
Chapter 39 Structure of the peninsula of Sleat and part of Strath, Skye

By C. T. Clough. The district described in this chapter is comprised in Sheets 61 and 71 of the map of Scotland, on the scale of 1 inch to a mile (1:63360)

The structural features of the district of Loch Alsh, described in the previous chapter, are prolonged into Skye, where some of them become more strikingly developed. The much greater thickness of the Torridonian series in this island than on the mainland to the north of Loch Alsh has doubtless led to a striking manifestation of the characters of this belt of complication among the members of that series. The great Torridonian inversion so clearly displayed on the opposite mainland crosses into the district of Sleat, where also, as already remarked, over-folding of the strata appears to be more prevalent than reversed faults in front of the great thrusts. The areas occupied by displaced Lewisian rocks in Skye are of comparatively small extent. The Cambrian quartzites and lower limestones in the districts of Sleat and Strath have, certainly in great part and perhaps wholly, been displaced and driven into their present positions by some of the great westward movements of the terrestrial crust. The great Moine thrust, which in the preceding chapters has been followed southwards from the north coast of Sutherland, crosses over into Skye and runs through the southern part of Sleat to the southern extremity of the island, bringing with it slices of the Lewisian rocks and its characteristic gneissose flagstones and siliceous schists. The structure of this portion of Skye will be best understood from the series of horizontal sections described in the present chapter, which are arranged in topographical order from north to south.

The section in (Figure 69) shows the general grouping of the rocks near the north end of Sleat. It will be observed that all the rocks here represented in the Skye portion of the section are Torridonian, with the exception of some dykes and a small patch of mylonised rocks which appear from under the sea at Dun Ruaige. Although the Torridon Sandstones are here in some places but little altered, it is nevertheless certain from what is seen near Broadford (Figure 61) and Ord (Figure 62) that they have all been thrust forward from the south-east over other rocks, consisting in part of Cambrian quartzite and limestone. They have been carried *en masse* with comparatively little disturbance, excepting near the axial plane, inclining gently southeast, of the great Loch Alsh inversion. Most of the strata on the top and to the east of Sgùrr na Coinnich lie in the upper limb of this fold, and in reversed position.

The red and chocolate arkoses of the Applecross division of the Torridon series (Bb) appear at the north-west end of the section, underlain in a south-easterly direction by the different divisions of the Diabaig group — the Kinloch beds (Ba⁴), the Beinn na Seamraig grits (Ba³), the Loch na Dal shaly series (Ba²), and the epidotic grits (Ba¹). The arkoses and most of the Kinloch beds lie in their normal order in the lower limb of the great fold, and dip north-west at angles ranging from 20° to 50°. The lower portion of the Kinloch division, however, together with a great part of the Beinn na Seamraig grits, as well as all the Loch na Dal beds and epidotic grits, are included in the upper or inverted limb of the fold. Since the inclination of the axial plane of this fold is not so great as that of parts of the south-eastern slope of Sgùrr na Coinnich, strata which lie in the lower limb of the fold crop out in this valley to the south of that hill and in their original order. Although some of them appear in the figure as if nearly flat, they have really a dip to northeast almost at right angles to the line of section. A north-easterly dip can also be observed for some distance southwest of the line of section. None of the beds which dip north-east lie far from the axial plane of the great fold, and it seems more probable that their inclination is connected with the production of the great fold rather than with any cross fold of later date.

