
Chapter 38 Structure of the ground between Auchnashellach and Loch Alsh

1. Area between Auchnashellach and Kishorn

This section of the present chapter is supplied by L. W. Hinxman. This district is contained in Sheets 71, 81, and 82 of the Geological Survey Map of Scotland, on the scale of one inch to a mile (1:63360).

The area of disturbance in the Coulin and Auchnashellach Forests, described in the previous chapter, is bounded on the west by a line of thrust, which, crossing the crest of Beinn Eighe, about one mile west of Sgurr Ban, runs southward over the eastern shoulder of Liathach and the hills south of Glen Torridon to Loch na Eun. It is thence continued southwards to the west of An Gorm Loch, where it is overlapped by another thrust, which brings forward heaped-up pipe-rock.

The area to the east of this line of dislocation is occupied by successive narrow belts of Cambrian and Torridonian strata, carried westward on a series of parallel major thrust-planes which run N.N.E. and S.S.W. The effect of the first of these, the course of which has just been traced, is to thrust the Torridonian rocks upon themselves along the greater part of the line of disruption. The Cambrian quartzites, however, appear beneath the thrust on the southern face of Beinn Eighe, and on the hill-top immediately south of Glen Torridon a small patch of the basal quartzite, resting in normal sequence on the Torridonian, is laid bare for a short distance below the thrust-plane. In Strath a' Bhathaich, at a point half a mile east of Loch na Suileig, a wedge of Cambrian strata makes its appearance beneath the thrust-plane, and the Torridonian grits which overlies that plane pass transgressively from the unmoved Torridonian on to the successive zones of the quartzite. Near An Gorm Loch, about a mile and a half south-west of An Ruadhstac, the thrust passes entirely into the Cambrian strata, bringing forward the pipe-rock upon itself along the slopes above Allt Ghiubhais, as far as the Collie Dhubh (Sheet 81). From this point westwards to the Kishorn the Middle Cambrian series is thrown against the undisturbed serpulite-grit along the outcrop of the thrust; though above Loch an Loin the latter is for some distance overlapped by a "sole", upon which the heaped-up limestones of Glen Kishorn have been brought forward.

The next thrust to the east crosses the head of Glen Torridon at Lochan Iasgaich, and runs with a somewhat sinuous course to Loch an Eoin, north of Meall a' Chinn Deirg, for the most part thrusting the Torridonian series upon itself. But small lenticular patches of basal quartzites appear, as in the first thrust, beneath the thrust-plane near Lochan Iasgaich, and in the crag above Loch Meall a' Ghuail, two miles south of Glen Torridon. A conspicuous feature marks the course of the thrust above the western shores of Loch an Eoin, whence the outcrop sweeps round the scarped front of Meall a' Chinn Deirg (3060 feet). This dislocation has brought forward the Torridonian grits (Bb) and the striped sandstones of Group III. that form the top of the last-named mountain, and has placed these strata upon the folded Cambrian quartzites (Ca, Cb) on its steep western face (Figure 53) and the hill-slopes that stretch southwards between Loch Coire an Ruadh Stac and Loch Cadh' an Eoidh, about a mile and a half S.S.W. of An Ruadh-stac. The quartzite rises in a steep cliff above the southern shore of the latter loch, curves round to meet the thrust, and completely overlaps the sandstones; while the thrust-plane, a short distance further south, buries itself beneath the piled-up fucoid-beds and serpulite-grit at the head of Allt a' Ghiubhais.

A third mass of Torridonian and Cambrian strata has been driven westward and superimposed transgressively upon the different zones and sub-zones of the Cambrian quartzite by a thrust which leaves the road at Loch Maireannach, near the head of Glen Torridon, and traverses the steep western face of Sgurr Dubh and the hills to the south a short distance west of the watershed. Between Sgurr Dubh and Lochan Uaine, at the base of the north slope of Beinn Liath Mhor, the dip of the thrust-plane is generally low, but as this plane passes through Coire Granda and crosses the western peak of Sgurr Ruadh where the sandstones rest upon intensely-folded basal quartzite — the angle of inclination rises from 30° to nearly 60°. The amount of disruption lessens as the outcrop is followed down into the head of Coire Fionnaridh, and on the slopes of Meall a' Chinn Deirg on the further side of the glen the thrust appears to have passed into an inverted fold.

The structure of the district will be most conveniently explained by means of some sections drawn across it. One of these (Figure 53), which runs from Beinn Damh (2958 feet) in a south-easterly direction to Strath Carron, shows at its west end the Cambrian quartzites (Ca) resting unconformably and at a lower angle and inclination upon the Torridon Sandstone

(Bb), the basal quartzite lying almost flat at the west end of the outlier which caps Beinn Damh. On the steep eastern face of the mountain the sandstones dip west at a high angle beneath the quartzite, but further down the slope the inclination rapidly lessens towards a great anticlinal fold in the line of Strath a' Bhathaich, till on the eastern side of that valley the beds dip to the south-east.

