Ordnance station on Am Marcach a lenticle of limestone may be seen by the side of Loch Maree in what seems to be a crush-line parallel to the loch.

Loch Garbhaig — With an actinolite mica-schist exposed in a burn rather more than a third of a mile E.N.E. of Loch Garbhaig we see a band of limestone, one or two feet thick, which contains in certain layers many small pink idiomorphic garnets and also small flakes of brown mica. These garnetiferous seams weather in retreat from the paler parts of the rock, some of which are mixed with thin streaks of granulitic quartz ([S4790](#)) [NG 966 728].

Inishglass — On the south-west side of the thick hornblende-schist a quarter of a mile slightly east of north of Inishglass, and in some other places along the same strike, a dark brown or almost black limestone with clustered fibres of hornblende is exposed. The hornblende is pale-brown macroscopically, but colourless in thin slices ([S4799](#)) [NG 969 700] and ([S4800](#)) [NG 971 699], and repeatedly twinned. Most of the rock is crowded with black amorphous grains

distributed irregularly.

(8) Calcareous biotite-hornblende-schists

Many of the limestones are immediately flanked by calcareous schists or gneisses, in which biotite, or a green mica, and hornblende (seldom radiate) occur in abundance. Thus, a wide band, which is poor in hornblende, appears near the limestone in the woods a quarter, and two-thirds, of a mile E.S.E. of Shieldaig, Gairloch. The calcareous-schist and the limestone together make in one place an outcrop not less than 130 yards wide, but the schists are not well exposed. Again, about a third of a mile E.S.E. of Folais, north-east of Loch Maree, 60 or 70 yards north-east of the Folais calcareous horizon, a calcareous biotite-hornblende-gneiss shows a somewhat acid gneiss on both sides.

Bands of somewhat massive biotite-hornblende-gneiss, with a considerable proportion of dark hornblende, may be seen in, and near, a limestone a quarter of a mile south-east of Lochan Druim na Fearn (two and a quarter miles south-east of Shieldaig, Gairloch), also in a band about ten yards wide in the middle of the limestone near Am Feur Loch, and again on the sides of the limestone a mile and a half south-east of the outlet of Loch Bad an Sgalaig. The band at the south-west side of the limestone, a quarter of a mile south-east of Lochan Druim na Fearn, contains augen composed of quartz and felspar. In most parts of the band near Am Feur Loch hornblende is in excess of biotite, but there are some layers, as much as a foot thick, which seem to be made up almost wholly of biotite.

(9) Kyanite gneiss

Three bands of kyanite gneiss with a north-west strike have been noticed near Carnmore (four miles N.N.E. of Letterewe), one about half a mile east, another two-thirds of a mile north-west, and a third nearly a third of a mile slightly west of north of the old house. These are of special interest, inasmuch as they all lie more than a mile and a half north-east of the strike of the nearest rocks which have been mapped as altered sediments.

The band east of the old house, which has been traced for a quarter of a mile, varies in thickness from 16 to 30 feet and dips N.N.E. at about 45°, both its sides being well-defined. The rock is mostly pale-grey and rather coarser than the contiguous gneiss which is reddish with subparallel streaks of white quartz. In the landscape, however, the kyanite gneiss appears darker than the adjacent gneiss. Near the margin of the reddish gneiss the dip of its foliation is the same as that of the kyanite gneiss, but further off it becomes more irregular and often almost flat. There are also various thrust-like lines, trending north-east, within the reddish gneiss, which suggest that the kyanite-bearing rock occurs along a line of movement. The kyanite crystals, sometimes two inches long, usually project from the weathered face of the rock. Their long axes and the flat sides of the biotite flakes lie rudely parallel to the sides of the gneiss. One type of the rock contains little else than kyanite and biotite, the latter in large crumpled plates sometimes half an inch long, together with occasional quartz-veins which include kyanite in somewhat larger crystals than usual. In the more common type of the rock quartz is abundant, and felspar has also been observed in the thin slices examined under the microscope.

(10) Cumingtonite garnet-schist

On the south-west side of a mica-schist, about 700 yards south-west of the outlet of Loch Bad an Sgalaig, in the Gairloch area, a rock which strikes northwest consists mainly of subparallel white threads of a fibrous hornblende (cumingtonite) enclosing small garnets. [\(S5125\)](#) [NG 839 705]. The band is several yards wide, but cannot be traced far. A bulk analysis of it gives as much as 7 per cent. of manganese oxide, and the analyses^{<ref>}For these analyses and for a description of the microscopic characters of the rock, see p. 83.</ref> of the two chief minerals — the garnet (spessartite) and the cumingtonite — show manganese oxide in both. The rock may perhaps be regarded as an altered mangiferous sediment.

(11) Chlorite-schists

An impure calcareous band in which chlorite is abundant is seen 300 yards E.S.E. of Auchtercairn (one mile and a quarter N.N.W. of Gairloch), where it forms a depression, twenty or thirty yards broad, between bands of hornblende-schist or hornblende-chlorite-schist. It is a soft shivery schist, weathering with a yellow colour, and showing rods of vein-quartz with their long axes parallel. Chloritic schist is likewise to be seen on the south-west side of the broad

mica-schist which passes from the wood near Flowerdale House (Gairloch) to Loch Bad an Sgalaig. It is occasionally accompanied by limestone, quartz-magnetite-schist, or by both these rocks. This band attains a maximum breadth of 50 yards, but is usually less, and sometimes disappears. In a few places certain bands seem to consist almost entirely of chlorite. Examples of this type may be seen a quarter of a mile south-east of Furnes (Loch Maree); in the burn by the road about a mile north of Folais; at the edge of the hornblende-schist about 1500 yards slightly south of east of Strathanmore; and in the more easterly of the two burns three-quarters of a mile N.N.E. of Isle Maree.

(12) Hornblende-schist and Hornblende-chlorite-schist

The thick bands of hornblende-schist which appear at the sides of, or within, the altered sediments form the most rugged scenery in the district, as exemplified in Beinn Lair, Beinn Airidh a' Char, An Groban, Sithean Mor (a mile and a half south-east of Gairloch), and in the wooded ridges and slopes near Flowerdale House and Gairloch Bridge. These bands collectively occupy an area which considerably exceeds that of the altered sediments. In that part of Gairloch which lies south of the Strath and Poolewe road, the two series of rocks are not unequally divided, but north of that road the sediments are almost entirely covered by the Torridonian rocks, while the harder and more prominent hornblende-schist which rose into hills even in pre-Torridon times has been laid bare by denudation, so as to protrude through the sandstones in several areas, one of which, including Cnoc Breac (five and a quarter miles north-west of Poolewe) and Meall Imireach (four miles W.N.W. of Poolewe), is more than three miles long and averages more than three-quarters of a mile broad. In the extreme south of Gairloch also, inliers of hornblende-schist form prominent features some miles from the nearest exposures of the altered sediments, though the latter may possibly lie hidden under the cover of Torridon Sandstone.

The general distribution of these bands of hornblende-schist can best be understood from the maps (Sheets 91 and 92).