The Applecross arkoses at the north-west end of the section are in a much less altered condition than the Torridonian rocks at the south-east end. They either display no cleavage or only a very weak one, while in the rocks at the opposite end the cleavage planes are strongly developed and often show sericitic lustre, as well as a considerable elongation of their large clastic grains, and the presence of many thin and short quartz-felspar veins. Besides this increase of alteration in a south-easterly direction, it has been ascertained that when the rocks of Sleat are traced along their strike from south-west to north-east the Torridonian series displays an augmented degree of alteration towards the north-east. Some of the Applecross beds on the north-eastern side of the line of section contain thin veins, usually less than an inch thick but sometimes six inches, of quartz, felspar, and chlorite. The lower beds of the Beinn na Seamraig grits are frequently crossed by micaceous foliation planes. In the Loch na Dal shales near Dun Ruaige the bedding planes are repeatedly crossed by similar lustrous foliation planes. On the sides of Loch na Dal, however, cleavage planes cannot always be

observed, and when present are never lustrous.

On either side of Dun Ruaige the epidotic grits have been thrown into small folds with axial planes that hade to southeast. In many places these strata have also been foliated parallel to the axial planes of the plication. They must be considerably above the axial plane of the great inversion. The small folds may have been produced during the thrusting forward of the mylonised rock of Dun Ruaige. In some places the beds have been folded by folds with steep pitch after they were already foliated. Many of the clastic grains or pebbles in the epidotic grits are so large that any deformation in them is readily perceived. Near the line of section, and all the way between Dun Ruaige and a point about three-quarters of a mile W.S.W. from the foot of Allt Thuill, deformation of these constituents is very evident, the long axes of the grains being parallel to each other and often three or four times as long as the other axes. The foliation-planes along which the elongation occurs sometimes cross the bedding at considerable angles, so that the pebbles are now inclined steeply to the planes on which they were originally deposited.

The Torridonian beds are overlain at Dun Ruaige by a patch of mylonised rock which has probably been thrust over them, and which may have been formed from Lewisian gneiss. The oncoming of the Moine-schists and the Lewisian gneisses associated with them is concealed under the Sound of Skye.

These rocks, however, are probably separated from the rock of Dun Ruaige by the Moine thrust, although along the line of section this thrust is perhaps itself hidden by a fault with a large south-easterly downthrow. The mylonised rock of Dun Ruaige only extends along the coast for 250 yards, with a breadth of not more than 70 or 80 yards. It is in a very different state from the epidotic grits near it. Though these grits have been much deformed, and partly recrystallised, their original bedding remains always distinct. In the Dun rock, on the other hand, no original banding can be recognised, and stretching is much more prominently shown than in any of the Torridon rocks. If the positions of the grit and the mylonised rock were supposed to be reversed, and if before reversal the grit lay unconformably upon the other rock, it would be necessary to suppose that other rock to have been already in a mylonised condition before the deposition of the grit. It seems more probable that between the grit and the Dun rock the plane of some great thrust must intervene. The Dun rock is for the most part a fine flaggy greenish-grey rock, with a sericitic or chloritic lustre on the parallel splitting planes. It contains many thin folded reddish veins of quartz and felspar, some of which are unsheared, while others have undergone the same mylonising as the rest of the rock. Many of the folds have closely appressed limbs, and axial planes inclining gently to E.S.E.

The fault which is believed to bring on at this part of the Skye coast the Moine-schist and the Lewisian gneiss associated with it, runs in a north-easterly direction with a hade and down-throw to south-east, and is seen on the north side of Glenelg Bay, where it has effected a surface displacement of a mile in. one of the boundary lines between the schist and the gneiss. Along the line of section the first rocks met with on the south-eastern shore of the Sound of Skye are granulitic Moine-schists (M) of a siliceous type. Further to the south-east these schists pass under a band, twenty to thirty feet thick, of garnetiferous mica-schist, which in turn is succeeded on the south-east by a coarsely granulitic biotite gneiss. The superposition of the gneiss over the Moine-schist in this section is no doubt due to folding and cannot be taken to indicate the original relations of these rocks. In many adjacent places the gneiss dips below the Moine-schist.

