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## Chapter 37 Structure of the ground from Strath na Sheallag by Loch Maree to Auchnashellach

This chapter has been prepared by B. N. Peach and J. Horne, with notes from E. Greenly. The district described is comprised in Sheets 82 and 92 of the map of Scotland, on the scale of 1 inch to a mile (1:63360).

In the tract to be described in the present chapter the complicated structure of the North-West Highlands attains a development comparable to that so well displayed in Assynt (Chapter 35). In the northern portion of the district within the Dundonnell Forest, as in the ground described in the last chapter, the complicated belt lying to the west of the Moine thrust is only about a quarter of a mile broad, but further south around the head of Loch Maree its width increases to some three miles, and in the Auchnashellach Forest to four miles. Moreover, in the northern tract the visible structure is comparatively simple, owing partly to the narrowness of the belt of complication and partly to the absence of imbricate structure in advance of the Ben More thrust on Mullach Coire Mhic Fhearchair. (Figure 47) Southwards, however, between the Heights of Kinlochewe and Auchnashellach striking proofs are displayed (1) of the reduplication of the strata over miles of ground by inverted folds and minor reversed faults in advance of the powerful lines of disruption, (2) of the folding and faulting of the great thrust-planes, (3) of the formation of a large outlier of displaced materials overlying the Kinlochewe thrust-plane, and (4) of the deformation of the Torridon Sandstone to the west of the Moine-schists in the neighbourhood of Coulin south of Kinlochewe. In the following description of this district, the Kinlochewe thrust is regarded as the equivalent of the Ben More thrust in Assynt and of the Kishorn displacement near Stromeferry.

The narrowness of the belt of complication in Strath na Sheallag and southwards in the direction of Loch an Nid is illustrated by the accompanying section (Figure 46), visible in a small stream on the eastern side of the valley, which joins the Loch an Nid River about half a mile east of Achneigie. Above the point where the tributary enters the alluvium of the main valley an ascending sequence of undisturbed Cambrian strata can be followed from the basal quartzites (Ca) to the fucoïd-beds and serpulite-grit (Cd). Just above the point where the burn is crossed by the hill-road leading to Dundonnell, the upper portion of the fucoïd-beds (Cc) is exposed, together with the bands of dark-blue shale (Cc<sup>■</sup>), which first yielded the *Olenellus* fauna. The normal succession of strata is here interrupted by a powerful thrust (Ben More and Kinlochewe) which has brought forward a thin wedge of Torridon Sandstone (B), considerably crushed, of a greyish tint, Not far to the east the sandstone is abruptly truncated by the Moine thrust (T<sup>■</sup>) and Eastern schists, the line of disruption being clearly displayed on the banks of the stream. When traced southwards in the direction of Loch an Nid this slice of Torridon Sandstone increases in thickness, and is seen to rest unconformably on Lewisian rocks (A), the materials having been driven westwards along the Ben More thrust-plane, the outcrop of which can be easily traced for about a mile on the prominent crag on the east side of the valley. (Sheet 92)

The relations of the strata at Loch an Nid and in the mountainous ground to the west are shown in the section given in (Figure 47). The western part of this section, beyond the belt of complication, illustrates how uneven was the land-surface on which the Torridonian sediments were laid down. On the western slope of Mullach Coire Mhic Fhearchair these sandstones and grits (Bb), which reach there a thickness of about 2000 feet, can be seen to have been accumulated around and above hills of Lewisian gneiss that rise to a height of 1000 feet, and are now gradually being uncovered in the progress of denudation. Above this pile of sediment the Cambrian quartzites (Ca) rest unconformably on the eroded edges of the Torridon Sandstone, followed in order by the pipe-rock (Cb), the fucoïd-beds (Cc), serpulite-grit (Cd), and a few feet of the basal dolomite (Ce). At this point in the Cambrian series the undisturbed strata are abruptly truncated by the Kinlochewe thrust, which has brought westwards a cake of Lewisian basic and acid gneisses traversed by epidiorite dykes (B<sup>G</sup>). These rocks (A) rest on the inclined thrust-plane (T), and form a serrated ridge on the eastern slope of the mountain. Several minor thrusts or reversed faults, not shown in the figure, affect the course of the dykes. On the west side of the Loch an Nid valley, on the dip slope of Sgurr Ban, a small patch of gneiss, which has been isolated by denudation from the thrust mass on Mullach Coire Mhic Fhearchair, is named Meallan an Laoigh (the calf hillock). The fucoïd-beds and serpulite-grit can be traced round this outlier, and the basal dolomite appears on its western side, truncated in like manner by the Kinlochewe thrust. (Sheet 92 and (Figure 47)) No trace, however, can here be seen of any imbricate structure beneath the slice of Lewisian rocks. The remarkable piling-up of the Cambrian strata in advance

of the displaced gneiss, so conspicuous in Eireboll and Assynt, is entirely absent.

East of Loch an Nid a normal sequence of undisturbed Cambrian rocks is traceable from the pipe-rock to the basal dolomite, above which the rest of the Cambrian series has been displaced, as on the west side of the valley, by the Kinlochewe thrust. The Lewisian rocks which now supervene are overlain by the Torridon Sandstone (B), with the basal quartzite (Ca) resting unconformably on both.

Not far to the north of this line of section the conglomerate at the base of the Torridon Sandstone lies in visible contact with the displaced gneiss. It is here a coarse deposit, its pebbles ranging from seven inches to a foot across, and consisting of felsite, jasper, quartz, and altered purple quartzite, with fragments of acid and basic gneiss. It is worthy of note that these pebbles are not deformed nor is the matrix schistose, as is the case with the same conglomerate above the Ben More thrust-plane in the Oykell valley, Assynt. The overlying purple and grey grits and shales have likewise escaped extreme deformation; they are not schistose, but merely crushed and traversed by a network of quartz-veins. Above these displaced materials, thrust furoid-beds and serpulite-grit, together with a thin wedge of Lewisian gneiss, are abruptly truncated by the line of disruption that has driven westward the granulitic schists of the Moine series (M).

From the ground traversed by the line of section in (Figure 47) southwards to the Heights of Kinlochewe and Beinn a' Mhuinidh the width of the area of displaced gneiss lying between the Kinlochewe and Moine thrust-planes gradually increases to three miles (Sheet 92), and presents many of the normal characters of the Fundamental Complex and of the later basic dykes to the west. Here as elsewhere the deformation of the Lewisian rocks between these great lines of disruption is more or less confined to certain zones near the thrust-planes. On the surface of this extensive plateau of displaced Lewisian rocks small isolated patches of Torridon Sandstone occur, as shown on the map. Thus, about half a mile east of Lochan Fada beyond the head of Gleann na Muice, the basal breccia is seen to rest unconformably on the old floor, followed by shales, but the strata are here highly contorted and inverted. Further to the north-east on the western slopes of Beinn Bheag and close to the outcrop of the Moine thrust-plane, the double unconformability of the Cambrian quartzite on the Torridon Sandstone and Lewisian gneiss is visible.