A short distance up the south-eastern slope of the same valley the boundary of the disturbed area is marked by the outcrop of the first major thrust, by which a wedge of Torridonian and Cambrian strata has been brought in along the lower part of the steep face of Meall a' Chinn Deirg. The two zones of the quartzite (Ca, Cb) are introduced by a sharp inverted fold, which includes a number of minor plications. The eastern limb of this fold is truncated by the next major thrust, which has carried westward more than 1000 feet of Torridonian rocks. The upper portion of this mass, which forms the summit of the mountain, is composed of fine-grained, violently false-bedded red sandstones. The laminae indicating current-bedding are usually here as elsewhere inclined at a high angle to the true bedding-planes, and often much contorted. Intercalated with the sandstones are several bands of greenish-grey flags and shales, one of which, at the base of the series, reaches an average thickness of 15 feet, and can be traced for nearly a mile. Similar rocks are found on the summit of Fuar Tholl, three and a half miles to the east, and, with those described above, may be assigned to the Cailleach Head group (III.) of the Torridonian series.

On the eastern slope of Meall a' Chinn Deirg the red sandstones are again followed unconformably by the Cambrian pipe-rock and basal quartzite, which are repeated by normal and inverted folds cut off on the east by a minor thrust. A few yards to the east of the second of these, the Torridon grits and striped sandstones once more make their appearance and rest in an inverted position upon the basal quartzite, both dipping south-east at angles of 25°–30°. The folded inverted junction is well displayed in the cliffs two-thirds of a mile north of the loch at the head of Alltnan Ceapairean, which drains the eastern slope of An Ruadh-stac.

For two miles eastward from this point the ground is occupied by isoclinally-folded Torridonian strata belonging for the most part to the arkose group (Bb) and dipping uniformly S.E.S.S.E. at an average angle of 15°. On the west side of Coire Fionnaridh the basal quartzite and pipe-rock again appear in natural sequence, followed in places by the fucoid-beds, which crop out at intervals from beneath a cake of thrust material, which, brought forward on two thrust-planes, covers the eastern slope of Cain Griogaig and descends to the roadside between Coulags and Balnacra in Strath Carron.

The rocks which rest upon the plane of the first of these thrusts consist of the middle members of the Cambrian series, repeated and driven together by numerous reversed faults. These strata are in turn overridden by the Kishorn thrust, which has here pushed westwards a mass of mylonised flaggy Lewisian gneiss (A). The rocks which repose upon the sole of this maximum thrust overlap in places the piled-up strata below, as well as the fucoid-beds on which these strata lie. On the top of the hill the gneiss can be seen resting directly upon the pipe-rock. An isolated portion of this thrust mass of material is found on the hill-side immediately above the foot of Loch Dhugaill in Strath Carron. It is bounded on the south side by a normal fault which forms a deep gully up the declivity. The precipitous southern face of this ravine is composed of shattered pipe-rock, while on its northern side the Kishorn thrust-plane is well exposed in section. The crushed and mylonised gneiss may there be seen to rest upon sheared fucoid-shales and dolomite. The rocks along this line of dislocation are much reddened, and filled with veins of calcite and haematite.

East of the Carron valley the granulitic quartzose schists of the Moine series (M), with inliers of Lewisian gneiss (A), are represented, and their relations to the displaced masses are not visible. The position of the Moine thrust, if present, is beneath the alluvial deposits of the River Carron, as shown in (Figure 53).

In the ground to the south of that represented in the foregoing section the structure of the disturbed belt becomes more complicated. The Torridon Sandstones that overlie the first thrust-plane on the east side of Strath a' Bhathaich are succeeded unconformably by the Cambrian quartzites, which have been thrown into a double isoclinal fold on the lower slopes of Ruadh Stac, whereby the outcrops of the pipe-rock and basal quartzite are repeated. Further up the side of that hill the eastern limb of this double fold is truncated by the second major thrust, which again brings forward a mass of Torridonian and Cambrian strata. The quartzites that form the crest and steep eastern face of the mountain are arranged in a series of complex isoclinal folds, most of which are broken on the eastern side by minor thrusts, the amount of

displacement in each case being, however, comparatively small. The intensity of the folding is well illustrated on the bare glaciated ridge between Ruadh Stac and Loch Cadh' an Eididh, where the different sub-zones of the pipe-rock are so distinctly traceable that the structure of the ground can be followed with comparative ease. From the foot of Ruadh Stac south-eastwards to Strath Carron the tectonic arrangement of the rocks is similar to that shown in the eastern part of the section drawn in (Figure 53).

The greater complexity of the structure in a southerly direction may be further illustrated by another section (Fig. 54) drawn, not far from the ground traversed by the last, in a south-easterly direction from the valley of Strath a' Bhathaach across the ridge of Glas Bheinn to the head of Loch Carroll at Kirkton. At the north-western end of this section the same anticlinal fold and the Fasagh fault are shown as in (Figure 53) traversing the Torridon Sandstones (Bb), which are succeeded unconformably by the lowest members of the Cambrian series (Ca-Ce).

South of the Gorm Loch, above the major thrust-planes, considerable area round the upper part of the Allt a' Ghiubhais glen and the pass that leads through to Strath Carron is occupied by repetitions of the fucoid-beds, serpulite-grit, and basal limestone, folded and driven together in great complexity. On the south side of that glen this mass of piled-up material is soon overlain by limestones belonging to the Ghrudaigh and Eilean Dubh groups. These have been carried forward by a thrust which traverses the southern slopes of the Kishorn valley, and gradually descends to the roadside at Rassal, where it is cut off by the Fasagh fault. A belt of ground, five miles in length and nearly three-quarters of a mile in breadth, is occupied by these limestones, which, though inclined at very high angles, are made to spread over so large an area by being incessantly repeated by folds and reversed faults.