Another section taken along a line three miles to the southwest of that described is given in (Figure 60). Here all the sedimentary rocks, except those at the base of the Mesozoic formations (f), which appear at the north-west end of the section around Skulamus, are Torridonian. They include the Apple-cross arkoses (Bb), Kinloch beds (Ba⁴), Beinn na Seamraig grits (Ba³), Loch na Dal beds (Ba²), and epidotic grits (Ba¹). All these strata form part of the great thrust mass already described; but, except near the south-eastern end of the section, they have retained their original order, the younger beds dipping over the older in a northwesterly direction at angles of between 30° and 50°. The last of the great Loch Alsh inversion is perhaps indicated along the south-east flank of Beinn Seamraig. A little south-west of the line of section the sandy shales of the Kinloch sub-division are excellently exposed, but show no cleavage. Further south-east some of the Beinn na Seamraig beds are crossed by cleavage planes dipping to southeast or E.S.E., between 48° and 65°.

Along certain lines a little northwest of Beinn na Seamraig the grits have been crushed, probably by thrusts, into finely-laminated halleflinta-like rocks. Two of these lines (tt) are indicated in the section, but how far they alter the position

of the rocks is not known. The Loch na Dal beds and the epidotic grits at the south-east end of the section are much folded and altered, and probably lie near the axial plane of the large fold shown in (Figure 59), and not far below some other higher dislocations, including the Moine thrust. On the coast their parallel splitting planes are slightly lustrous, but not so much so as near Dun Ruaige and Kyle Rhea. The pebbles and clastic grains in the grits are conspicuously elongated, and where the planes on which the grains are observed dip south-east the direction of elongation is generally nearly east and west.

The chief folds in these altered rocks are, on the north-west side, a rather wide and gentle anticline, with the limbs dipping in opposite directions, and on the south-east side an isoclinal syncline, with both limbs dipping south-east.

The next section (Figure 61) drawn at a distance of three miles from the last across Strath and Sleat, so as to take in one of the chief areas of Cambrian strata in Skye, shows the reality of the displacement of all the Torridonian rocks of this region. Its most striking feature is the appearance of a mass of Cambrian limestone (Ce and Ce VI.) emerging from beneath the Applecross grits (Bb), which have been pushed forward along a major thrust-plane. This plane can best be seen near Ben Suardal, where it has been folded into an anticline with an axial plane striking to N.N.E. and hading to south-east. It may be conveniently called the Ben Suardal thrust.<ref>The disturbed condition of the beds on Ben Suardal was described by Sir A. Geikie (On the Age of the Altered Limestones of Strath, Skye. *Quart. Jour. Geol. Soc.*, 1888, vol. xlv., p. 70). He inferred that the whole of the limestone on this hill has been pushed westward.</ref> In Allt Beinn Deirge, nearly a mile north-west from Ben Suardal, a small patch of Applecross grit, surmounted by the unconformable basal quartzite, is seen to rest almost horizontally on Cambrian limestone, the same thrust-plane intervening between the two rocks. This thrust-plane is also recognisable on the south-eastern slopes of Creag Strollamus, about two miles and a quarter slightly west of north of the place where the line of section crosses Allt Beinn Deirge, so that in this district the breadth of the belt of Post-Cambrian complication must be at least nine miles and a half.

The Cambrian limestones are sharply folded and crossed by minor thrust lines, and they probably all lie on some great thrust-plane not exposed at the surface. Most of the rocks between them and the Moine thrust *at* the east end of the section are Torridonian. But among them lies a synclinal basin of Mesozoic rocks (*ff*, left blank in (Figure 61)), which were deposited long after the thrust-movements had ceased. East of Allt a' Mhuilinn the Ben Suardal thrust is hidden beneath Applecross grits, and never reappears further eastward along the line of section. Unless it should crop up beneath the Mesozoic basin — which seems hardly likely — it must underlie all the Torridonian beds in the section. It may possibly be a continuation of the folded thrust of Sgiath-bheinn Tokavaig (Figure 62) and (Figure 64). A fold which affected the Ben Suardal thrust also bent the Mesozoic beds which circle round the north end of this hill. The whole of the folding exhibited by the thrust may not be so late as these beds, but most of it must be, for the beds in each limb of the anticline dip almost the same as the thrust.