In Gairloch the most prominent of them is that of An Groban–Sithean Mor, which is sometimes half a mile broad, and forms the north-eastern margin of the main sedimentary area, though a few thin actinolite-mica-schists appear on its north-east side. The thick parallel bands of hornblende-schist which lie further south-west vary in number and breadth, but become fewer, though broader individually, in a north-west direction. A quarter of a mile west of Loch Bad an Sgalaig four of these parallel bands may be seen, while near Kerrysdale there are two bands averaging each 200 yards in breadth. On the north-east side of the Flowerdale Glen fault there is only one parallel band, but this is about half a mile wide, and gradually approaches the An Groban outcrop in a north-westerly direction till in the Meall Imireach inlier they coalesce, the mica-schist between them having meanwhile wedged out. It may be surmised that all these outcrops may really be portions of only one band which has been repeated by folding. If this be the true structure of the ground the north-eastern margin of the most easterly hornblende-schist at Kerrysdale will correspond to the south-west margin of the Sithean Mor hornblende-schist. The sediments are not the same at each of these margins, but this might be accounted for on the supposition that the igneous rock from which the hornblende-schist was formed was transgressive.

In the area to the north-east of Loch Maree the most prominent band of hornblende-schist of the whole district rises into the rugged mountainous masses of Beinn Lair and Beinn Airidh a' Char. It stretches for eight miles from north-west to south-east, and mounts up to a height of 2817 feet. The breadth of this huge inlier on Beinn Lair is about a mile, but other outcrops of similar schist on its south-western side are only separated from it by thin strips of altered sediments. On Beinn Airidh a' Char one may walk almost entirely on hornblende-schist across the usual strike for a distance of about two miles. In doing so one crosses the limbs of a synclinalorium with axial planes striking north-west. Side the base of the band changes its course on the north-west side of Beinn Airidh a' Char, and curves southwards to Loch Maree while the hornblende-schists on the south-east slope of this hill are repeatedly folded with a band of mica-schist. Near Folais a broad outcrop of hornblende-schist which lies between the mica-schist just alluded to and the limestone and calcareous rocks is also folded by the syncline and disrupted along its edge by mylonising movements.

The inlier of Lewisian rocks on the eastern shoulder of Slioch is mainly composed of hornblende-schist, which is no doubt an extension, in a south-eastern direction, of the Beinn Lair schist.

There can be little doubt that the hornblende-schists now under consideration were originally intrusive igneous rocks. Portions of them resemble the sheared basic dykes. Their general uniformity of composition and texture and the rarity of

inclusions in them which can be regarded as detached fragments of other rocks, or distorted amygdulites, are hardly consistent with the supposition that they are altered contemporaneous lavas, but, on the other hand, they have nowhere been observed to transgress the sediments in any clear section. In general they are more finely foliated than most of the dykes, either near them or elsewhere. At various places their margins can be traced for distances, varying from one to three miles, parallel to certain beds in the series of altered sediments. Thus, between Flowerdale and Loch Bad an Sgalaig the margin of one of these bands keeps to the horizon of the quartz-magnetite-schist and limestone for about three miles. Between Letterewe and Regoilachy (Loch Maree) another band continues near a hard siliceous mica-schist for nearly a mile. A similar want of evidence of intrusion is, however, found at the sides of various thin bands of hornblende-schist, which are regarded as dykes which have been sheared and dragged in an unusually intense degree.

It is improbable that these hornblende-schists can be older than the basic dykes in the gneisses of the Fundamental Complex, for they are never intersected by these dykes, even in places where the adjoining gneiss is repeatedly traversed by them. Perhaps these hornblende-schists represent intrusions which were fed by dykes. Before the shearing of the dykes into schists, the gneiss probably contained few divisional planes compared with the bedding planes of the sediments, and a mass of molten rock which had come up almost vertically through fissures in the massive gneiss might perhaps, on reaching the sediments, find more ready passage between the planes of stratification and take the form of sills. No clear union of a basic dyke with any of the thick hornblende-schists has been seen, but in a good many places the margins of these schist-bands are lines of powerful movement, which may partly explain the want of parallelism<ref>See p. 216.</ref> occasionally observed between these bands and the neighbouring dykes.

The most common type among the hornblende-schists associated with the altered sediments is a very finely foliated dark-green schist, in which the crystals of hornblende are needle-like and so minute that they can hardly be distinguished by the unaided eye. These crystals lie on the parallel planes of foliation, but their orientation is variable, though it is usually in one direction — that of stretching. This is the type of rock which was described by Dr. Hicks and Mr T. Davies from the Falls of the Kerry<ref>p. 108. Hicks, H. On the Pre-Cambrian Rocks of West and Central Ross-shire, with Petrological Notes by T. Davies. Geol.Mag., Dec. II., Vol. VII., pp. 103, 155, 222, 266, and 327. </ref>. Thin layers of different colours usually lie parallel to the foliation, some being almost black, others dark-green, and others a dirty white. In many places these layers are sharply folded or broken by numbers of thin thrust-like lines. The thin slide ([S3746](#)) [NG 851 718], prepared from a finely foliated hornblende-schist on the north-east side of Loch Bad an Sgalaig, shows under the microscope that the rock consists of green hornblende, felspar in allotriomorphic and mostly water-clear grains, epidote, calcite, and a few grains of sphene. A few thin lenticular folia are composed solely of granulitic felspar (? albite) and idiomorphic epidote.

It is not clear why the most finely foliated type should also show the best banding. There may have been more segregation during the shearing, or the various bands may have been derived from parts which already differed in general colour before the deformation. On the latter supposition it may be inferred that the rock near the interior of a band was sometimes of a more uniform character than that at the sides.

In another less common variety of these schists no distinct colour-banding appears. The specks of white felspar have their long axes parallel, and help to define the foliation, but they are equally abundant through considerable thicknesses of rock. This type, which resembles the most common form of schist in the basic dykes, is well seen near the middle of the band on Sithean Mor. Two other varieties are common in certain areas; one coarse in grain and showing so little foliation that it may be called epidiorite; the other, a shivery schist, containing more chlorite than hornblende. The massive or poorly-foliated type has only been noticed in that portion of the An Groban–Sithean Alor outcrop which lies east of Loch Bad an Sgalaig. ([S4439](#)) [NG 855 714]. It passes gradually into the foliated variety which is without colour banding, and forms one or more zones near the middle of the band. One of these zones is about 70 yards wide.

Near Kerrysdale chloritic schists occur on both sides of the more north-westerly of the two hornblende-schists. Further to the north-west the broad band of hornblende-schist at Auchtercairn is mixed throughout with chloritic schists, containing small needles of hornblende on the foliation planes. These schists merge into the hornblende-schists. Frequent sharp flexures in the chlorite-schist show nearly vertical axial planes, parallel to which the flakes of chlorite are often arranged. Thin quartz-veins, often disposed in folds, likewise small crystals of magnetite and calcareous spots and streaks, appear more commonly in the chloritic than in the hornblendic schists. The chloritic schists usually effervesce freely with

hydrochloric acid, even when no carbonate can be recognised macroscopically, and one of the calcareous streaks near Auchtercairn is a good limestone. Near Kerrysdale many specks of ferriferous carbonate, about the size of peas, have been observed, with their long axes parallel to the foliation planes of the chlorite-schists: these are not due to decomposition near the weathered surface, but form an essential part of the rock. It is doubtful whether the thin streaks of limestone, an inch or two thick, occasionally found in the hornblende-schists, represent segregations formed during the shearing process and the change of a lime felspar into albite, or whether they are relics of sedimentary beds incorporated in the igneous material during intrusion or movement. Examples of these calcareous streaks may be seen about 700 yards south-east of Gairloch Bridge, close to the north-east margin of the hornblende-schist, and in a schist on the north side of the path about half a mile south-west of Regoilachy, Loch Maree.