A short distance west of the Allt a' Ghiubhais pass the limestones are themselves overlapped by another thrust-plane on which the quartzite has been carried westward. On the watershed at the head of the pass the pipe-rock dips at a high angle beneath the basal quartzite, which is in turn followed in inverse order by Torridonian grits, these again being overlain in a similar manner by Lewisian gneiss. The double unconformability is thus represented here in inverted order. Owing, however, to folding and crushing, the boundary lines of the different rocks are considerably involved, and it is besides often extremely difficult to separate the basement breccia of the Torridonian series, made up as it is of fragments of gneiss, from the gneiss itself.

On the south side of the pass rise the steep craggy sides of Glas Bheinn, a mass of Lewisian gneiss which has been brought forward by a powerful dislocation (Kishorn thrust) that truncates the different members of the Cambrian and Torridonian series between Loch Dhugaill in Strath Carron and Loch Kishorn. This great line of disruption runs northward from Loch Kishorn to Tornapress, whence it follows the course of the Allt Mor and sweeps round the base of Glas Bheinn to the head of the Tullich Glen. The materials driven forward upon its sole consist of Lewisian gneiss (A) and portions of the lowest Torridonian group (Ba). The two formations preserve their normal unconformable relations, but in inverted order, so that the gneiss rests upon the younger rock and forms the highest part of the hill.

The Kishorn thrust-plane is well displayed in the deep ravine cut by the Allt Mor above Tornapress. Its angle of inclination is here high, ranging from 50° to 80°. The stream flows along the actual line of dislocation, between steep walls composed on the one side of crushed and reddened Eilean Dubh limestone, and on the other of sheared Torridon grits and flagstones.

The same plane of movement is laid bare along the stream that flows eastward from the head of the Tullich Pass into the Amhainn Bhuidheach, where also the water follows the line of displacement between the quartzite below and the mylonised gneiss above.

East of the Tullich Glen the moved mass of Lewisian rocks which lies upon the Kishorn thrust-plane is for the most part underlain by the platform of fucoid-beds and serpulite-grit that have been driven together as above described. In places, however, the gneiss overlaps on to the fucoid-beds and pipe-rock below the sole on which these Cambrian strata have been carried forward. The thrust-plane finally descends to the valley of Strath Carron near Coullags, where it is concealed beneath the alluvium of the River Carron.

In addition to the great lines of disruption here described, the successive masses of Torridonian and Cambrian strata brought forward on the major thrust-planes have undergone a further amount of intricate plication and movement, which, though perhaps as much developed in the older as in the younger formation, can only be recognised in its full complexity among the easily-distinguishable zones and sub-zones of the Cambrian series.

Only a comparatively feeble degree of metamorphism is observable among the successive masses of Torridonian grit and sandstone where they have been cut through by the thrust-planes, except in the case of the Kishorn thrust. A certain amount of crushing and incipient shearing can be detected along the line of the major thrusts in Glen Torridon and on the slopes of Meall a' Chinn Deirg, though at a short distance from the line of disruption the rocks often appear to be entirely unmodified. The appearance of veins and strings of white quartz in the otherwise unaltered sandstones is an invariable feature in the thrust masses. Though no interstitial movement has taken place in these rocks, they have been much fractured and jointed, the resulting cracks and fissures being now filled with segregated quartz forming a network of ramifying veins, which on glaciated and weathered surfaces stand out in high relief.

It is along the line of the great Kishorn or Kinlochewe thrust-plane that the internal differential movement in the rocks has reached in this district its maximum development. The Torridonian grits and sandstones have been converted into green and red flagstones, in which the constituent particles have been drawn out along the lines of movement, and the original lithological character of the rocks has been more or less obliterated.

The basal shaly beds pass into black slaty schists and flagstones; and the immediately overlying gneiss, partaking in the same movements, is crushed and mylonised to such a degree that in some places it is difficult to determine the actual junction-line between the two formations. Even the basal Torridonian breccia is in some places simulated by a pseudo-conglomeratic rock, which has been produced by the crushing of the gneiss where it is filled with veins of pegmatite.

On the east side of Glas Bheinn (Figure 54) the relations of the Moine-schists to the Lewisian gneiss are unfortunately obscured by a normal fault, which throws down the siliceous flagstones and phyllites of the Moine series (M) against the deformed gneiss. But immediately to the west of this dislocation it is evident that the original characters have here been effaced, the rocks having been converted into the banded mylonites with marked flaser structure, which have been shown in the previous chapters to be so persistent an accompaniment of the Moine thrust-plane.

II Area between Loch Kishorn and Loch Alsh

This section is by B. N. Peach and J. Horne.

The most striking feature of the belt of complication in the ground now to be described is the stupendous inversion of the Torridon Sandstone and Lewisian rocks above the Kishorn thrust-plane. The overturned gneissic floor, lying at a gentle angle on the inverted epidotic grits, black shales, and sandstones of the lowest Torridon division, forms a bold and conspicuous escarpment to the north and south of the entrance to Loch Carron. The boundary line between the two formations has been traced from the western slope of Cearcall Dubh, north-east of Kishorn, southwards to a point in Loch Carron about a mile west of North Strome, thence on the south side of the loch by Fernaig and the prominent crag east of Duncraig to Gleannan Dorch, where it is truncated by the Balmacara thrust. This remarkable piece of topography, so continuous for several miles, is without parallel in the North-West Highlands.