The calcareous rocks under the Ben Suardal thrust comprise the Ben Suardal, Strath Suardal, and Beinn an Dubhaich zones. In many places the rocks are saccharoidal, and crowded with needles of tremolite and prisms of malacolite developed by contact metamorphism near the large Tertiary igneous masses. The Ben Suardal thrust-plane and the overlying Applecross grits are never isoclinally folded, but the limestones often are, and they must have been folded either before, or at the same time as, the Torridon rocks were being thrust over them. The later movement which folded the thrust-plane must, however, have also bent the axial planes of the isoclinal folds. Various thrust-like lines have been noticed in the limestone, and two of them are shown in the section to the north-west of Allt a' Mhuilinn. In a few places the cherts and fossils in the Ben Suardal limestone have been considerably deformed. On the north-west side of Loch Lonachan, about 700 yards S.S.W. of the outlet, the small black cherts have been broken and dragged into trains of small granules in a north-west direction, at right angles to the strike, and some of the fossil *Maclurea* have been elongated in the same direction.

That the inclination of some parts of the north-west limb of the Ben Suardal thrust-plane must be rather steep is indicated near a limestone scar which faces westward on the east side of the thin patch of Applecross grit on the western slope of Ben Suardal. The inclination of the thrust-plane must here be steeper than the face of the scar. The south-east limb is broken in places by a fault, or several parallel faults, with a downthrow towards south-east. Crush-breccias appear along the later faults, often with a breadth of several feet and nearly vertical, whereas along the thrust-plane no such rock exists nor any marked sign of disturbance. The Applecross grits above the thrust appear to be remarkably little disturbed. The

bedding is, however, less distinct, and joints are more abundant than in most unthrust rocks. There is sometimes, also, a slight brecciation and alteration of colour, from red to pale buff, for a little distance above the thrust.

From the evidence supplied by the exposures near Creag Strollamus, it is probable that Applecross grits in a thrust condition overlies high zones of the Cambrian' limestone for a distance from E.S.E. to W.N.W. of at least three miles, and that the grits near this Creag have been thrust at least as far as the sum of this distance and the distance required to get in the strata which in the undisturbed sequence come between these grits and the most south-easterly portion of the limestone exposed beneath the thrust-plane. These strata include some portion, but perhaps not much, of the Applecross' grits, all the quartzite, fucoid-beds, and serpulite-grit, and four or five of the lowest divisions of the limestone. If these members of the Cambrian series succeed each other in their normal order to the south-east of the limestone, and have the same dip as at Ord in Sleat, then the movement along the thrust-plane cannot have been less than three miles and three-quarters, but it may, however, have been much more.

South-east of the tract of Mesozoic rocks the Applecross grits (Bb) emerge at the surface with a north-westerly inclination of 25° to 50°, followed by the underlying Kinloch shales (Ba⁴), which continue for two miles as a belt which owes its breadth chiefly to the gentle dip which occasionally prevails, and to local folding. Although towards the south-east these shales are more steeply inclined and are sometimes vertical or even reversed, none of them are appreciably altered, nor do they usually show any cleavage. They are succeeded by the Beinn na Seamraig grits (Ba³) and the Loch na Dal shales (Ba²), but before the base of these shales is reached a line of crush, running north-east and hading towards south-east, brings on the Moine-schist (M). The inclination of this crush is here steeper than that usually presented by the Moine-thrust, but it decreases in a southwesterly direction. The band of Moine-schist next the Torridon rocks thins out in the same direction, and its place is taken by the Lewisian gneisses and hornblende-schists.