The abundance of carbonate in the chloritic schist is perhaps due to chemical changes during the alteration of hornblende into chlorite, which may have taken place during renewed contortion after the rock was already in the form of hornblende-schist. The chlorite-schists are sharply contorted, and many of them lie along the margins of the sills of hornblende-schist — in positions where they would be peculiarly exposed to shearing movements. That the abundance of chlorite in the thick band near Auchtercairn, Gairloch, may be due to intense shearing is suggested by the changes in structure along the course of the An Groban–Sithean Mor band, which indicate that the shearing in this district increased in intensity in a north-westerly direction, as far at least as the road between Strath and Poolewe.

The thick hornblende-schists are in certain places richly garnetiferous, the garnets being sometimes bordered with granules of white felspar like those common in the foliated basic dykes.

In the area lying to the north-east of Loch Maree the broad bands of hornblende-schist chiefly consist of the finely-foliated type. No parts of them have been observed to be free from foliation, but the shivery chloritic type is rarer here than in the Gairloch area. Examples of the less finely-foliated varieties occur in the following places: on the north side of Loch Garbhaig, half a mile N.N.E. of this loch, between three-quarters of a mile, and a mile, W.S.W. of the summit of Beinn Airidh a' Char, and between the two burns about 700 yards north-east of Am Marcach. The rock at the last-mentioned place is an imperfectly schistose epidote-amphibolite, medium-grained, dark in colour, composed of hornblende and granular aggregates of felspar which are often crowded with small grains and crystals of epidote ([S5491](#)) [NG 905 769].

Thin zones in which the hornblende forms augers may be seen in the Beinn Lair schist half a mile slightly north of east of the foot of Loch Garbhaig, a third of a mile slightly north of west of Beinn Lair, and at other places. Here and there, as in the ice-polished scars on the north side of the road by Loch Bad an Sgalaig, small streaks and pieces of felspar probably represent granulitised phenocrysts. In the Beinn Lair schist also an exposure, by the east side of a small burn rather more than three-quarters of a mile east of the head of Lochan Fada, shows a good many imperfect lath-shaped sections of felspar, about half an inch long.

In Beinn Lair and Meall Mheinnidh certain zones contain lenticles of a dirty white opaque substance, which may be noticed at frequent intervals from about two-thirds of a mile east of Strathanmore to three-quarters of a mile S.S.W. of the head of Lochan Fada. Perhaps they are best exposed 200 yards east of the path nearly two miles N.N.E. of Letterewe pier, where the most northerly zone includes several bands, from one to three feet thick, of finely-foliated hornblende-schist enclosing the white lenticles referred to. Of these lenticles, which are sharply defined and project from the weathered faces of the rock, a considerable number are more than a foot long, while some exceed three feet. Their long axes lie parallel with each other and, in these exposures, nearly at right angles to the strike of foliation, although at other places the direction of elongation is different. On the average, the long axes are three times as long as the widths along the foliation, and eight or nine times as long as the width in a direction at right angles to the foliation. The lenticles are sometimes so crowded that they exceed in aggregate amount the matrix of hornblende-schist which lies between them, but they are of irregular occurrence, and the different horizons in which they occur cannot be traced far without interruption. In slice ([S4423](#)) [NG 95 71], prepared from one of the lenticles near the path, the only constituent definitely recognisable is epidote in short and slender prisms. The matrix is almost opaque, and the rock is considered by Mr Total to be a variety of saussurite. (See (Plate 28)) The schist containing the lenticles is not crossed by many strain-slips, and there is no reason to suppose that it is more crushed than the adjoining schist. The lenticles are rare in places; indeed, an isolated instance was recorded at a distance of 60 yards from any others — a mode of occurrence hardly explicable on the supposition that they have been produced by the breaking up of a once continuous band. More probably they

represent concretions in the igneous rock before its conversion into schist. They may have been originally nearly spherical, and analogous to spherulites; occasionally, indeed, as at a place one-third of a mile slightly east of south of the head of Lochan Fada, examples of them have been noted which give nearly circular sections.

Many of the thin quartz veins in the hornblende-schists northeast of Loch Maree contain tourmaline, of a black tint, in extremely thin needles, which are often combined into sheaves. It usually forms only a small proportion of each vein, the rest consisting of quartz, or of quartz, axinite, and epidote. Such veins are seen on Meall Mheinnidh, from 150 yards north-west of the hill-top to rather more than a quarter of a mile south-east, also 700 yards north-east of the big island in Loch Garbhaig, where some of the tourmaline crystals are an inch long. The axinite, which does not possess good idiomorphic outlines, is of a pale yellow, or sometimes of a faint pink, colour, and generally exceeds the tourmaline in quantity, forming pieces an inch or more in width. Again, in the quartz-veins exposed three-quarters of a mile south-west of Beinn Lair, where large bundles of thread-like crystals of tourmaline occur, these are sharply contorted along folds which have their axes placed almost at right angles to the general direction of the threads. Such indications of movement after the formation of the tourmaline prepare us to find the broken bits of tourmaline vein-stuff which occur in the Folaish mylonised rocks<ref>See p. 233.</ref>. The occurrence of rounded pieces of finely-foliated hornblende-schist in the Folaish rocks, together with the frequent truncation of the foliation planes of the hornblende-schists by these rocks, prove the schists to have suffered considerably from mylonising movements, although not many mylonites appear to have been formed from hornblende-schist alone.

Within the sedimentary zone north-west and south-east of Smiorasair bands of a compact, hard, black flinty-looking rock show under the hand-lens no recognisable minerals except hornblende in a fragmentary form. This material appears to have been subjected to some process of complete reconstruction, presumably by crushing. It occupies the same position in the series as the hornblende-schist, and seems to have been mainly derived from it.

Near Torridonian rocks the hornblende-schists are often crossed by thin epidotic strings, and the foliation planes and the sides of the veins of quartz and pegmatite are also stained with haematite. The pebbles in the basal Torridonian breccias are sometimes crossed by epidotic strings, which, as they do not pass into the matrix, must have existed in the Archaean rocks before the formation of the conglomerates. They were doubtless formed in pre-Torridon time by decomposition near the rock-surface. On the north side of the burn about a mile E.S.E. of A' Chosag (two and a quarter miles W.S.W. of Slattadale) a steeply inclined hornblende-schist is intersected by epidotic strings, many of which are nearly horizontal (perhaps rudely parallel to the pre-Torridonian rock-surface) and cut the earlier quartz veins. They often contain quartz as well as epidote, but some are entirely composed of grass-green needles of epidote, often about half an inch long.

(13) Hornblende-schists with brown mica and pyrites

Many of the thin bands of hornblende-schist within the area of the altered sediments have a close resemblance to some of the actinolite mica-schists. They contain calcareous streaks, brown mica, and pyrites, together with hornblende crystals which are frequently arranged in radiate forms, and are of a stouter build than those in most portions of the thick bands. The thin bands of hornblende-schist which occur in the north-eastern portion of the crushed mica-schist, half a mile E.N.E. of Regoilachy, belong to the finely-foliated type so common in the thick bands, and probably some, if not all, of them may represent folded or faulted portions of thick bands. Most of the other bands further to the west, likewise most of the thin bands between Regoilachy and Letterewe, half a mile W.N.W. of Coppachy, and in some other places, belong entirely or in part to the type of schist under description. In Gleann Tulacha pyritous biotite-hornblende-schists appear again near the base of the Beinn Lair hornblende-schist, at the head of Lochan Fada, two-thirds of a mile above the loch, and in some places near the north-east side of the sediments. In the Gairloch district schists of this type are rare excepting near the south-west margin of the Bad an Sgalaig belt of mica-schists.

A slide cut from specimen [\(S4773\)](#) [NG 967 698], from an exposure of these schists at -the loch-side 350 yards west of Inishglass, when examined under the microscope proved to be in a mylonised condition. A portion with rounded outline and less calcareous than the rest is a hornblende-schist of finely-foliated type. The rest is composed of streaks which sweep round the edges of this schist.