Within the belt of complication in this district a high grade of metamorphism is observable among the lowest Torridon strata usually at or near their inverted base-line. This alteration may be studied with advantage at Fernaig in the conglomerate which crops out there. This rock is traceable only for a limited distance, but when it is absent its place is taken by epidotic grits and shales, which lie in contact with the old floor of gneiss.

Considerable differential movement has taken place in some parts of the Lewisian rocks and underlying epidotic grits. New divisional planes have consequently arisen, which are inclined at gentle angles to E.S.E.

Thin pegmatites of quartz and felspar appear in the displaced sandstones and shales crossing the planes of schistosity. A high degree of metamorphism is likewise observable in certain outliers of the basal Torridonian beds at Loch nan Gilleann and Loch na Leitire, east of the great crag of gneiss beyond Duncraig. (Sheet 71) Above the Balmacara thrust-plane that stretches from the shore of Loch Alsh at Ard Hill north to near the head of Balmacara Burn, and thence in a winding course round Coille Mhor and Sgorr Beag to Gleannan Dorch, highly deformed Lewisian gneiss is observable, together with patches of epidotic grits and shales, which here and there have likewise undergone much alteration.

The position of the Moine thrust-plane is defined at certain places between Braeintria in Strath Ascaig and Kirkton of Lochalsh. Of special interest and importance is the evidence of the crushing and deformation of the siliceous schists above that plane.

At the western end of the section drawn in (Figure 55) the position is shown of the great fault (f) which has already been referred to as letting down the thrust Cambrian dolomites, limestones, and underlying quartzites against the undisturbed Torridon Sandstones of the Applecross region. This dislocation passes under the sea and runs down the length of Loch Kishorn. The heaped-up dolomites are in turn overridden by pipe-rock, furoid beds, and serpulite-grit, these being abruptly truncated by an intermediate displacement which, coming in advance of the Kishorn thrust, brings forward a small core of crushed gneiss and red sandy shales (Torridon). Eastwards the belt of inverted Torridon Sandstone, composed, as already indicated, of the Diabaig group (Ba), and inclined at gentle angles to E.S.E., is traversed by an east and west fault that runs along Glen More and shifts the outcrop of the Kishorn thrust-plane westwards to the sea-floor. (Sheet 81)

On the west and south slopes of An Sgorr the black and grey shales and epidotic grits at the base of the Torridon series pass in inverted order underneath the Lewisian floor, which, not far above the line of junction, consists of a prominent sill of epidiorite and hornblende-schist (B^G), underlain in places by grey gneiss (A), mica-schists, and rusty-brown, slightly graphitic schists, recalling the types of rock that appear north of Loch Maree in the undisturbed area of gneiss. In Sheet 81 the development and distribution of this intrusive mass are shown. It ranges southwards to North Ströme, near to which place it may be examined in some excellent exposures.

On the southern slope of An Sgorr the Lewisian rocks and the inverted Torridon Sandstone below them have been thrown into a gentle arch, indicative of the folding of the displaced materials after their inversion. Eastwards the grey gneiss and associated hornblende-schist are followed by masses of basic material with red pegmatites, which on the higher part of the eastern declivity are not much deformed. Towards Slumbay, however, the development of mylonites is well marked, both the grey acid gneiss and pink pegmatites showing fine flaser structure. The position of the Moine thrust probably lies here beneath the sea-level, as shown in (Figure 55). On Sgeir Chreagach, in the middle of Loch Carron, fine garnetiferous mica-schist appears, and on the east side of the loch granulitic, siliceous Moine-schists (M) are followed by a mass of reconstructed Lewisian gneiss (A). The granulitic hornblende-gneiss seems to occur here in the form of an arch, as the siliceous flagstones are met with higher up the slope.

The great fault in Loch Kishorn splits into several branches which skirt the southern shore of Applecross, and there produce marked brecciation of the unthrust members of the middle division of the Torridon Sandstone. East of this normal displacement in Loch Kishorn, the beds of arkose forming the Applecross group (Bb, (Figure 56)), also the various sub-divisions of the Diabaig group (Ba^1 to Ba^4) met with in Sleat (Skye), can be traced succeeding each other, but in inverted order. They are finally surmounted by the Lewisian gneiss on Creag Dallag east of Duncraig. The higher Kinloch beds of Sleat (Ba^4) appear west of Reraig; the Beinn na Seamraig grits (B^3) on the promontory of Ardaniaskin and on the islands in Loch Carron; the Loch na Dal beds (Ba^2), the epidotic grits, and the local basement conglomerate (B^1) on the slope beneath Creag Dallag. Throughout this line of section there is a persistent dip to E.S.E. at gentle angles. Though flaser structure is apparent in the grits on Ardaniaskin, the deformation becomes much more pronounced near the overturned floor of Lewisian rocks, where the epidotic grits, the basal conglomerate and gneiss have acquired common planes of schistosity inclined to E.S.E.

Eastwards from the inverted base-line of the Torridon Sandstone flaser-structure decreases. Granulitic gneiss of the Meall Riabhach type (Loch Maree), including bands of hornblende-schist, occur on the ridge, and near the south-east limit of this mass the large sill of hornblende-schist (B^G) appears as the southern prolongation of that on An Sgorr

referred to in the previous section. Mica-schists are not found here in association with this intrusive sheet, but east of Port a' Chuillin and about a mile west of Stromeferry they are met with on the shore. In the railway cuttings west of Stromeferry Station fine examples are seen of phacoidal structure in the pegmatites and basic gneiss. (See (Plate 29), Part 1, Chapter 14)

The sill of hornblende-schist is truncated by a well-marked thrust with a low dip, which brings forward a mass of highly-sheared platy gneiss. A second line of disruption supervenes, above which the Lewisian rocks still show some of their original characters, and further east a third displacement (the Balmacara thrust) has driven westwards some intensely-sheared gneiss, to be referred to in the sequel.