The outcrop of the Kinlochewe thrust-plane, which bounds the displaced Lewisian rocks on the west, is here well defined. To the north-east of Lochan Fada it has been shifted for about a mile to the south-west by the Fasagh fault. It then passes southwards along the conspicuous escarpment west of Beinn a' Mhuinidh to the Kinlochewe River. At the Heights of Kinlochewe evidence has been observed of an intermediate displacement in advance of the Moine thrust, accompanied by marked deformation. A triangular mass of highly-sheared gneiss here displays a narrow infold of Torridon Sandstone and shales (Diabaig group), traceable along the east side of Gleann na Muice for three-quarters of a mile. These sediments have been rendered schistose, an alteration specially apparent in the grits. The deformed gneiss and Torridon Sandstone have been driven westwards along a plane that runs up Gleann na Muice and truncates the underlying Lewisian gneiss with its basic dykes.

Over a great part of the area between Loch an Nid and the Heights of Kinlochewe the exact position of the Moine thrust can with difficulty be fixed, owing partly to the absence of sections in the direction of the dip of the strata, and partly to the mylonised rocks which so often accompany this great line of displacement. These mylonised materials have resulted from the shearing of gneiss and green epidotic grits. They are well developed near Loch a' Mheallain Odhair, two and a half miles north of the Heights of Kinlochewe, and also on the western slope of Sron Dubh. But on the south-west declivity of Beinn Bheag, and particularly in the valley of Abhuinn Bruachaig below the Heights of Kinlochewe, the Moine thrust is clearly traceable. Indeed, in the latter area, where the ground is bare of drift, the Eastern schists above that plane of disruption pass transgressively across the displaced Lewisian gneiss and the Torridon Sandstone with a small patch of the basal quartzites. At the Heights of Kinlochewe the thrust-plane is shifted westwards for about half a mile by an E.N.E. and W.S.W. fault.

Beyond the Heights of Kinlochewe the structure of the country becomes remarkably complicated. A conspicuous example of this complexity may be seen on the rocky ridge on the north side of the Kinlochewe River (Figure 48), where, owing to the inversion of the displaced materials, the folding of the Kinlochewe (Ben More) thrust-plane, and the subsequent denudation of the rocks overlying that plane, the structure has been found most difficult to unravel. The western part of this section supplies another illustration of the uneven land-surface on which the Torridon Sandstone

reposes, the ridge of Meall Riabhach being flanked by pre-Torridonian valleys on either side. In Gleann Bianasdail the position of the Fasagh fault (f) is shown, whereby the Torridon Sandstone on the east side of the valley is let down against the hornblende-schists of Lewisian age to the west. Along the eastern slope of this valley runs the unconformable junction between the Cambrian quartzites (Ca, Cb) and underlying red sandstones (Bb). A normal sequence can here be followed from the basal quartzites to the representatives of the *Olenellus* zone (the Middle Series), and in places to the basal dolomite (Ce).

On Craig Roy the succession is interrupted by the Kinlochewe (Ben More and Kishorn) thrust-plane (T), above which appear the Lewisian rocks (A) with an infold of the basal quartzite (Ca), the unconformable junction between the two rocks being well exposed. Eastwards across the slope the Lewisian plateau is traversed by lines of movement producing no marked deformation. About half a mile to the south of the top of Beinn a' Mhuinidh the Lewisian rocks are covered unconformably by the Torridon Sandstone (Ba), with infolds of the basal quartzite, arranged in isoclinal folds. The axial planes of these folds are inclined generally to the E.S.E., and are truncated in places by minor thrusts hading in the same direction. These red sandstones stretch eastwards from Meallan Gobhar to the hills beyond Allt Chnaimhean (the burn of the bones), and cover more than a square mile of ground. Along their northern margin their unconformable boundary-line with the gneiss has been traced (Sheet 92), and they are there found to be usually inverted and to pass underneath the older formation. The basal breccia at the line of junction contains fragments of the underlying gneiss.

The gorge in the lower part of Allt Chnaimhean has been cut by the stream through the overlying cake of thrust Lewisian rocks, Torridon Sandstone, and basal quartzite, so as to reveal the piled-up fucoïd-beds, serpulite-grit, and basal dolomite beneath the Kinlochewe thrust-plane (T). The exposure of these successive layers of displaced materials is due not only to denudation, but partly also to the folding of the rocks above and below this line of displacement, as represented in (Figure 48). A still more striking example of this complicated structure occurs about half a mile to the east of Allt Chnaimhean, where the thrust-plane, together with the rocks which it separates, has been sharply folded, and where the thin veneer of gneiss and red sandstone overlying the thrust-plane has been removed from the crest of the arch. The dome-shaped arrangement of the Cambrian strata beneath that plane is well seen on the hill-top and southern slope facing the road that leads to Kinlochewe. The third sub-division of the pipe-rock is the lowest Cambrian zone here represented. It is followed by the higher sub-zones, the fucoïd-beds, and serpulite-grit, which are repeated by reversed faults. Further east, owing to a minor fold, a lobe of the displaced materials which lies above the Kinlochewe thrust-plane consists of gneiss with an infold of the red sandstone. Although represented as an outlier in (Figure 48), it is really connected with the main mass. On the slope towards Abhuinn Bruachaig the bare plane of the Kinlochewe thrust is exposed, and for part of the distance the Lewisian gneiss rests mainly on the Cambrian limestone. Here, too, the inverted junction of the Torridon Sandstone (Ba) with the gneiss (A) above the line of displacement is visible, while to the south of the outcrop of the thrust-plane the repetition of the fucoïd-beds, serpulite-grit, and basal dolomite is clearly observable.

In the channel of Abhuinn Bruachaig (or "Glen Logan"), about two miles up the valley from Kinlochewe, the same important line of disruption is laid bare, where pink epidotic granitoid gneiss ("Logan Rock" of Heddle) is superimposed on the dolomite of the Ghrudaïdh group, the upper serpulite-band being visible within a few yards of the plane. Close by are the fucoïd-beds, which have yielded fragments of *Olenellus*. Further down the stream the gneiss, exposed in several places, is associated with a mass of crushed Torridon Sandstone (Ba) in the triangular space between the Abhuinn Bruachaig and Glen Docherty. At one locality, as shown in (Figure 48), the crushed sandstone is succeeded by the basal quartzite (Ca) beneath the Moine thrust-plane (V).

Reference has already been made to the correct identification by Professor Bonney of the Lewisian gneiss and Torridon Sandstone in Abhuinn Bruachaig (Glen Logan), and to the recognition of the reversed fault whereby the gneiss has been brought to the surface.

The horizontal section in (Figure 48) shows that the materials above and below the Kinlochewe thrust-plane, together with that plane itself, have been thrown into a compound anticline and syncline, and that the folding was developed subsequent to the thrusting.

Before describing the effects of the great fault that runs along Loch Maree and up the valley of Glen Docherty, whereby the undisturbed strata, the successive thrust-planes, and the displaced masses have been shifted westwards on the

south side of the dislocation, it will be desirable to indicate the relations of the strata on the south side of the Kinlochewe River and the head of Loch Maree.