(14) Actinolite-schists without either quartz or felspar

In the mica-schist about 1000 yards slightly east of south of the Ilubh Loch (three miles south-east of Gairloch) and near a finely-foliated hornblende-schist three bands, one of them 25 yards wide, consist almost entirely of confused aggregates of small pale-green actinolite needles [\(S5130\)](#) [NG 857 706], and weather with brown and rounded surfaces.

Pre-Torridonian movements

As in the district between Scourie and Kylesku, so in the ground described in this chapter, many of the movements which led to the first production of foliation in the basic dykes proceeded parallel to these dykes, sharply contorting the early broad banding in the older Archiean rocks, and giving them a northwest strike. A feature of special interest in the present district is the evidence which it affords that subsequently to these movements, folds, of a comparatively gentle character, were developed which plicated the already partly-sheared dykes, and led to the further foliation of some dykes which were not previously sheared throughout. (See (Plate 27)) Another noteworthy characteristic here is the development of "rodded" structure both in the gneiss and intrusive dykes. In some rocks the constituents have been thrown into the form of rods and in sections at right angles to the lengths of the rods show no parallel arrangement, as may be specially observed near the centres of the large folds by which the basic dykes have been plicated, for instance, near the centre of the broad anticline south-east of Loch Tollie, and a mile and a third S.S.W. of Beinn. Lair. This structure is evidently of secondary origin and due to causes which have affected diverse varieties of rocks over considerable districts. Where the acid-gneisses are rodded, the other gneisses are found to be in the same condition. The basic dykes are sometimes rodded in these areas, but elsewhere they show plane-parallel foliation. This peculiar structure is well represented in (Plate 26), which is taken from a photograph of part of a cliff-face, five-eighths of a mile north of Meall an Spardain, Poolewe.

A quarter of a mile N.N.W. of Loch Doire na Herrie (three and a half miles E.S.E. of Gairloch), where the acid-gneiss has been sharply folded, it has been changed in places from a rodded into a finely-foliated condition with the divisional planes almost vertical and striking north-west. In the rodded parts it is sometimes hard to distinguish any broad early folia, but those which can be discerned incline south-eastward. The rods dip in the same direction. Near the places where the fine vertical foliation is seen the broad early folia change their strike and become much thinner, while the granules of quartz and felspar are less in size and more elongated in a direction parallel to the foliation. The influence of the rodded structure on the topography of the ground is well illustrated in (Plate 25), which, gives a view of the landscape a quarter of a mile to the north-east of Meall an Spardain, Poolewe.

Similar variations in dip and strike are common in other parts of the folded area south-east of Loch Tollie. Most of the gneiss in the central parts of the anticline shows only an obscure foliation, older than the intrusion of the dykes. The early folia where recognisable are generally broader than those in the steep 'south-west limb, and often nearly flat or rolling irregularly. But in spite of the attenuation in this limb the gneisses there are not always thoroughly granulitic. If the observer crosses in a south-west direction from the centre of the anticline to the thick hornblende-schist near Loch Airidh Mhic Criadh (a mile and a half north-east of Gairloch) he can readily notice the differences between the obscurely and the closely foliated gneisses. In addition to these differences, it is observable that thin quartz veins, from half an inch to six inches thick and with occasional specks of red felspar, are much more abundant in the limb of the fold than in the 'centre. The basic dykes in the former show fewer evidences of intrusion than in the centre, which is probably due partly to the great drag which the different rock masses have received in this limb, and partly to the development of a strong second foliation that has obscured the earlier foliation of the gneiss. As in other districts, the second foliation in the gneiss is here always parallel to the foliation in the dykes, and generally parallel to their sides.

Mixed with the more massive gneiss near the centre of the Tollie anticline some thin zones of finely-foliated and yet gently dipping gneiss appear, which must have acquired their structure before the time of the great folds that plicated the basic dykes.

As a rule these early lines of shear have proceeded along the sides of the dykes. A good section of one of them may be seen two-thirds of a mile slightly north of east of the outlet of Loch na Larach, 2¼ miles north-east of Gairloch. In the upper part of this section the early bands of the gneiss are nearly vertical but broad. In the lower part they suddenly twist into a horizontal position, parallel to a thin basic dyke, while at the same time they become much thinner, so as to show

hardly a third of the breadth which they have when vertical. The quartz and felspar granules in the horizontal bands have also been attenuated and elongated in a direction parallel to the sides of these bands. Where still broad the bands are crossed by a weak second foliation parallel to the axial planes or twists, but where thinned they seem indistinguishable in structure from those in the south-west limb of the anticline, though they were probably altered before. most of those in this limb. The basic dyke is foliated parallel to its sides, in consequence, presumably, of the same movement which modified the gneiss near it. Sections of this kind show that parts of the gneiss in the limb may have been altered before the dykes were folded, but the general contrast in structure between the gneiss in the limb and that near the centre of the fold must be due to alterations which accompanied the formation of the anticline. (Plate 24). represents the structures shown by the fine-grained biotite-gneiss in the south-west limb of the Loch Tollie anticline.

In the folded area about a mile and a third S.S.W. of Beinn Lair the biotite-gneiss with felspar augen frequently shows no plane-parallel foliation,- but is well rodded throughout. Where the dykes strike N.N.E., the direction of the rods is usually almost at right angles to that strike, with a south-easterly inclination at about 20°. Some sections in this ground suggest that a rodded structure may have resulted from movements which elsewhere produced a plane foliation. The minute contortions and strain-slips, which in folded areas have acted on banded rocks, may cut the bands into thin strips or rods, which run parallel to the axial planes of the large folds affecting the rocks. The rods must also incline in the same direction as the broad bands or early foliation, since it is from these bands that the rods have been formed. There are, however, certain areas — for instance, on the shore of Loch Maree, a mile W.N.W. of Ardlair — in which, although the rocks are well rodded, they display no certain proof of having been folded.

Many mylonised rocks have been formed since the first foliation of the basic dykes. In. all the thick bands the mylonised laminae are affected by many thrusts or faults, as well as folds, and these laminae are frequently broken and faulted as well as folded.

Those which have been formed from the gneisses<ref>Mylonites formed wholly or in part from the altered sediments and the thick' hornblende schists are described in connection with these rocks.</ref> are best developed between Folaish and Fasagh, in the area in which the other mylonites are also most conspicuous. They also appear in various parallel bands which run from a mile and 700 yards south-west of the summit of Beinn Lair to the west end of Loch Garbhaig. Most of the bands do not exceed a few yards in thickness, and at least six may be observed in a breadth of a quarter of a mile. Here the folia are thinner and more sharply folded than those of the adjacent gneiss, and in some places resemble crumpled leaves of paper. They are crossed by a number of thrusts, and in various places are mixed with thin strips of hornblende-schist which have been broken off from adjoining basic dykes. Some of these mylonites may have been formed from pegmatites, but the edges of others seem to pass into the biotite-gneiss at their sides. East of the burn a mile and 200 yards S.S.W. of Beinn Lair a mylonite, about 40 yards wide, has been formed in part from an acid gneiss containing basic streaks and lenticles. Some of the streaks no doubt belong to the Fundamental Complex, but others may represent dykes. The mylonised rocks formed from the acid gneiss have a conchoidal fracture and are of a dark brown or black colour when fresh, but they weather with a dirty white crust, and contain white or pink eyes of felspar. Those which have been produced from the basic streaks intermixed with the acid. gneiss do not differ much in character and colour of fracture, but they weather with black or dark brown surfaces.