In Allt Duisdale a sheet of red lamprophyre has been injected along the Moine-thrust. Since parts of it have been crushed into a stiff grey crush-clay, there appears to be evidence here of at least two periods of movement along the thrust — one that gave rise to the line of fracture along which the lamprophyre was intruded, and another of later date which crushed the lamprophyre. In the gneiss above the thrust-plane other crushes appear parallel to the main thrust, and the earlier crystalline structure of the gneiss has been partly broken down. A little further south-west, across a large fault, a band of siliceous Moine-schist lying just above the thrust-plane has likewise had its earlier crystalline structure broken in places.

A good junction between the Moine-schists and the gneiss rocks may be seen on the shore in the south-eastern part of Camas Croise. Although no signs of unconformity are there visible, yet in the adjacent area bands in the gneiss strike at a gentle angle against the junction, and in different places vary in distance from it.

In the section drawn in (Figure 62) two major thrust-planes are shown to have been folded into anticlines, the axes of which strike N.N.E. The higher of the two is well seen a little south of the line of section on the west side of Sgiath-bheinn Tokavaig, and may be called the Sgiath-bheinn Tokavaig thrust. The lower line of dislocation, which is nearly always distinct, *may* be named after Sgiath-bheinn an Uird, a hill composed of rocks that lie beneath it.

These two thrusts and the rock-masses below are exposed on the south-western or upthrow side of a large fault which runs in a N.N.W. direction from Ob Snusaich, in the Sound of Skye, past the west side of Ben Vokie, and through Loch an Eilean. On the north-west side of Loch Eishort this fault has thrown down the conglomerates at the base of the Mesozoic rocks in a north-easterly direction between 500 and 600 feet, and to the south-east of the loch it has depressed the older rocks in the same direction. Hence neither of the thrust-planes can be seen in that part of Skye which lies to the north-east of the fault between Loch an Eilean and Ob Snusaich. As already stated, the Cambrian limestones in Ben Suardal also underlie a great folded thrust-plane, which may possibly be a continuation of that on Sgiath-bheinn Tokavaig, but it has been folded along an axis which lies two or three miles further to the north-west.

Along the line followed by this section all the rocks exposed beneath the Sgiath-bheinn an Uird thrust are Cambrian, but a little further south Torridon rocks are also visible, sometimes in a reversed position above the quartzite. More than half of the ground covered by Cambrian strata is occupied by the quartzite, which has been thrown into folds with axial planes hading to the south-east. The top of the quartzite (Cb) generally dips steeply towards W.N.W. under the fucoid-shales (Cc), followed by the serpulite-grit (Cd) and the Ghrudaidh limestone (Ce I).

The grit is repeated by a nearly vertical thrust, and most of the beds are inclined at high angles, but they have been bent by minor folds with nearly horizontal axial planes, whereby the outcrops along the same strike are made to dip towards W. N. W. or E. S. E. alternately. West of the Ghrudaidh limestone comes the Eilean Dubh sub-division (Ce II), succeeded by a small portion of that of Sailmhor (Ce III).

It is probable that originally the Sgiath-bheinn an Uird thrust-plane had a gentle inclination towards the southeast, as is the case with so many of these thrusts, and that the beds below it were once arranged in a set of folds with axial planes hading to the south - east. Thereafter the whole of the rocks below the western limb of the thrust, as well as this portion of the thrust itself, may be supposed to have been bent, so as to dip for the most part in an opposite direction to their first inclination. Besides the minor thrust which repeats the serpulite-grit there may be others which are not distinct. A little south of the line of section other thrusts do appear, some of which are of considerable importance, and are indicated in (Figure 63).

Below the Sgiath-bheinn an Uird thrust the strata are not cleaved, nor is there any noticeable distortion of the pipes in the pipe-rock. In considerable areas of the quartzite, however, the bedding is obscured by joints and planes of crush which present no clear general strike. The crushed surface of quartzite under the south-eastern limb of the thrust-plane makes a conspicuous scar on the east side of the hill. It generally strikes to north or N.N.E., and is inclined towards east or E.S.E. at angles of 50° or more, but along the line of section its inclination is lower than usual. The material that forms the scar is often brecciated and contains broken pieces of quartzite, some of which are rounded and look like pebbles. A crushed face of serpulite-grit, exposed just below the north-western limb of the thrust-plane rather more than a quarter of a mile south-west of the line of section, inclines at 50° in a north-westerly direction.