Along the south-west side of Loch Maree, in the undisturbed Torridon Sandstone in Glen Grudie (Sheet 92), we find the prolongation of the Fasagh fault, which has been shifted about three miles to the west of its position in the Fasagh Glen at the head of the loch. On the eastern slope of Glen Grudie (as shown in (Figure 49)) undisturbed Cambrian strata, ranging from the basal quartzites to the serpulite-grit (Ca to Cd), and in places to the basal limestone, dip in an easterly direction at angles varying from 10° to 20°. These undisturbed strata are abruptly truncated by the Kinlochewe thrust, and are overlain by a large mass of Torridon Sandstone (Ba, Bb) with inliers of Lewisian gneiss (A), which together cover an area of a square mile and a half round Meall a' Ghiubhais. This prominent hill (2882 feet), about two miles to the west of the head of Loch Maree, forms a conspicuous outlier of displaced materials. The thrust-plane on which these materials lie can be traced round the mountain, where it appears as a circular fault or line of discordance between the rock masses. While the Torridon Sandstone rests on undisturbed Cambrian strata on the north and north-west, a slice of basal quartzite and pipe-rock, which has been driven westwards by an intermediate minor thrust, comes beneath the thrust-plane on the south and east, and is recognisable from a distance owing to the white fringe which the strata form beneath the darker overlying sandstone. In this outlier the Diabaig and Applecross groups of the Torridon Sandstone are both represented, the strata being arranged generally in the form of a syncline with a compound anticline towards the west. They rest on the gneiss, which, as shown in (Figure 49), appears in places between them and the thrust-plane. On the west side of the mountain, near the base of the red sandstones, a portion of the basal quartzite (Ca) has been infolded with the Diabaig beds. The strata are here not much deformed, save near the thrust-plane and the other minor displacements. Where the arkose has become slightly schistose, the dark and grey shales have been cleaved, and along the actual lines of movement the strata have been transformed into flinty crush-rocks. A small patch of displaced Torridon Sandstone which lies to the east of the main outlier on Meall a' Ghiubhais rests partly on basal quartzite and partly on serpulite-grit.

Eastwards for a distance of two miles the Cambrian zones up to the serpulite-grit are repeated by inverted folds and reversed faults, their general inclination being towards E.S.E. and E. The underlying Torridon Sandstone has shared in these plications, for, on the wooded slopes facing Loch Maree and in the cliff above, the members of that system, not much deformed, can be seen to rise from underneath the quartzite in great flexures, and along the line of section (Figure 49) in sharp isoclinal folds.

About three-quarters of a mile west of Cromasag (Sheet 82) the main outcrop of the Ben More thrust-plane appears, where the Torridon Sandstone is superimposed on the lowest sub-zone of the pipe-rock. In that stream the beds of arkose (Applecross group, Bb) dip to the south-east at angles ranging from 35°–45°, with little trace of schistosity, but traversed by numerous veins of quartz. Flaser-structure, which begins to appear in the grits on the west side of the valley, not far from the Kinlochewe Hotel, is finely developed among these rocks in the bed of the Kinlochewe River south of Cromasag, close to the Moine thrust-plane. This line of disruption is here concealed by alluvium, but the green schists which overlie it are exposed in the river not far to the north and south of Cromasag.

A comparison of the structures on either side of the valley below Glen Docherty, as revealed in the foregoing sections (Figure 48) and (Figure 49), will show the great horizontal displacement produced by the fault which runs along the length of Loch Maree. It will be seen that (1) the Fasagh dislocation has been shifted three miles to the west to Glen Grudie; that (2) the outcrop of the undisturbed quartzite on Beinn a' Mhuinidh has been carried westwards to a point beyond Rim Noa Pier on Loch Maree; and that (3) the outcrop of the Moine thrust-plane has been also borne westward from the hill-slope east of Bruachaig to the valley at the Kinlochewe Hotel. In like manner the axes of the compound syncline and anticline between Beinn a' Mhuinidh and Abhuinn Bruachaig have been moved further west on the south side of the displacement to Meall Ghiubhais and the ridge south-west of Tagan. Accompanying this horizontal displacement there has been a vertical downthrow of about 1000 feet on the north side of the Loch Maree fault.

Southwards, in the direction of Beinn Eighe and the Coulin deer forest, further evidence has been obtained of the enormous compression of the Torridonian and Cambrian strata by reversed folds and faults in advance of the Kinlochewe thrust, and of the deformation of the Torridon Sandstone beneath or close to the Moine displacement. The Kinlochewe or Ben More thrust-plane can be followed southwards from the Cromasag Burn to Loch Clair, where the Torridon Sandstone

overrides successive zones of the quartzites and fucoid-beds. Thence the outcrop of the thrust-plane passes southwards through the Coulin Forest, skirting the western base of Cnoc Daimh, and by the east declivity of Carn Odhar to Achnashellach. Over the greater part of this ground it is difficult to locate the exact position of the Moine displacement, owing to the development of mylonised rocks and to the metamorphism of the basal parts of the Torridon Sandstone overlying the Kinlochewe thrust-plane, where they assume a structure resembling that of Moine-schist.

The structure of the mountainous ground rising to the west of Kinlochewe is represented in the section drawn in (Figure 50). At the west end of this section the Fasagh fault, with a downthrow to the east, is shown in the Torridon Sandstone. The line of section then runs eastwards along the crests of the long ridge of Beinn Eighe. The summit of Sail Mhor, the most westerly peak of the mountain, is capped with a small outlier of basal quartzite (Ca). Further east the successive members of the arenaceous series, resting unconformably on the Torridon Sandstone, are followed in order by the fucoid-beds (Cc) and part of the serpulite-grit (Cd). For a considerable distance the various zones of the pipe-rock (Cb) are repeated by isoclinal folds, sometimes accompanied by minor thrusts. About a mile and a half east of Sail Mhor the Torridon Sandstone (Bb) is superimposed on the basal zone of the pipe-rock by means of a minor thrust. The red sandstones form here a continuous belt across the mountain, and further east they are again covered unconformably by the quartzite (Ca), followed by the pipe-rock (Cb) up to the fourth sub-zone, which is in turn truncated by another reversed fault that brings forward the basal quartzite. On Sgurr Ban a conspicuous anticline and syncline of the Torridon Sandstone and Cambrian quartzite are visible on the north and south slopes, where the isoclinal nature of the folding is clearly displayed.

Beyond Sgurr Ban, along the ridge towards Meallan na Circefraoich for a distance of two miles, the various zones of the arenaceous series are constantly reduplicated by inverted folds and reversed faults. An examination of the southern slope in an easterly direction about the 1250-foot contour-line shows that the underlying Torridon Sandstone has participated in these flexures and displacements. Notwithstanding this extreme plication, however, the rocks have not been much deformed. Here and there the Torridon Sandstone has been brushed and is traversed by quartz-veins. On the further side of the Kinlochewe thrust-plane (T), which is well seen in small burns about a mile north from Loch Clair, close by the junction of the roads leading to Torridon and Coulin Lodge, the metamorphism of the Torridon Sandstone is well developed. Above this line of disruption the beds of arkose of the Applecross group (Bb), dipping to the E.S.E., are exposed in the stream (A' Ghairbhe) that issues from Loch Clair. West of the river the bedding planes in these strata are preserved, but in the stream-section at Doire na Gairbhe and below that point they have been effaced, the beds becoming schistose along planes parallel with those of thrust. The larger grains of quartz and felspar in these rocks have been elongated and appear as eyes in a mylonitic matrix, in which minute flakes of sericitic mica have been developed, showing that in addition to the differential movement of the constituents a certain amount of reconstruction has been induced.