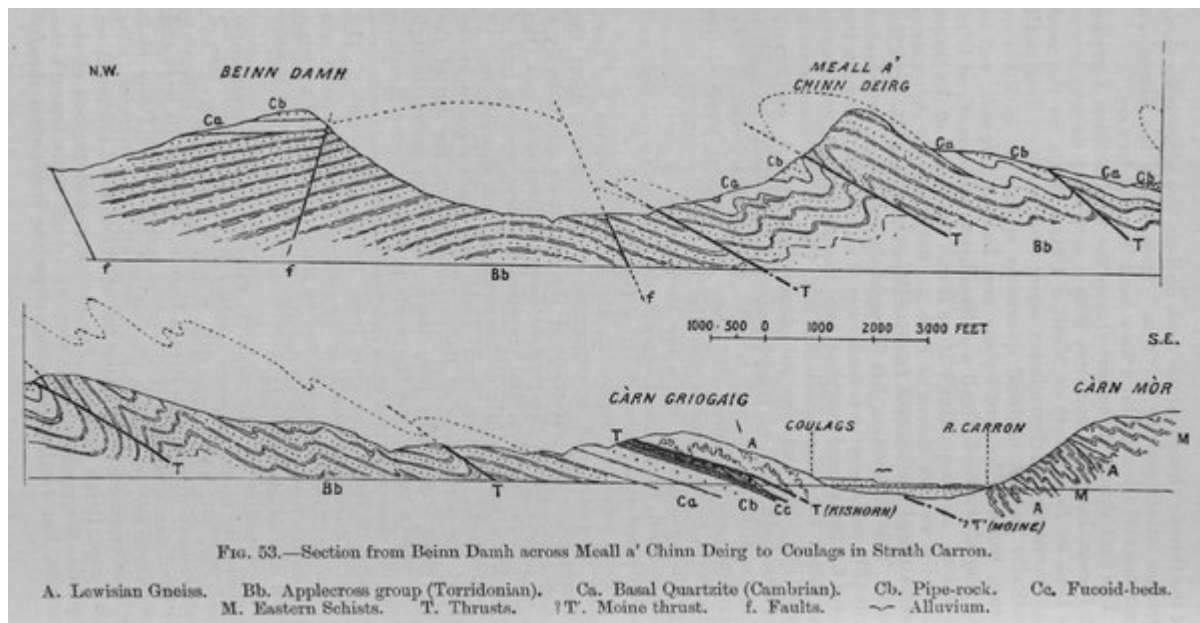
West of Braeintrá, in Strath Ascaig, the plane of the Moine thrust is well exposed in a little side stream on the hill-slope, where an outlier of siliceous schist rests on deformed gneiss. Here the ordinary structures of the Moine-schists have been broken down by the post-Cambrian movements. The main outcrop of the Moine thrust-plane lies not far to the east. It is worthy of note that three-quarters of a mile south of Braeintrá, at the bridge by the side of the road, an epidotic schistose grit appears at the inverted junction of the siliceous Moine-schists with the granulitic biotite gneiss of Lewisian age. Beyond the narrow belt of quartzose flagstones overlying the main outcrop of the Moine displacement outliers of Moine-schist (M) may be observed within the area of granulitised Lewisian gneiss (A). (Figure 56)

East of the headland of An Dubh Aird, at the mouth of Loch Carron, all the Torridon strata are inverted (Figure 57). The axial line along which the inversion begins is situated among the members of the Applecross group (Bb), some of which have a normal dip to the west, while others are inclined to the east. As those with an eastward inclination are followed inland they are seen to pass in inverted order beneath the Diabaig group (Ba). The zone of Kinloch beds (Ba⁴) is developed round the shores of the bay between Plockton and Duncraig, whence it extends eastwards beyond the mansion of Duncraig. These are followed in inverted order by the other sub-divisions of this lowest Torridonian group (Ba³ to Ba¹), till, on the bold escarpment of Carn a' Bhealaich Mhoir, the basal conglomerate (Ba¹) is overlain by grey granulitic gneiss (A), on which it normally rests. The amount of deformation at this place is much less than that at Fernaig, already described. Beyond the gneiss lies the sill of hornblende-schist (B^G), previously referred to in this chapter, which is cut off by a thrust that brings forward platy crushed gneiss. Not far to the east a second thrust supervenes, which has driven westwards a slice of Lewisian gneiss with small outliers of the basal members of the Torridon Sandstone (Ba¹, Ba²), showing a high degree of metamorphism. The general strike of the foliation of the Lewisian series here is north-west and south-east, but near the lines of disruption it roughly coincides with their trend. The gneiss is massive and hornblendic, with bands of epidiorite. The patches of inverted Torridon strata lie in several folds, two of which appear in the line of section. (Figure 57) They comprise the basal conglomerate, epidotic grits, together with dark shales and flaggy grey siliceous sandstones of the Loch na Dal group of Sleat. These rocks show flaser-structure, peripheral granulitisation of the grains, and a development of sericitic mica. They are visible on the south-east shore of Loch nan Gillean and on the south side of Loch na Leitire, three miles north of Kirkton of Lochalsh. (Sheet 81) About 200 yards east of the latter lake the pebbles in the basal conglomerate have been flattened and elongated.