Specimen [\(S4774\)](#) [NG 982 710] of the mylonite, composed of alternating strips of grey and dark brown colour, from the west side of the burn just alluded to, shows under the microscope well-marked augen. Those in the paler strips are mostly of felspar, and those in the dark bands of hornblende. Some of the augen show signs of crush, and the fine streaks of the cryptocrystalline matrix wind round them, and are sometimes also contorted and crossed by small faults. Mr. Barrow has analysed a portion of this specimen with the following result:

Silica	60.3
Alumina	15.3
Ferric Oxide	10.7
Lime	5.6
Magnesia	1.30
Potash	1.7
Soda	3.3

The percentage of silica must be much higher in some of the bands than in others.

Many of the flinty streaks which occur in the crushed and mylonised bands have probably been formed in the latter stages of the movements which affected the rocks, and are of a somewhat different type from the common mylonites, but they are all considered to be, and many of them can be proved to be, of pre-Torridonian age. Thus the zone of this material which flanks the north-east side of the An Groban–Sithean Mor hornblende-schist does not cross the Torridonian breccia near Loch Airidh Nhic Criadh, though some of the breccia lies in the direction of the main crush. The Flowerdale Glen fault, which shifts the outcrop of this zone, is also of pre-Torridon age. Part of the fault-rock, about three feet across, is seen on the coast 200 yards south of Gairloch Free Church, where it contains various kinds of black and green flinty material. Although the Lewisian rocks near these strings are much twisted, the Torridonian breccia about 200 yards W.N.W., and close to the direction of the fault; is uncrushed and undisturbed. It also contains various compact green pebbles which closely resemble some of the strings in the fault-rock.

Again, about 1000 yards north-east of the outlet of Loch a' Bhealaich (about six and a half miles S.S.E. of Gairloch) the Torridonian breccia, which is seen a few yards off the flinty crush-lines at the south-east boundary of the Lewisian area, has not been disturbed and contains pebbles, some of them eight or nine inches long, which consist of a reddened acid gneiss with black flinty streaks like those in parts of the crush-zone. Other instances might be adduced from Gleann Tulacha and Fasagh, north-east of Loch Maree, where these crush-lines strike at the undisturbed Torridon strata, and where pebbles of the flinty rocks are found in the basal breccias.

In the most compact and flinty crush-rocks no mica can be discerned with a hand lens. The weathered surfaces show a close streaky structure, the streaks being often interrupted by lines of fault, and those in one portion of them striking at those in another, so that the rock as a whole has a less streaky appearance than most of the mylonised rocks. Many hand specimens show no distinct eyes, and do not betray the nature of the parent rock, but in field exposures the flinty rock is always seen to be mingled with other less-altered material. The broad bands shown by - yellow lines on the one-inch map (91) are not entirely of flinty rock, but zones in which there is a special abundance of flinty streaks.

Flinty crushes particularly abound on the north-east side of the An Groban–Sithean Mor hornblende-schist, where a zone, usually consisting of several bands that do not keep strictly parallel, runs along nearly the whole of the band, excepting for about a mile near and south-east of Am Feur Loch. It has been shifted for nearly three-quarters of a mile by the Flowerdale Glen W.N.W. fault, which is also accompanied by flinty crushes.

Another still thicker nearly parallel zone runs from a little west of Tollie Farm to near the shore of Loch Maree south-east of Doire. Between these two main zones various other bands run in different directions. The areas south-west of the An Grobansithean Mor schist contain comparatively few flinty crushes. Besides the black crush-streaks, the same zones occasionally present dark-brown, grey, or black strings, rarely more than an inch thick, which do not displace the folia crossed by them. These strings sometimes bulge out in rounded projections, or end bluntly and look like intrusive felsites. They are, however, confined to zones which have been crushed, and it seems probable that many of them are isolated on all sides by the adjoining rocks. It is difficult to see how they can be intrusions of true igneous rock. Perhaps by the intensity of the crushing near them sufficient heat may have been generated to fuse small portions of the rock<ref> Mr. Holland (The Charnockite Series, *Mem. Geol. Survey of India*, vol. xxviii., Part II., p. 198–202) has described gneiss with strings and tongues of a black compact character which look macroscopically like injected basic material. These had originally been taken as igneous rocks, and the gneiss in which they occur had been called trap-shotten gneiss. Mr. Holland states, however, that the black substance has, under the microscope, no igneous structure; it is composed of a black dust through which angular fragments of quartz and other transparent minerals are disseminated, and the whole rock is highly crushed, with the production of mylonite and frequent microscopic faulting. The rocks around being often acid in composition, the black colour of the mylonite strings is a matter of surprise. The bands under the microscope include innumerable minute opaque black bodies which suggest sublimation by heat, or introduction of material in solution. Examination of very thin slices seems to show the beginnings of crystallisation in the black dust. Sometimes shallow bays in the quartz-pieces are filled with the black dust, as if corrosion had commenced. These phenomena

indicate that the rock has been greatly heated, but not to so high a temperature, as to fuse the dust completely. Mr. Holland crushed a specimen of acid charnockite and heated the powder to a white heat, sufficient to produce a very imperfect fusion; the result was a fritted black cake. </ref>.

A band of much-crushed gneiss striking north-west in the wood on the north-west side of the Loch Maree Hotel, Talladale, contains various black felsite-like strings which behave as if they were intrusions. In a thin slice, [\(S5270\)](#) [NC 922 227], the substratum of the rock gives an obscure microcrystalline reaction, and resembles certain felsites. It is unlike any rock yet recognised as a product of crushing. Irregular fragments of quartz and felspar lying in this substratum show unmistakeable signs of deformation. Again, just below the summit of Meall Riabhach, Smiorasair, felsite-like strings, varying from mere threads to about three inches thick, are excellently exposed at intervals in a zone about three yards thick. They cut the gneiss in all directions. In one place only, near the east end of the zone, do they show macroscopically any structure like that of a mylonite. The gneiss is clear, fresh, and granular up to the edge of the veins, but there are dislocations near by. A specimen, [\(S4281\)](#) [NH 006 666], of one of the strings shows under the microscope a microlitic structure in the ground mass, and some signs of fluxion. The fragments of quartz and felspar included in the ground mass show strongly-marked cataclastic structures.

Other faults which are not accompanied with mylonites or flinty crush-rocks can also be proved to be of pre-Torridonian age, as, for instance, the one that runs south from about 230 yards west of the outlet of Lochan Druim na Fearna, and is covered by an outlier of undisturbed Torridonian breccia.

The old lines of movement which existed before the Torridon Sandstone was laid down have in some places been used again in post-Torridonian time.

Gneiss affected by the post-Cambrian movements

Above the Kinlochewe thrust-plane, Lewisian rocks reappear in various isolated parts of this district, all of which, with one exception are of small extent. The structural relations of these masses will be described in the section dealing with the post-Cambrian movements (Part 4). Attention is here called to the petrographical characters of the largest and most important mass that lies north of Kinlochewe. Measuring seven miles in length from north to south, and about three and a half miles in breadth, it covers an area of about twelve square miles.

As already mentioned, Professor Bonney recognised the petrographical characters of some of the rocks of this displaced mass, and noticed the presence of a rather granitoid variety of the Hebridean gneiss, the occurrence of dykes, and of a green schist with marked fragmental structure due to crushing<ref>Quart. Journ. Geol. Soc., vol. xxxvi., p. 93. </ref>.