On the east side of the A' Ghairbhe River the sheared grits are succeeded in inverted order by black and grey shales, flags, and epidotic grits of the basal division of the Torridon Sandstone (Diabaig group, Ba), until these strata plunge under a crag of Lewisian gneiss (Creag Ghairbhe) traceable southwards to Loch Coulin. The Torridonian sediments are here all more or less schistose, and in places show a marked platy structure similar to that of the mylonised rocks associated with the Moine-schists. Sericitic mica has been developed on their divisional planes, and frequently lines of striping appear on the surfaces of the horn-stone like bands, trending in the direction of the post-Cambrian movements. Generally the deformation and reconstruction increase towards the junction with the overturned gneiss. These metamorphic structures are well displayed along the face of the crag that runs southwards from Doire na Gairbhe to the southeast corner of Loch Clair. The inverted base of the Torridon Sandstone appears along this crag, though in the line of section it is cut out by a thrust, but of no great moment.

The wedge of overlying gneiss has likewise been deformed, though the original structures of the rock are still traceable. Beyond this appearance of the ancient Lewisian floor mylonites (M■) supervene, showing the double system of folding characteristic of the Moine-schists, and soon followed by the siliceous flagstones of the Eastern series (M). Not improbably the epidotic grits and dark flags of the Torridonian series may be represented in this mylonised zone between the Lewisian gneiss and siliceous flagstones.

The section given in (Figure 51) is drawn through the high ridge of Liathach (3456 feet) eastwards across the head of Glen Torridon and Sgurr Dubh to the Coulin River. Its eastern portion is of special importance on account of the supplementary evidence which the ground traversed by it affords of the deformation of the Torridon Sandstone above the Kinlochewe (Ben More and Kishorn) thrust-plane, and of the presence of certain sediments of intermediate type between the deformed members of the Torridonian Diabaig group and the granulitic schists of the Moine series.

At the west end of this section a hill of Lewisian gneiss is seen to protrude through the red sandstones to a height of 800 feet. On the west slope of Mullach an Rathain the position of the Fasagh fault is represented. The enormous pile of red sandstones on Liathach is capped with outliers of Cambrian quartzite, including the false-bedded grits (Ca) and part of the pipe-rock (Cb). On this mountain the Torridon Sandstone and overlying Cambrian rocks have been thrown into a flat arch, on the west side of which the red sandstones present the westerly dip characteristic of them in Applecross to the south, and likewise in the northern district of Stoer in Assynt and the Parph west of Durness.

High up on the eastern slope of the most easterly peak of Liathach a normal fault (f) lets down the sandstones on that side, beyond which for two miles the ground is occupied by beds of arkose (Applecross group) interrupted by two minor thrusts.

On Sgurr Dubh (2566 feet) — a prominent feature in the landscape as seen from Kinlochewe — the Torridon Sandstone and basal quartzite display incipient fan-structure, the beds being inverted and repeated by minor thrusts on the western declivity. On the crest of the mountain infolds of the lowest sub-zone of the pipe-rock (Cb) have survived. The eastern slope displays several compound flexures of the red sandstones and overlying quartzite. South-eastwards beyond the slope drained by the two tributaries of Alltna Luib, where the usual repetition may be seen of both divisions of the arenaceous series (Ca, Cb), the western flank of the hill that overlooks Loch Coulin presents the outcrop of the Kinlochewe thrust-plane, with the basal members of the Torridon Sandstone (Ba) above it and the fucoid-beds (Cc) below.

It may be mentioned that on the south slope of Cnoc Daimh, where the driving together of the fucoid-beds, serpulite-grit, and basal limestone is admirably displayed beneath the Kinlochewe thrust-plane, the general structure differs to some extent from what appears in Assynt and thence northwards to Eireboll.

The piled-up strata have not here been driven westwards along an underlying plane of movement or "sole", for the minor folds and thrusts are traceable downwards into the underlying pipe-rock.

The strata which have here been carried forward on the Kinlochewe thrust-plane belong to the Diabaig group (Ba) of the Torridon Sandstone, and comprise epidotic grits, black and grey shales and flags, and, thin bedded sandstones with cores of Lewisian gneiss, arranged in isoclinal folds that dip to the E.S.E. at angles varying from 15° to 36°. Several of these gneiss lenticles which occur on the hill one mile N.N.W. of Cnoc Daimh cannot be traced far, but the most easterly one forms a continuous band extending southwards from Loch Coulin and across Cnoc Daimh to Easan Dorcha.

An examination of the hill west of the keeper's house at Coulin and in Allt Cnoc Daimh has shown an increase in the grade of metamorphism as the rocks are followed eastwards from the Kinlochewe thrust-plane. On the hill-top the most westerly arch of Lewisian gneiss (A, (Figure 51)), 150 yards east of the thrust-plane, forms a lenticle about 200 yards long, flanked by the epidotic grits and black shales (Ba), which dip east at angles from 13° to 35°. Beyond an interval of 300 yards, in which an inverted syncline of the Diabaig group appears, the second inverted anticline about 100 yards long of Lewisian rocks consists of green epidotic gneiss with eyes of hornblende-rock. Here the Torridonian strata have not been much deformed, though they become rudely schistose in places. But 300 yards further east at the third arch of gneiss the metamorphism is much more pronounced. On the west limb the basal epidotic grits are concealed by a small thrust, but they rise from underneath the gneiss lenticle on the north and rest unconformably on it on the east. A small burn that crosses the eastern limb of this fold has exposed the epidotic grits in an intensely-sheared condition, with abundant sericitic mica and secondary magnetite. These altered rocks are regarded by Dr. Teall as similar to the Torridonian rock at Fernaig, which under the microscope presents structures like those of Moine-schists. Five hundred yards further east a fourth fold of Lewisian gneiss, the most easterly of the series, appears, underlain by similar sheared epidotic grits. Although only this fold is exposed a little to the south in the Cnoc Daimh Burn, the evidence furnished by

this stream is of extreme interest. Below the 800-foot level an almost continuous section has been laid bare of the grey and black slaty shales, flags, and epidotic grits, dipping eastwards in inverted order at angles varying from 10° to 12°. The grits are sheared and their quartz grains more or less granulitised. Not far below the 500-foot level the Lewisian gneiss overlies the inverted basal conglomerate of the Diabaig group, the gritty matrix of which is intensely sheared and contains epidote, chlorite, and magnetite, like the rock at Fernaig above referred to.