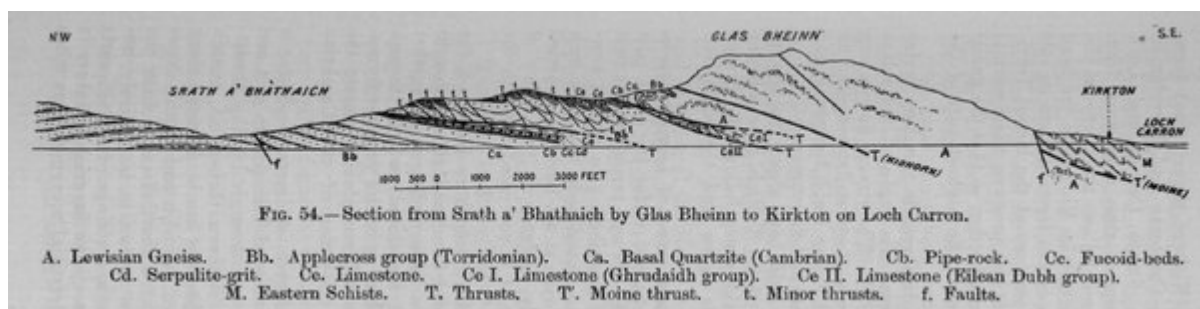
About 100 yards south of Loch na Leitire the outcrop of an important thrust-plane (Balmacara) has been laid open in a small burn, where the grey flaggy beds of the Diabaig group are superimposed on sheared gneiss. On the cliff south of that lake the black shales of the Loch na Dal group are surmounted by the epidotic grits and basement conglomerate that pass, in inverted order, beneath the overturned Lewisian floor (A). Here the thrust Torridonian strata show a considerable degree of alteration. Still further to the east along the same line of section a remarkable development of intensely-sheared gneiss appears on Beinn Raimh. In this Lewisian mass the original structures have been almost wholly effaced, its band of acid and basic rock with pegmatites being now represented by red, grey, and green striped mylonites. On the eastern declivity of the same hill these rocks are truncated by the Moine thrust (T'), which has here carried westwards four inverted folds of siliceous schist (M, M) with intervening bands of gneiss (A). The type of Lewisian rock in these intervening arches is a granulitic, epidotic, hornblende-biotite gneiss with large lenticles of hornblende-schist. At the eastern margin of the third infold of siliceous schist and at the western edge of the fourth belt, exposed in Gleann Udalain, a conglomeratic rock makes its appearance, having a hole-crystalline, micaceous, and hornblendic matrix, and containing pebbles of quartz and of an epidotic gneiss like the underlying Lewisian type.

At Erbusaig, on the west coast of the peninsula between Loch Carron and Loch Alsh, and on the outlying islands, the beds of the middle division of the Torridon Sandstone have a normal inclination to the west. Further east lies the axial north and south line of inversion, east of which, for a distance of four miles, the Torridonian strata are inverted. The arkose of the Applecross group (Bb), extending eastwards to near Loch Scalpaidh, is followed eastwards in inverted order by the members of the Diabaig group (Ba⁴ to Ba¹), which, thrown into gentle anticlines and synclines, seem so regular and undisturbed as to make it at first hardly credible that they can be in reality all upside down. They are eventually abruptly truncated by the Balmacara thrust, which has driven some intensely-deformed gneiss over the sheared Beinn na Seamraig grits and sandstones. The deformation that accompanies this plane of movement is well exposed on the shore south of Ard Hill and on the wooded hill north of Balmacaro, Hotel. The original structures have been here so completely effaced that it is difficult to determine at what point the line of disruption should be drawn. (Figure 58)

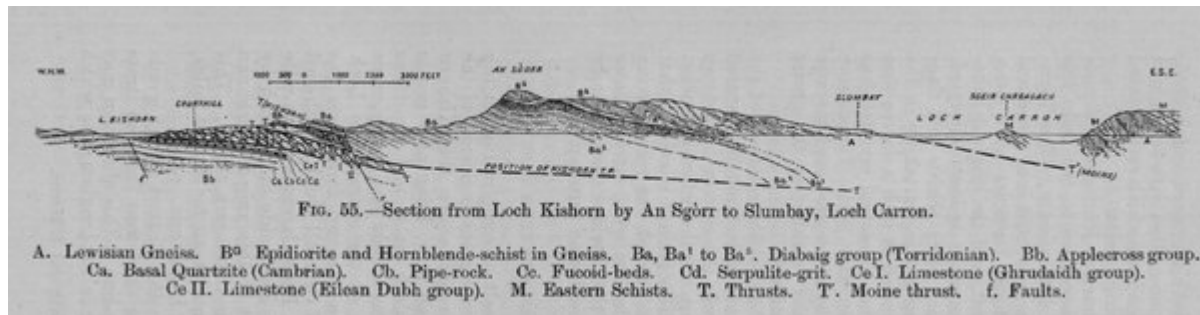
Beyond this mass of flaser-gneiss which forms the high ridge of Kirkton Hill the Moine thrust supervenes near Auchtertyre. This gigantic displacement has here brought westwards a belt of siliceous (Moine) schists (M), from 300 to 500 yards broad, well exposed in the burn that drains the hollow between Kirkton and Auchtertyre hills. They are interleaved in places with thin bands of hornblende-biotite-schist, and dip at gentle angles to E.S.E. Near the thrust-plane their structures have, as usual, been crushed and deformed by the post-Cambrian movements. Along their eastern margin they are overlain by flaggy biotite and hornblende-gneisses with early basic masses of Lewisian type, and they pass transgressively across the acid and basic rocks. It will be observed that in the Loch Alsh district the intercalation of masses of undoubted Lewisian rocks above the Moine thrust-plane reaches a remarkable development, and that a considerable body of these rocks lies below that plane within the sphere of movement of the Balmacara thrust. It is to be remembered also that deep below all these rocks and beneath the inverted Torridonian series the Kishorn thrust-plane has its place. (See (Figure 57))