This detached portion of the Fundamental Complex contains knots, lenticles, and larger masses of ultra-basic and early basic material, which, in some cases, show a banded arrangement of the constituents that must have been developed, in part at least, before the injection of the later more acid gneiss. Some of the early basic parts are about half a mile in diameter, and consist of hornblende-gneisses and amphibolites. The most characteristic feature of the whole outlier, however, is a coarse granitoid gneiss with biotite, and showing rude banding. This rock invades and isolates the older basic portions of the mass, and, save near the thrust-planes, has been little deformed by the post-Cambrian movements. Northwards from the Heights of Kinlochewe, beyond Gleann na' Muice, in the Pass of Beallach Bhain, that leads to Loch an Nid, this type becomes a gneissose granite, and in places shows no banding at all, consisting of plagioclase, orthoclase, microcline, quartz, and chlorite after biotite, and showing a strong resemblance to the older part of the Fundamental Complex south of Gruinard in the undisturbed area to the west (Chapter 40). Over much of the tract the foliation Planes roll about at low angles, but near the Heights of Kinlochewe their strike is north-west.

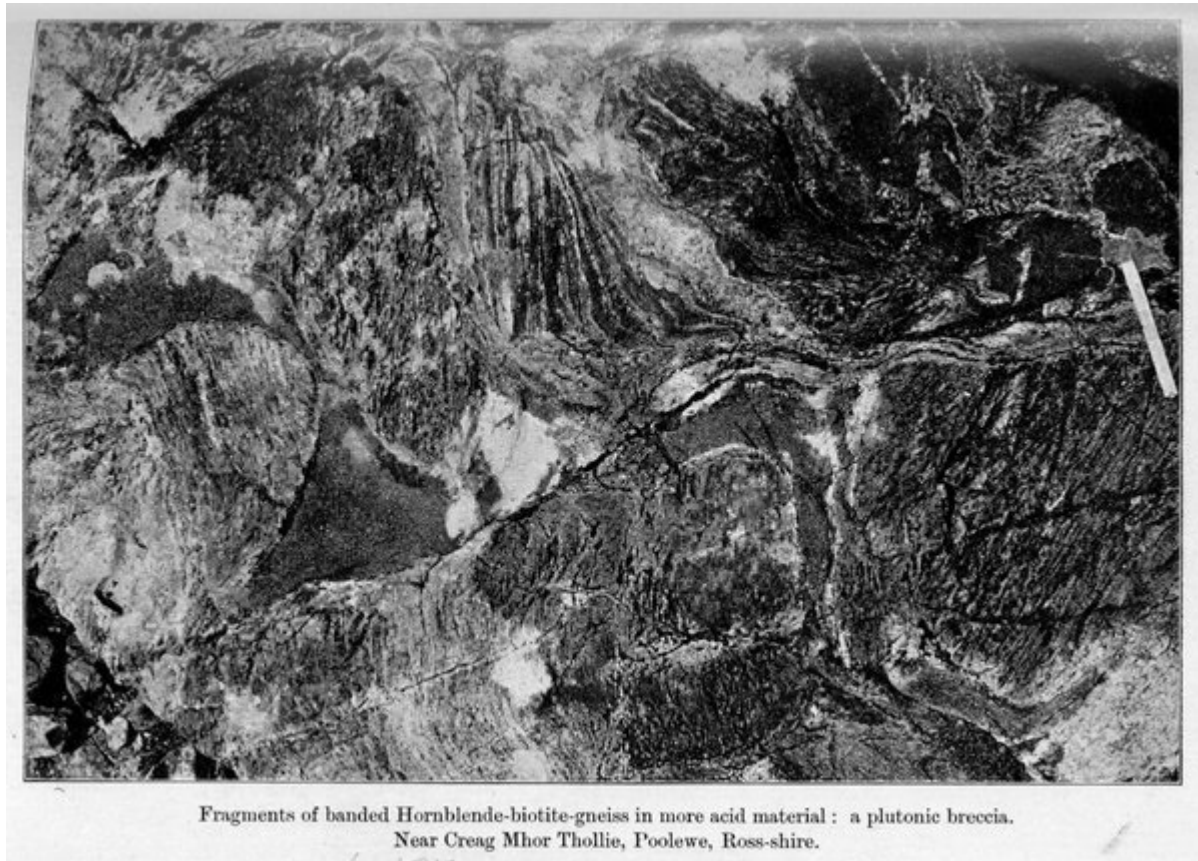
Another noteworthy feature is the occurrence of numerous dykes of epidiorite that traverse the gneiss in a W.N.W. or north-west direction, and show their intrusive character as clearly as in the typical area between Scourie and Loch Inver.

(Plate 2), which represents a portion of this displaced mass, shows two epidiorite dykes intersecting the rudely-foliated granitoid gneiss near the Heights of Kinlochewe. As in the undisturbed areas referred to, the dykes here rise along more or less vertical fissures; they have chilled margins, and no instance was noted where a dyke had been changed into

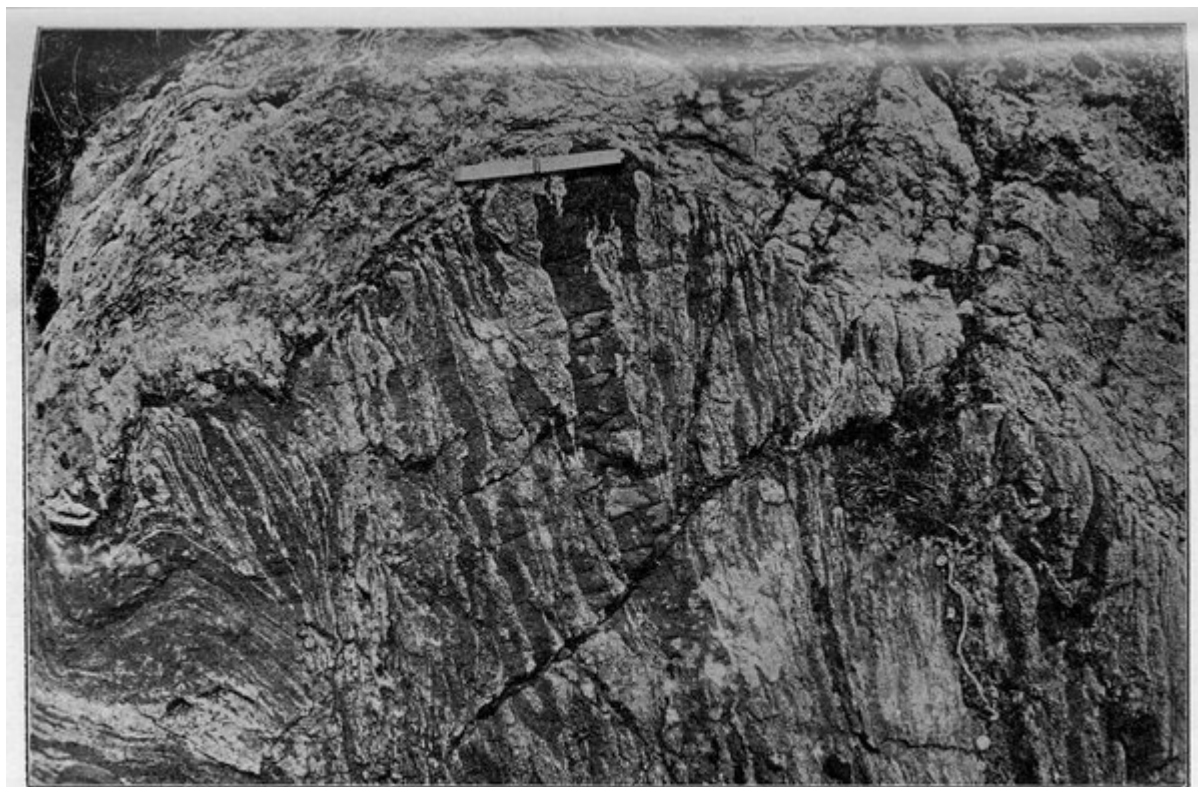
hornblende-schist. A few small dykes of ultra-basic rock (picrite) also occur here.