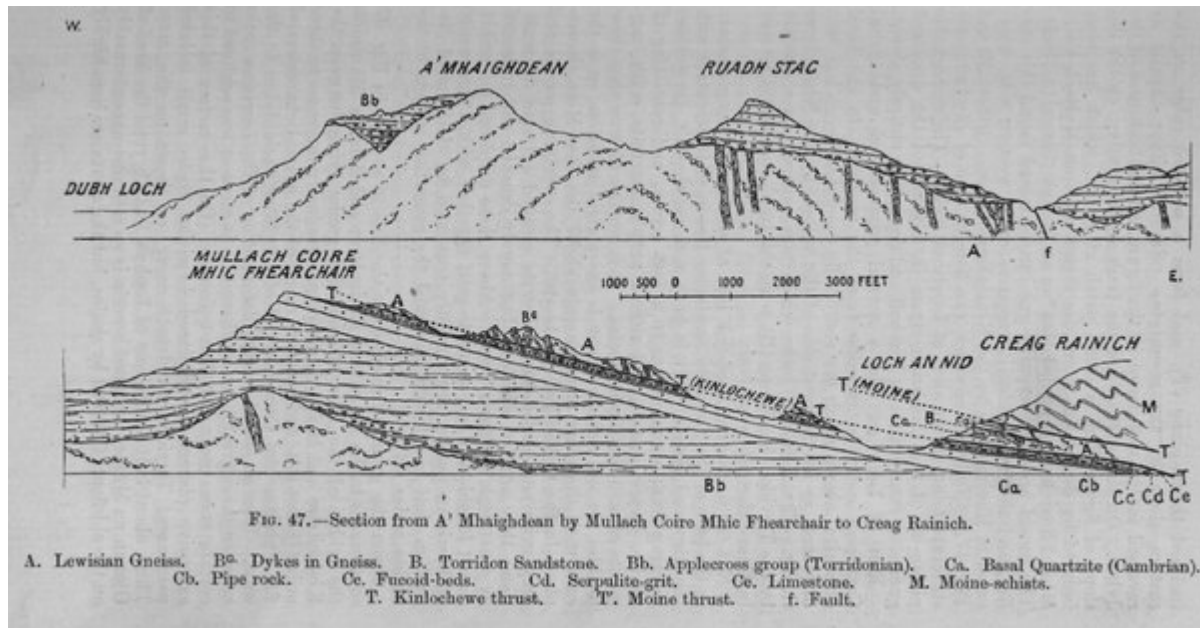
The acid gneiss with basic lenticles which overlies this basal conglomerate has been so intensely crushed that it has been described by Dr. Teall as having the appearance of a clastic rock with much secondary mylonitic material. It is visible in the stream at the bend below the 500-foot contour-line. Below it for a distance of 250 yards the stream exposes a continuous section of strata of sedimentary origin, resting on the deformed Lewisian gneiss, and presenting slightly different characters from the Diabaig beds in the inverted limb of the arch. At its upper margin the epidotic gneiss is practically a mylonite. It is immediately succeeded by fine-grained, dark platy schist, which Dr. Teall finds to be composed of quartz, felspar, sericitic mica, small scales of brown mica, and minute grains of epidote. He further notes "that under a low power this rock resembles a sandy shale, but under a high power the structure is more allied to that of a crystalline schist. It is difficult to avoid the conclusion that this is one of the sandy shales of the Torridon system". It may be remarked that this platy rock has the alternating dark and grey films so characteristic of the shaly bands of the Diabaig group, but the basal conglomerate, so well developed on the inverted limb of the arch, is here unrepresented.

About the 400-foot level these dark platy schists contain a few garnets, and, further down stream, they are succeeded by fine-grained grey siliceous schist with scattered "eyes" of felspar. Dr. Teall remarks of this rock that it "appears to be a sheared epidotic grit, and, like the previous finer-grained rocks, is intermediate in structure between a normal sediment and a true crystalline schist". The precise geological horizon of these intermediate strata (M■) is uncertain. If they represent the basal beds of the Diabaig group, it is obvious that they mark a higher grade of metamorphism than the same bands on the inverted limb of the arch. Beyond the alluvium of the River Coulin the normal granulitic schists of the Moine series make their appearance, the outcrop of the Moine displacement being not improbably concealed under the alluvium.

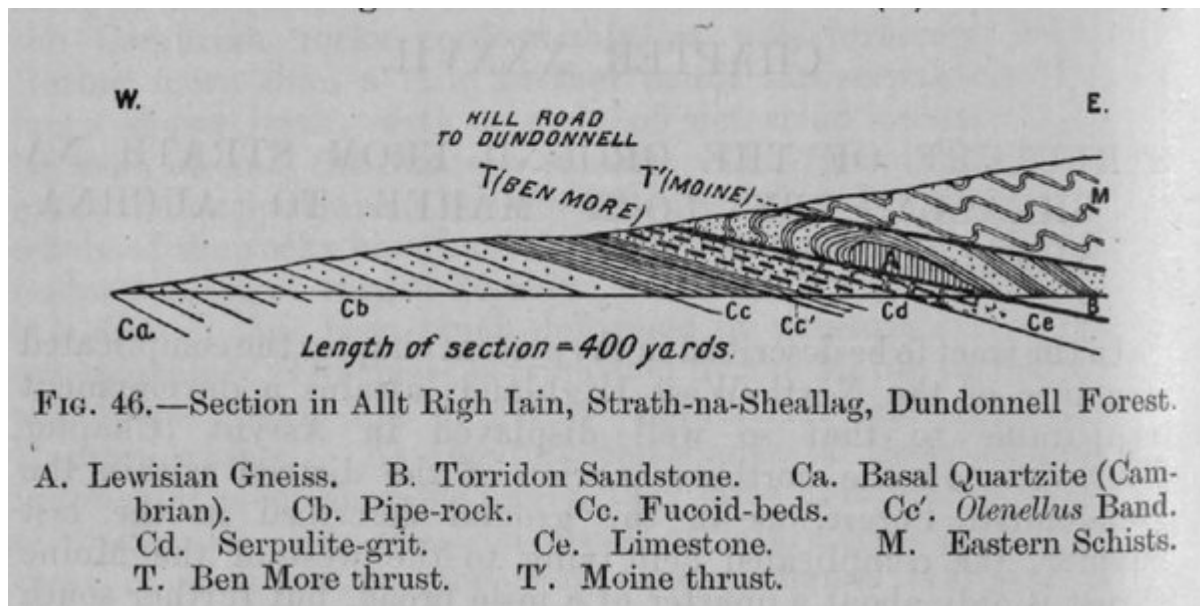
At no part of the long belt of complicated structure is the evidence of great displacement more clearly visible, even from a distance, than in the range of wild mountainous ground lying between Glen Torridon and Strath Carron. In the Beinn Liath group of hills the dark Torridon sandstones and the white Cambrian quartzites present such a contrast of colour as to reveal on the steep declivities the positions into which the two groups of rock have been thrown by plications and ruptures. The structure of this ground is illustrated by the section in (Figure 52) and in (Plate 39). At the west end of the great ridge of Beinn Liath Mhor the basal quartzite (Ca) and pipe-rock (Cb) have been thrown into a series of compound flexures, all inverted and truncated on the east side by a reversed fault. On the slopes of the westmost and highest peak of the mountain (3034 feet) the great folds of Torridonian and Cambrian strata are clearly displayed, arranged in a compound anticline and syncline. The westerly arch of Torridon Sandstone is shown on the left side of (Plate 39), and appears on the mountain top in basal quartzite (Ca) that passes below pipe-rock (Cb) to the east and west (Figure 52). Beyond the second infold of pipe-rock, which is overridden by a patch of basal quartzite, the bare thrust-plane may be seen along which the Torridon Sandstone has been driven.