Near the north-western limb of this thrust various considerable patches of a curious siliceous rock overlie, or crop out in, the Sailmhor, Eilean Dubh, and Ghrudaidh limestones. Some parts of this rock look rather like portions of serpulite-grit, though they never contain clastic grains. Other parts are cherty, though some of the largest patches occur near horizons which are normally almost free from chert. It seems probable on the whole that the rock is a vein rock — perhaps formed by solutions percolating downwards from the formerly overlying thrust-plane.

The rocks that lie between the two thrusts of Sgiath-bheinn an Uird and Sgiath-bheinn Tokavaig are chiefly Torridonian, but in the north-western limb of the anticline a strip of unconformable Cambrian strata makes its appearance. It includes all the groups between the basal quartzite (Ca) and the Sailmhor (Ce III), or (perhaps in one place) the Sangomore limestone. The Torridonian rocks belong chiefly to the Applecross group (Bb), but comprise also shales and grits which may form the top of the Kinloch division, and which in Allt a' Chinn Mhoir are a good deal confused. The Applecross grits above the north-western limb of the Sgiath-bheinn an Uird thrust-plane generally dip north-west at nearly the same angle as that limb. If this part of the thrust-plane were bent into its probable original position, so as to incline gently to south-east, the overlying grits and most of the Cambrian rocks which rest upon them would also be made to incline gently south-east.

A little to the west of the Rudha Dubh Ard quartzite, on the shore south of the line of section, a nearly vertical thrust repeats a part of the fucoid-shale and serpulite-grit, and probably several other more obscure thrusts are likewise present there. The Ghrudaidh, Eilean Dubh, and part of the Sailmhor limestone are well exposed in the islands of Loch Eishort, at the west end of the line of section, generally striking slightly west of north, but varying continually in the direction of their dip owing to the presence of some small folds with nearly horizontal axial planes. In the western island the junction of the Eilean Dubh and Sailmhor limestone is repeated by a steep thrust.

The rocks that come above the Sgiath-bheinn an Uird thrust have not in most places been so much folded or crushed as those underneath, and, like them, they are never cleaved. Near the north-western limb of this folded thrust-plane the Applecross grits are here and there changed in colour from red to pale-grey, while close to the overlying Sgiath-bheinn Tokavaig thrust they have also in places assumed a greenish-grey hue for a few inches, or are crossed by thin quartz-veins without any general direction.

The dip of the south-eastern limb of the anticline of the Sgiath-bheinn Tokavaig thrust-plane is E.S.E. at 32° or 33°. The opposite limb is hidden under Loch Eishort, but in its course northward from Ord Bay it must have a direction slightly west

of north, for otherwise it would cross, or pass east of, the western island shown in the section. The rocks above the south-eastern limb of this thrust-plane consist of shales and fine-grained grits belonging to the Kinloch division (Ba⁴). Owing to their strong Ethological difference from the red Applecross grits (Bb), which on the west side of them lie below the thrust, the thrust-plane is here easily traced in spite of some faults. Near it the Kinloch beds are much shattered and contorted along axial planes that hade to south-east, but no cleavage is here discernible parallel to these planes. A little further south-east, however, some shales are crossed by a cleavage the planes of which incline slightly south of east from 50° to 60°.