Apart from the resemblance in petrographical characters, the horizon of this thrust gneiss is clearly proved by the fact that it is covered unconformably by the Torridon Sandstone, and shows the double unconformity between the Cambrian strata and the Torridon and Lewisian rocks.

South of Kinlochewe a narrow belt of gneiss, in places highly deformed, occurs not far below the outcrop of the Moine thrust-plane east of Coulin, 4½ miles south of Kinlochewe, which will be referred to in Part 4. Small bosses appear in the Coulin Forest forming the cores of isoclinal folds in the basal division of the Torridon Sandstone. The surfaces of these displaced masses in the Kinlochewe region show the appearances characteristic of the weathering in pre-Torridonian time, in that they are traversed by numerous strings of epidote and are much epidotised.

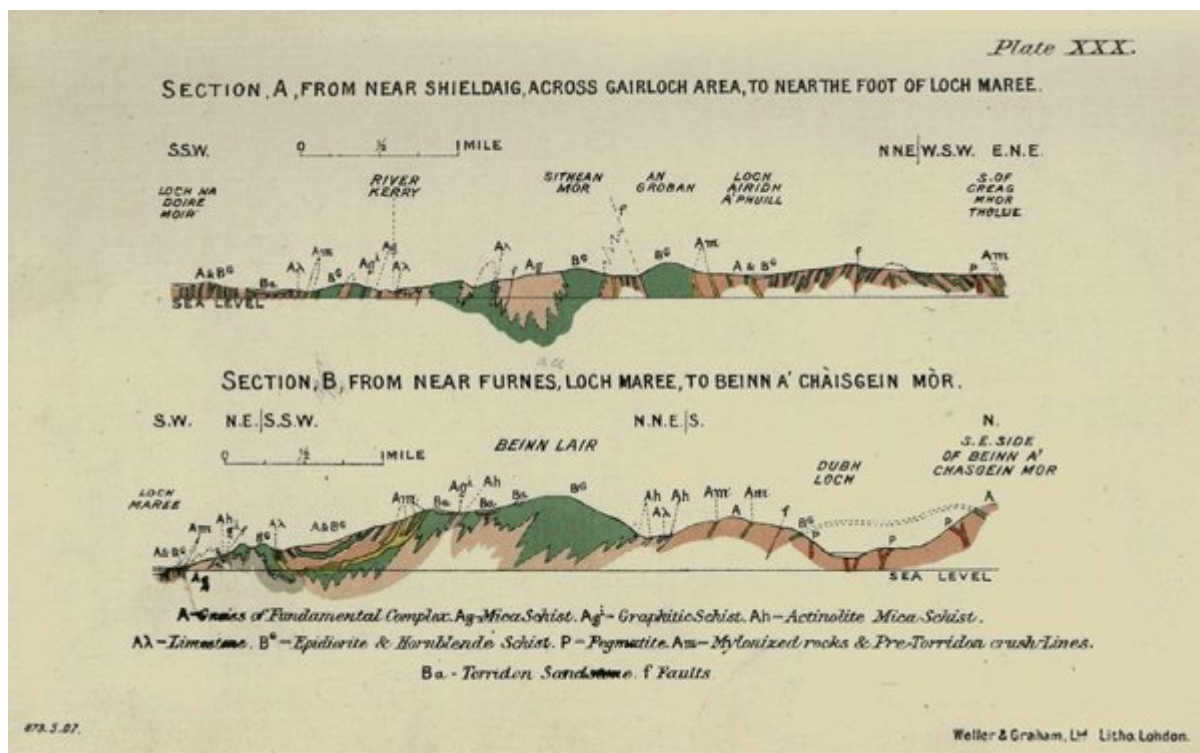


(Plate 10) Fragments of banded hornblende-biotite-gneiss in more acid material — a plutonic breccia; near Creag Mhor Thollie, Poolewe, Ross-shire. B100–B101.

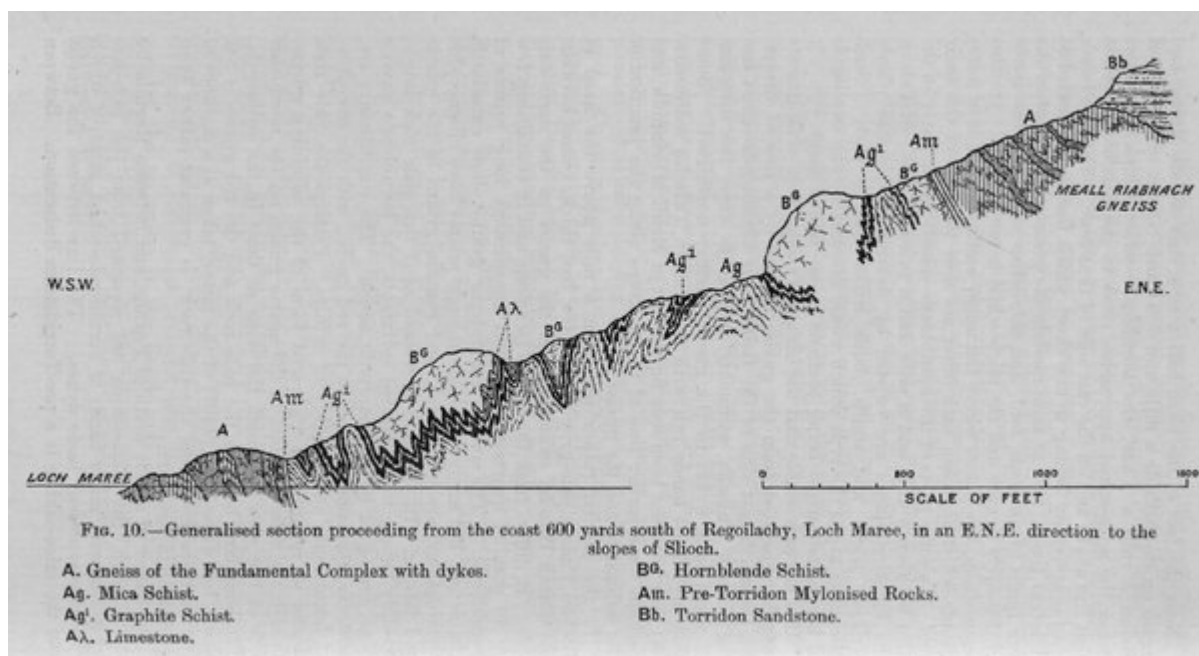


Junction of one of the included fragments with the matrix shown in Plate X. 1200 yards S.E. of the top of Creag Mhor Thollie, two miles south of Poolewe, Ross-shire.