Further east on the ridge small patches of basal quartzite again appear, truncated in succession by reversed faults, till near the eastmost peak a great fold of the arenaceous series (Ca, Cb) runs down the southern slope for 1000 feet. Northwards this infold of quartzite can be traced across Allt Coire Beinne Leithe to Beinn Liath Beag. On the eastern limb of the syncline on the top of the ridge the basal quartzite dips to the west at angles varying from 25° to 72°, but on the southern slope the beds are inverted and the junction line is corrugated. Here also the inverted arch of Torridon Sandstone culminates in a minor thrust, which, though of small amount, forms a conspicuous feature on the northern declivity, and is traceable to the N.N.E. for two miles. The Torridon Sandstone capped by the basal quartzite dips gently to the east on the eastmost peak. The section here described illustrates two important features in the tectonics of the region — (1) that a normal fold may pass gradually into an inverted fold, the dip of the axial plane being to the E.S.E., the direction from which the pressure came; and (2) that an overfold may pass upwards and laterally into a reversed fault or thrust.

East from Beinn Liath Mhor the outcrop of the Kinlochewe thrust-plane runs on the east side of the valley of Allt nan Dearcaig, where a slice of Lewisian gneiss (A) and the inverted beds of the Diabaig group (Ba) have been driven westwards over the piled-up Cambrian strata. Beyond the gneiss mylonised materials (M■) and the Moine-schists (M) come in, together with an inlier of gneiss of Lewisian type exposed in Allt Doire Bheithe.

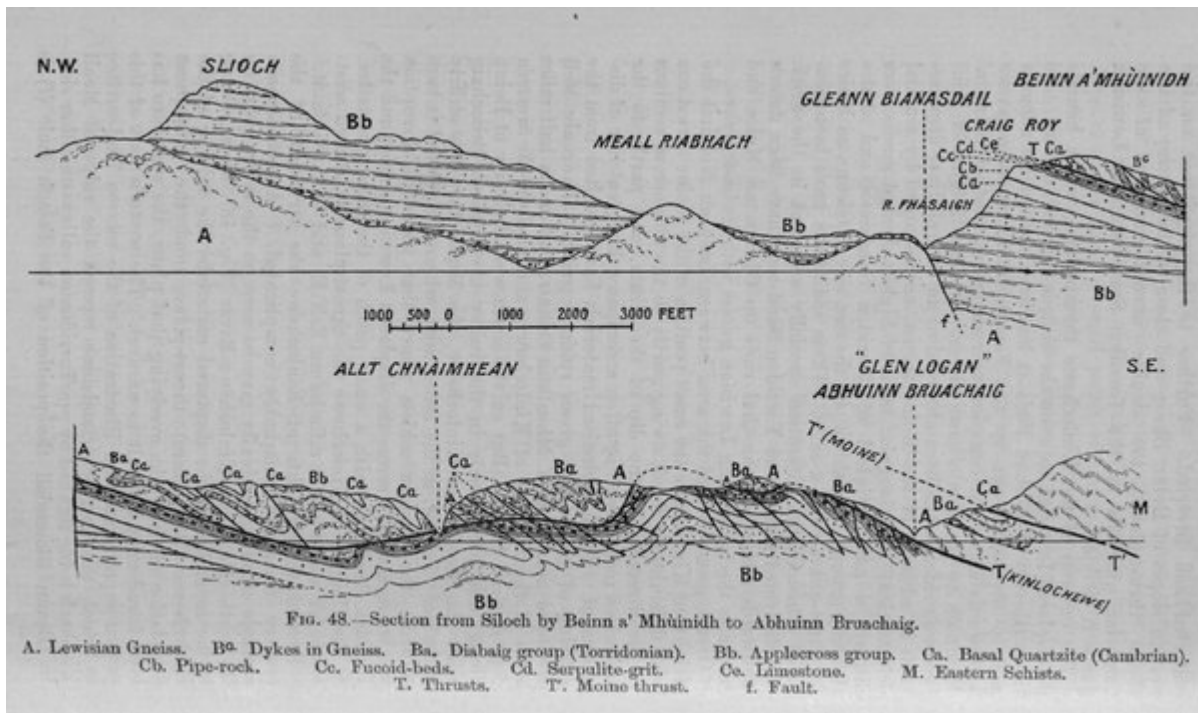


(Figure 47) Section from A' Mhaighdean by Mullach Coire Mhic Fhearchair to Creag Rainich. A. Lewisian Gneiss. B<sup>G</sup>. Dykes in Gneiss. B. Torridon Sandstone. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe rock. Cc. Fucoïd-beds. Cd. Serpulite-grit. Ce. Limestone. M. Moine-schists. T. Kinlochewe thrust. T'. Moine thrust. f. Fault.

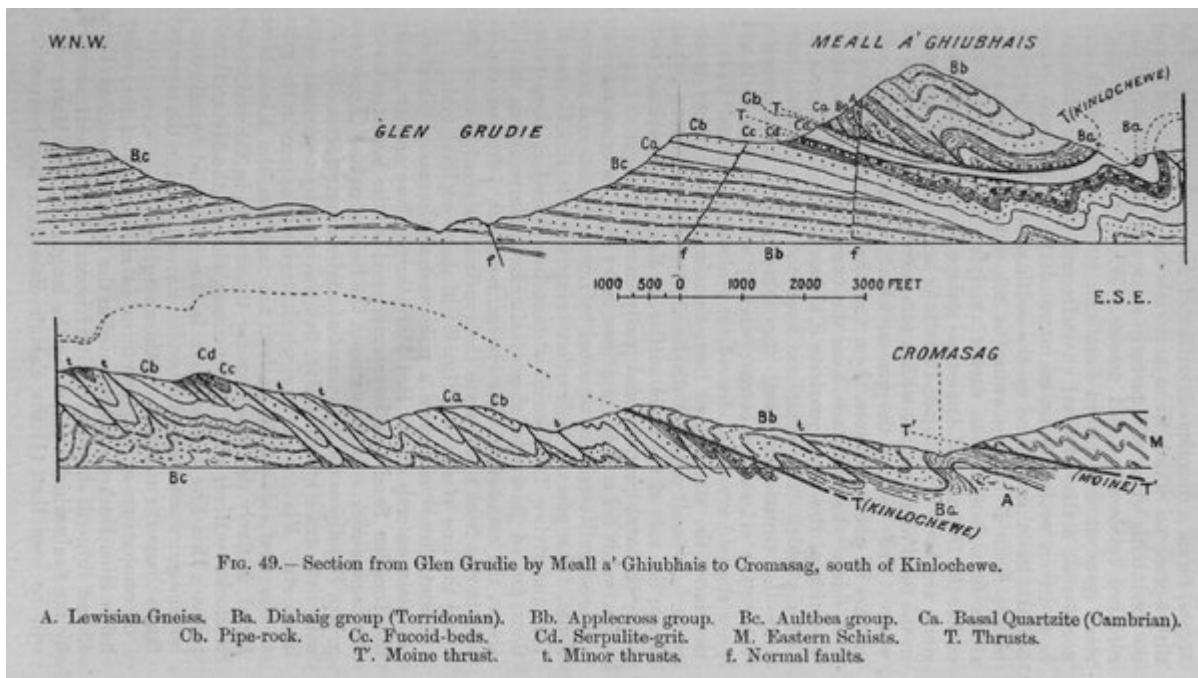


(Figure 46) Section in Allt Righ Iain, Strath-na-Sheallag, Dundonnell Forest. A. Lewisian Gneiss. B. Torridon Sandstone. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoïd-beds. Cc'. Olenellus Band. Cd. Serpulite-grit. Ce. Limestone. M. Eastern Schists. T. Ben More thrust. T'. Moine thrust.