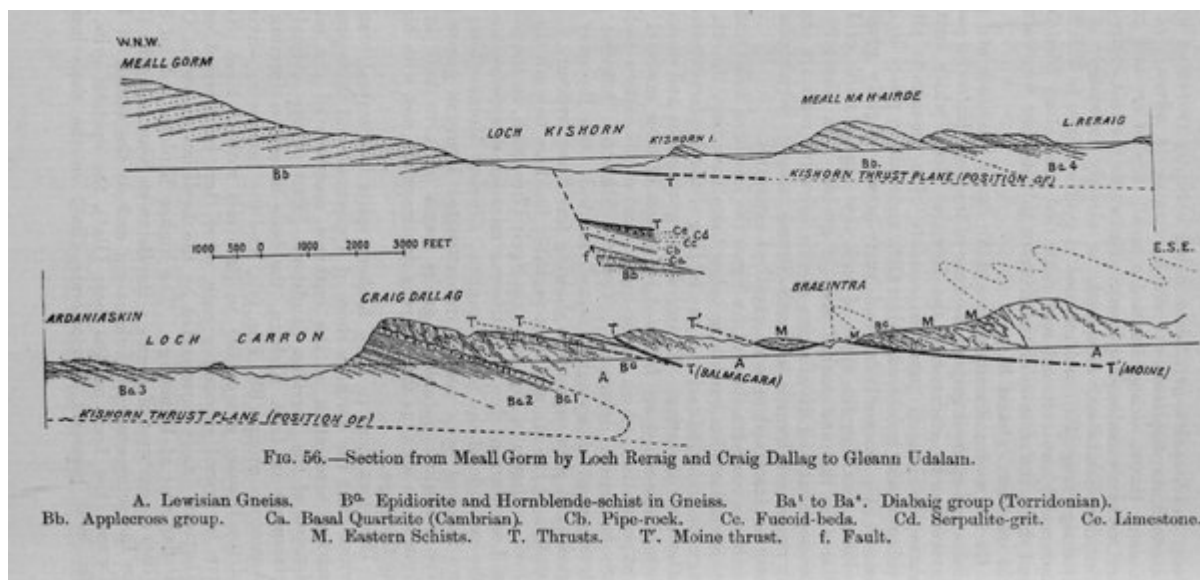
(Figure 53) Section from Beinn Damh across Meall a' Chinn Deirg to Coulags in Strath Carron. A. Lewisian Gneiss. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. M. Eastern Schists. T. Thrusts. ? T. Moine thrust. f. Faults. [symbol] Alluvium.



(Figure 54) Section from Srath a' Bhathaich by Glas Bheinn to Kirkton on Loch Carron. A. Lewisian Gneiss. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Furoid-beds. Cd. Serpulite-grit. Ce. Limestone. Ce I. Limestone (Ghrudaidh group). Ce II. Limestone (Eilean Dubh group). M. Eastern Schists. T. Thrusts. T'. Moine thrust. t. Minor thrusts. f. Faults.



(Figure 55) Section from Loch Kishorn by An Sgòrr to Slumbay, Loch Carron. A. Lewisian Gneiss. Ba Epidiorite and Hornblende-schist in Gneiss. Ba, Ba¹ to Ba³. Diabaig group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Furoid-beds. Cd. Serpulite-grit. Ce I. Limestone (Ghrudaidh group). Ce H. Limestone (Eilean Dubh group). M. Eastern Schists. T. Thrusts. T'. Moine thrust. f. Faults.