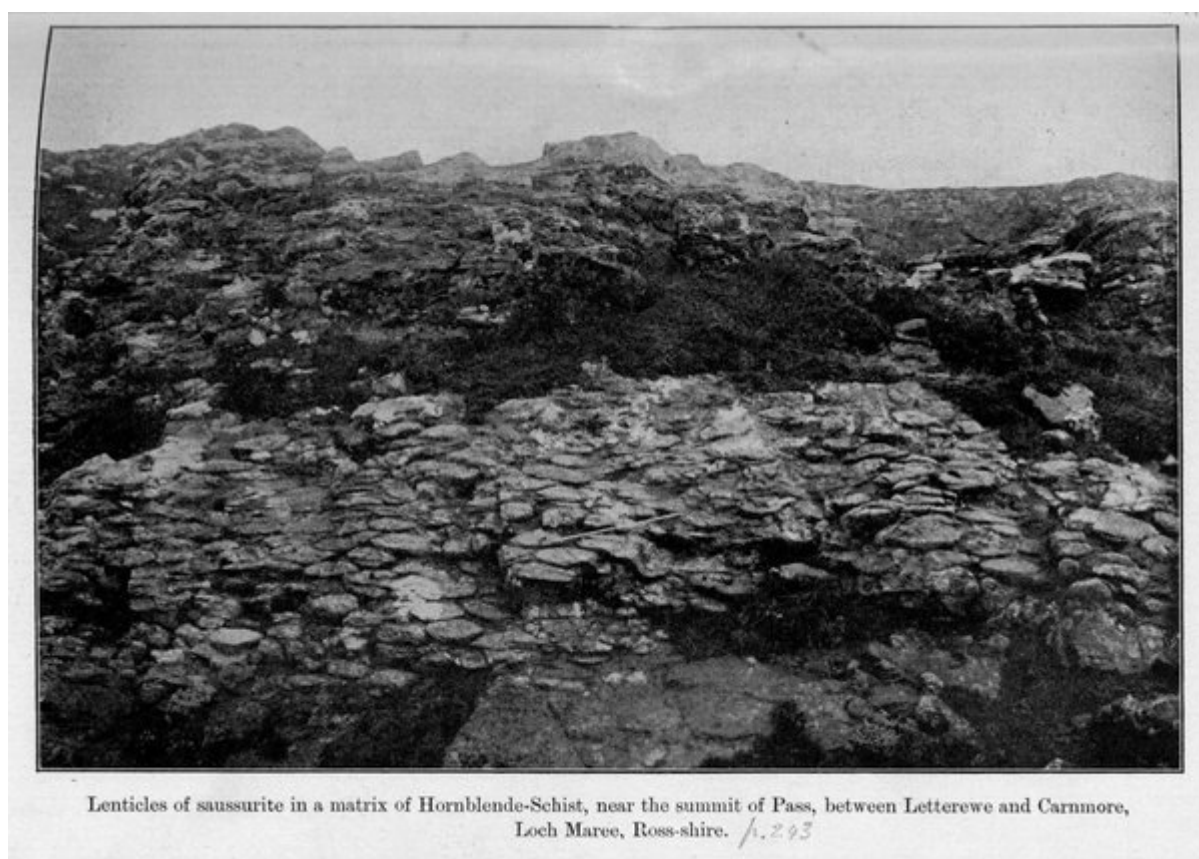
(Plate 11) Junction of one of the included fragments with the matrix shown in



(Plate 30) Coloured sections across Lewisian series; Loch Maree and Gairloch.



(Figure 10) Generalised section proceeding from the coast 600 yards south of Regoilachy, Loch Maree, in an E.N.E. direction to the slopes of Slioch. A. Gneiss of the Fundamental Complex with dykes. Bg. Hornblende Schist. Ag. Mica Schist. Am. Pre-Torridon Mylonised Rocks. Ag'. Graphite Schist. Bb. Torridon Sandstone. Aλ. Limestone.

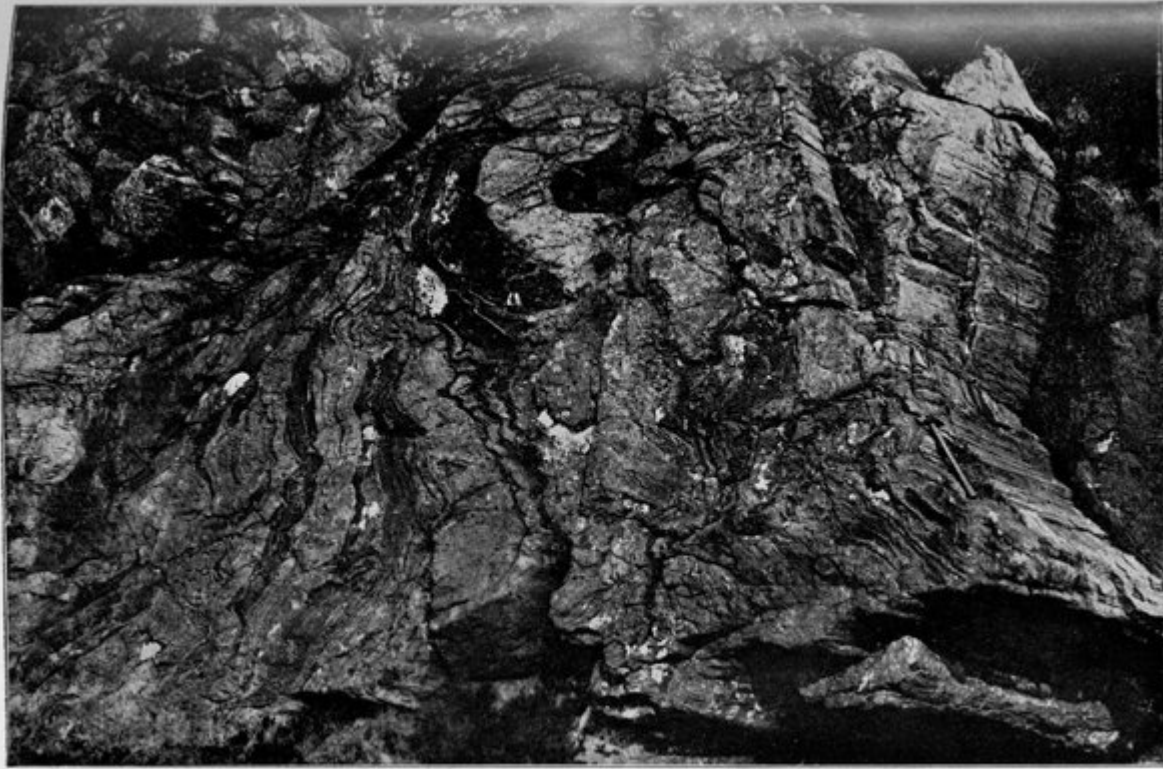


(Plate 28) Lenticles of saussurite in a matrix of hornblende-schist, near the summit of Pass, between Letterewe and Carnmore, Loch Maree, Ross-shire. B71



Junction of Hornblende-Schist with banded Hornblende-Gneiss.
Meall an Spardain, Poolewe, Ross-shire.

*(Plate 27) Junction of hornblende-schist with banded hornblende-gneiss; Meall an Spardain, Poolewe, Ross-shire.
B106-B107*



Convoluted Hornblende-Gneiss. Striations on surface to right are parallel to the slope of the mullion surface in Plate XXV. Meall an Spardain, Poolewe, Ross-shire.

(Plate 26) Convoluted hornblende-gneiss. Striations on surface to right are parallel to the slope of the mullion surface in



Rod-like or mullion structure in Lewisian Gneiss, Poolewe anticline, produced by movements later than the dykes. Half-mile north-east of Meall an Spardain, Poolewe, Ross-shire.

(Plate 25) Rod-like or mullion structure in Lewisian gneiss, Poolewe anticline, produced by post-dyke movements; half a mile north-east of Meall an Spardain, Poolewe, Ross-shire. B103



Fine grained granulitic Biotite-Gneiss. About $\frac{1}{2}$ mile W.S.W. of Loch Tollie, near the road between Poolewe and Gairloch.

(Plate 24) Fine-grained granulitic biotite-gneiss, about half a mile W.S.W. of Loch Tollie, near the road between Poolewe and Gairloch. B113