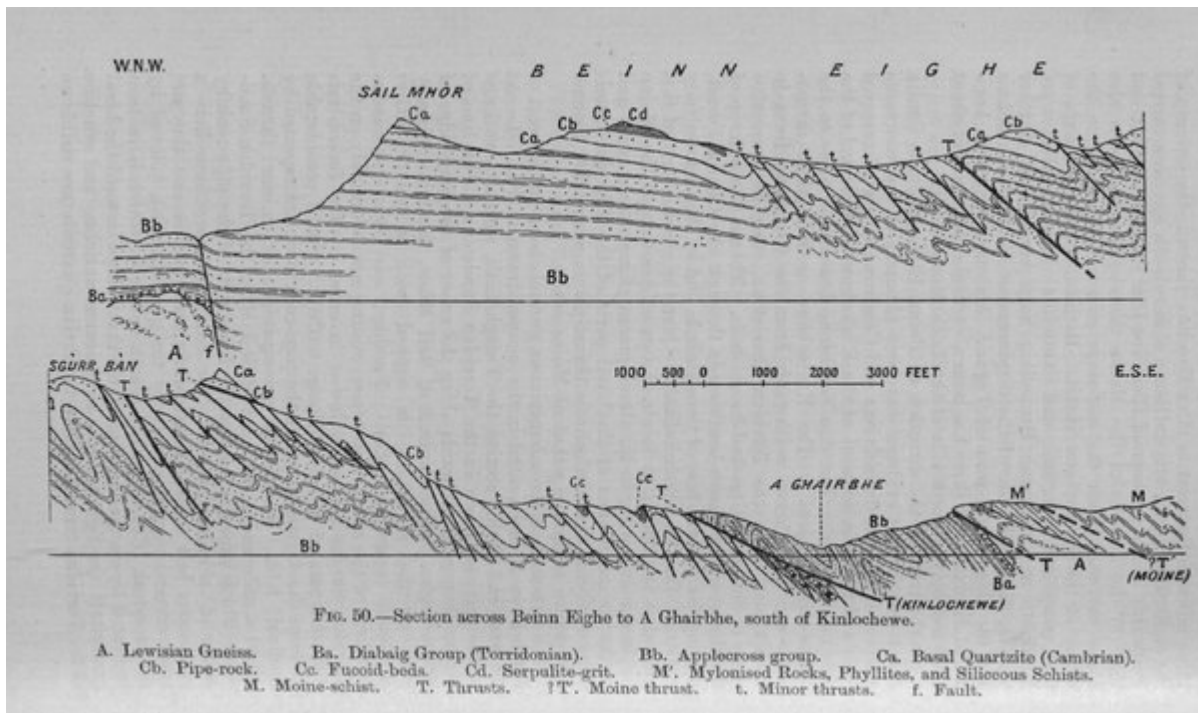




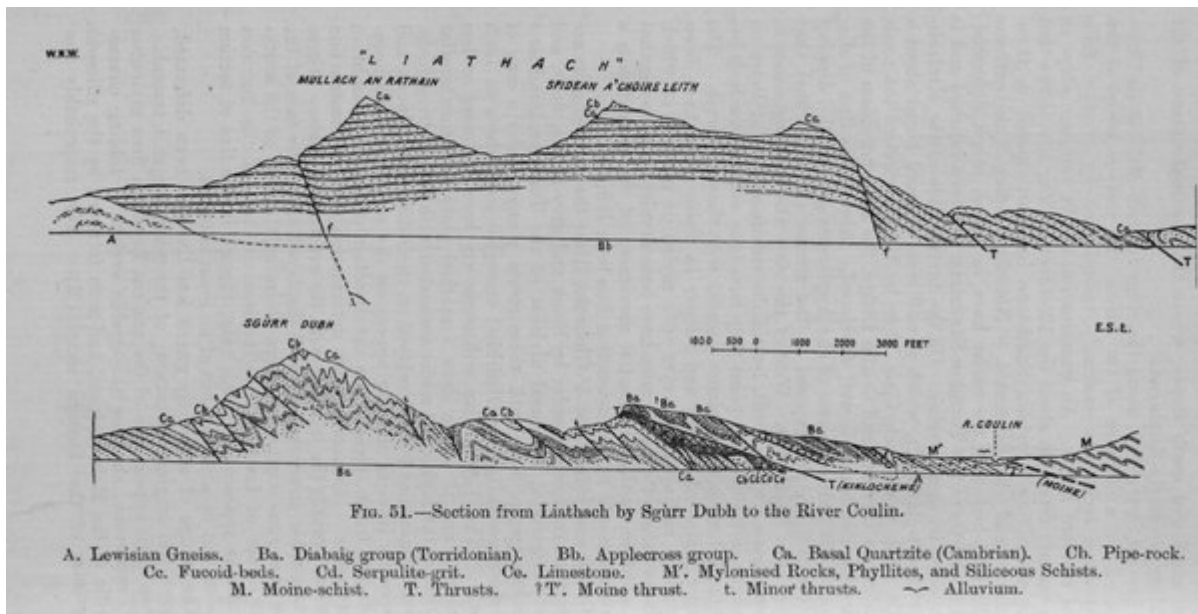
(Figure 48) Section from Siloch by Beinn a' Mhùinidh to Abhuinn Bruachaig. A. Lewisian Gneiss. B<sup>a</sup>. Dykes in Gneiss. B<sup>a</sup>. Diabaig group (Torridonian). B<sup>b</sup>. Applecross group. C<sup>a</sup>. Basal Quartzite (Cambrian). C<sup>b</sup>. Pipe-rock. C<sup>c</sup>. Fucoïd-beds. C<sup>d</sup>. Serpulite-grit. C<sup>e</sup>. Limestone. M. Eastern Schists. T. Thrusts. T'. Moine thrust. f. Fault.