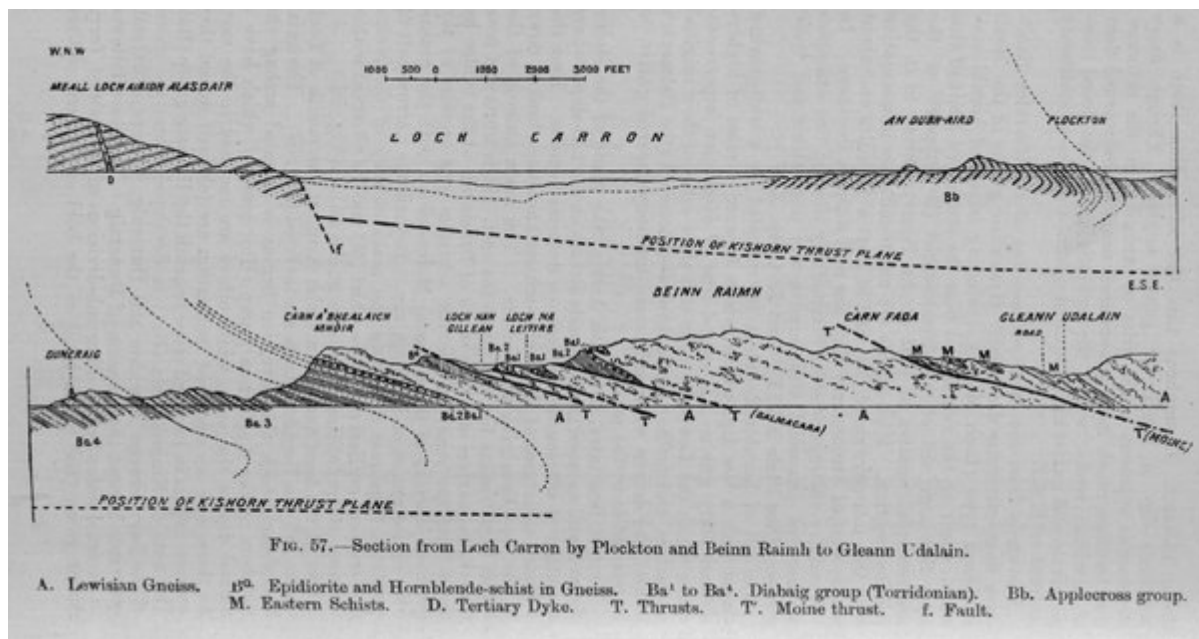


(Figure 56) Section from Meall Gorm by Loch Reraig and Craig Dallag to Gleann Udalan. A. Lewisian Gneiss. B^G Epidiorite and Hornblende-schist in Gneiss. Ba¹ to Ba⁴. Diabaig group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Furoid-beds. Cd. Serpulite-grit. Ce. Limestone. M. Eastern Schists. T. Thrusts. T'. Moine thrust. f. Fault.

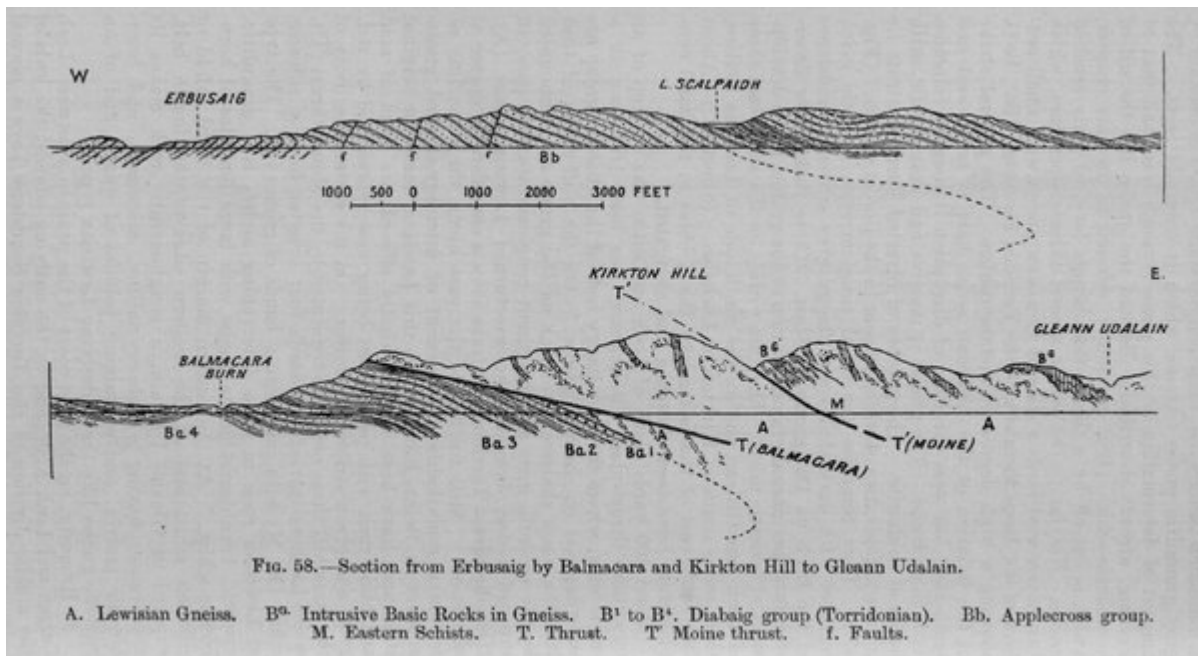


Phacoidal structure in Biotite-Gneiss and pegmatite, produced by post-Cambrian movements. Three-quarters of a mile west of Stromeferry Railway Station, Ross-shire.

(Plate 29) Phacoidal structure in biotite-gneiss and pegmatite, produced by post-Cambrian movements; three-quarters of a mile west of Stromeferry Railway Station, Ross-shire. C64



(Figure 57) Section from Loch Carron by Flockton and Beinn Raimh to Gleann Udallain. A. Lewisian Gneiss. B. Epidiorite and Hornblende-schist in Gneiss. Ba¹ to Ba⁴. Diabaig group (Torridonian). Bb. Applecross group. M. Eastern Schists. D. Tertiary Dyke. T. Thrusts. T'. Moine thrust. f. Fault.



(Figure 58) Section from Erbusaig by Balmacara and Kirkton Hill to Gleann Udalain. A. Lewisian Gneiss. B^G Intrusive Basic Rocks in Gneiss. B¹ to B⁴. Diabaig group (Torridonian). Bb. Applecross group. M. Eastern Schists. T. Thrust. T' Moine thrust. f. Faults.