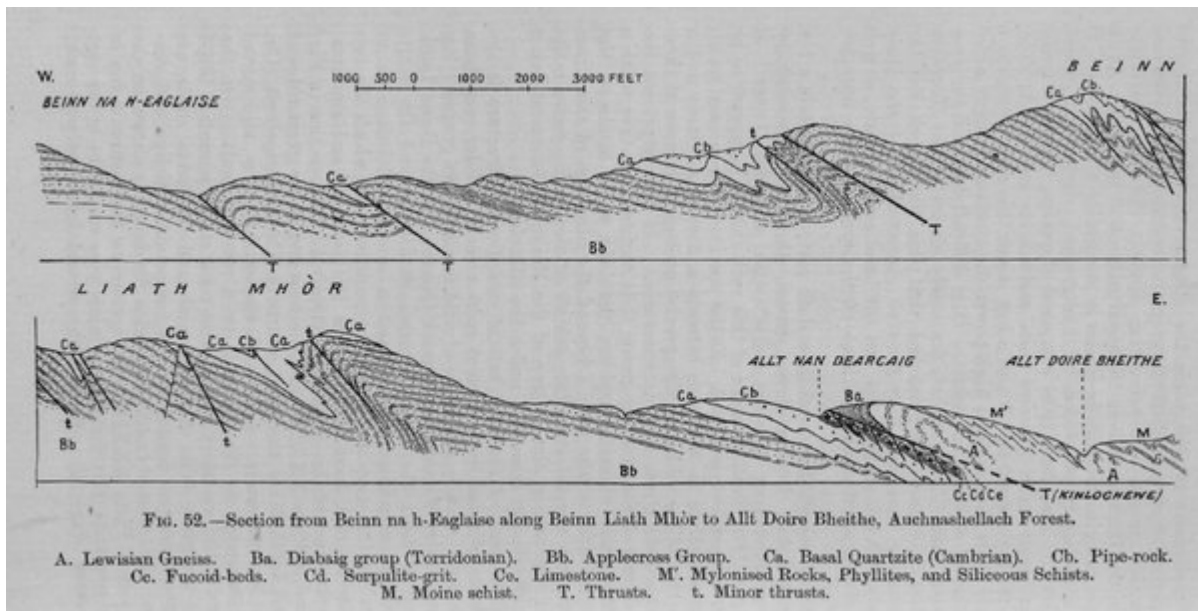
(Figure 49) Section from Glen Grudie by Meall a' Ghiubhais to Cromasag, south of Kinlochewe. A. Lewisian Gneiss. B<sup>a</sup>. Diabaig group (Torridonian). B<sup>b</sup>. Applecross group. B<sup>e</sup>. Aultbea group. C<sup>a</sup>. Basal Quartzite (Cambrian). C<sup>b</sup>. Pipe-rock. C<sup>c</sup>. Fucoïd-beds. C<sup>d</sup>. Serpulite-grit. M. Eastern Schists. T. Thrusts. T'. Moine thrust. t. Minor thrusts. f. Normal faults.



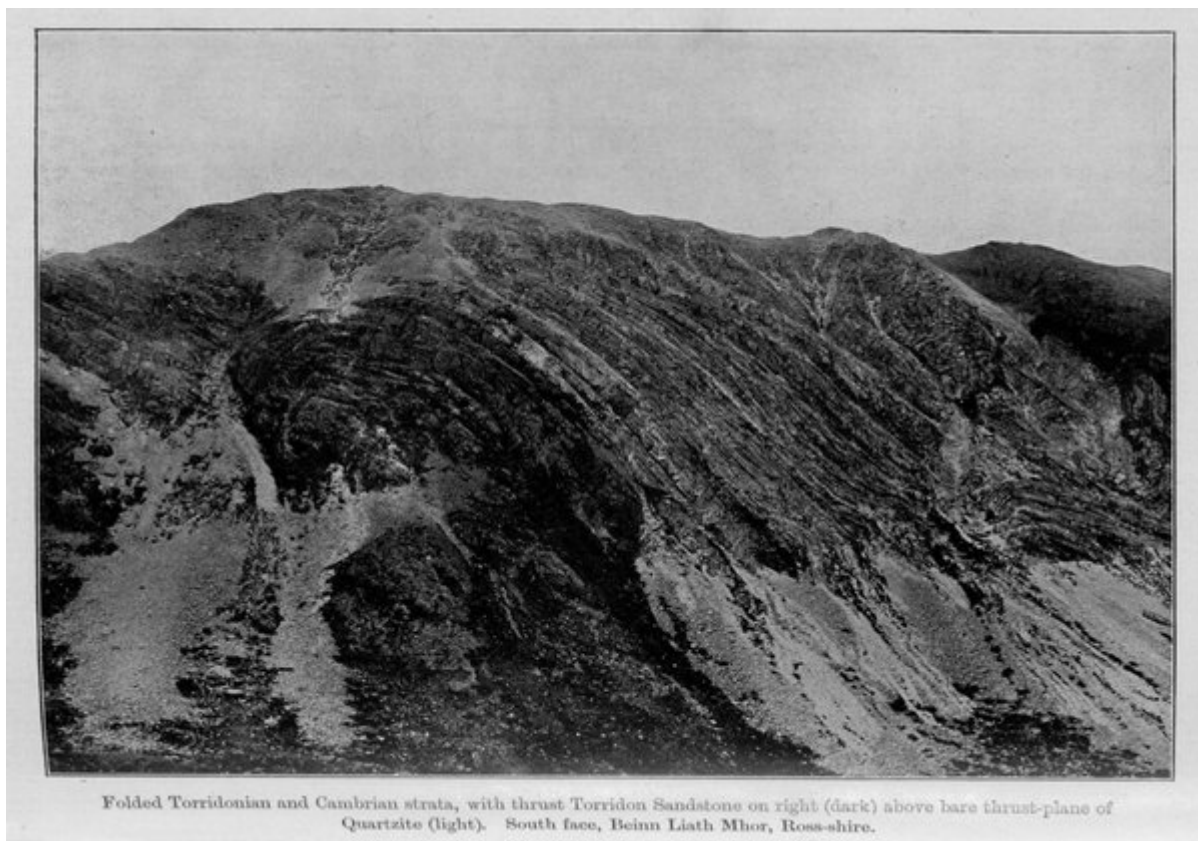
(Figure 50) Section across Beinn Eighe to A Ghairbhe, south of Kinlochewe. A. Lewisian Gneiss. BA.. Diabaig Group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoïd-beds. Cd. Serpulite-grit. M'. Mylonised Rocks, Phyllites, and Siliceous Schists. M. Moine-schist. T. Thrusts. ? T. Moine thrust. t. Minor thrusts. f. Fault.



(Figure 51) Section from Liathach by Sgurr Dubh to the River Coulin. A. Lewisian Gneiss. Ba. Diabaig group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Ch. Pipe-rock. Cc. Fucoïd-beds. Cd. Serpulite-grit. Ce. Limestone. M'. Mylonised Rocks, Phyllites, and Siliceous Schists. M. Moine-schist. T. Thrusts. ? T. Moine thrust. t. Minor thrusts. [symbol] Alluvium.



(Figure 52) Section from Beinn na h-Eaglaise along Beinn Liath Mhòr to Allt Doire Bheithe, Auchnashellach Forest. A. Lewisian Gneiss. Ba. Diabaig group (Torridonian). Bb. Applecross Group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoïd-beds. Cd. Serpulite-grit. Ce. Limestone. M'. Mylonised Rocks, Phyllites, and Siliceous Schists. M. Moine schist. T. Thrusts. t. Minor thrusts.



(Plate 39) Folded Torridonian and Cambrian strata on left; thrust Torridon sandstone on right t above bare thrust-plane of quartzite; south face, Beinn Liath Mhor, Ross-shire B135