(Figure 63) gives a section across a complicated portion of the rock-mass which underlies the Sgiath-bheinn an Uird thrust a little south of the line of section in (Figure 62). The south-eastern portion of this mass is a continuation of that shown under this thrust in the last section. It is separated from the north-western portion by a distinct crush or thrust (T) which runs in a general north and south direction; the rocks on its western side being Applecross grits with some beds of shale (Bb), while those on the other side consist of a broad exposure of pipe-rock (Cb). This line of rupture does not seem to affect the rocks above the Sgiath-bheinn an Uird thrust. It twists more sharply than most normal faults of later age than the great post-Cambrian movements. On its north-western side the Applecross grits are succeeded by Cambrian strata extending up to the Eilean Dubh limestone (Ca to Ce II), all generally in a reversed position and crossed by various thrusts. The plane of one of these dislocations, at the base of the serpulite-grit, must have been folded before the production of the Sgiath-bheinn an Uird thrust.

The serpulite-grit on the north-west side of the fucoid-shale forms part of an anticline with its axial plane striking to N.N.E. and hading to south-east. In all parts of this anticline the beds which comprise the Ghrudaiddh and part of the Eilean Dubh limestone, as well as the serpulite-grit, are reversed. The Ghrudaiddh limestone is often absent either wholly or partly, in consequence of a minor thrust at the base of the serpulite-grit, which has been folded together with the grit. The beds at the south-western apex of the anticline are cut by a straight portion of the Sgiath-bheinn an Uird thrust-plane, so that the anticline must have been formed before this plane was folded. Before the later folding the limbs of the anticline cannot have been inclined as they are now, and at that time the beds in the south-eastern limb of the thrust were perhaps not reversed. Near the south-western apex of the anticline the outcrop of the fucoid-shale is so unusually narrow that perhaps the pressure below the Sgiath-bheinn an Uird thrust may have squeezed out some of the shale from between the more massive serpulite-grit and quartzite. Some parts of the quartzite seem also to be missing here. Along all the exposed portion of the northwestern limb of this little anticline the serpulite-grit is overlain by the Torridonian (Applecross). grits. About 60 yards north from the line of section the crushed face of serpulite-grit just under the Sgiath-bheinn an Uird thrust-plane inclines at 42° towards north-west. The position of the south-eastern limb of the thrust is not quite clear in the line of section, but it must have Applecross grits on both sides of it.

The Applecross grits above the north-western limb of the Sgiath-bheinn an Uird thrust do not always show any clear dip, but to the north-east of the line of section they dip to north-west at high angles. The same rocks above the eastern limb of the thrust generally dip to north-west, and are underlain by shales which may belong to the Kinloch division.

The section given in (Figure 64) is drawn along a south-easterly line about a mile to the south-west of the last. It shows the same anticlinal folding of the two thrust-planes as in (Figure 62).

It differs from that section chiefly in showing above sea-level the western limb of the Sgiath-bheinn Tokavaig thrust-plane and the overlying rocks, and in extending further to the south-east so as to show the position of the Moine thrust with its Lewisian gneiss which may once have stretched westwards over all the other rocks in the section. The rocks indicated in the present section below the Sgiath-bheinn an Uird thrust are separated from those shown in the same position in (Figure 62) by the nearly vertical crush which in the section in (Figure 63) divides the mass below the thrust into two nearly equal parts. The Torridon Sandstones are a continu-

ation of the mass on the west side of the crush, and include beds belonging both to the Applecross (Bb) and the Kinloch divisions (Ba⁴).

The western limb of the Sgiath-bheinn an Uird thrust is sometimes reversed, with an inclination of 70° or 80° to E.S.E. The beds on the western side of this limb must have been pushed over those on the east side, for the outcrop of the

thrust can be traced all round the south-west apex of the anticline. At this apex the crushed surface of quartzite which marks the thrust-plane is generally inclined southward at angles between 26° and 30°, while two or three hundred yards further north - east similar crushed surfaces along the south-eastern limb of the thrust dip towards south-east at 60° or 70°. The portion of this limb which has Torridon rocks on either side of it is not so easily traced as the other, for the Applecross grits (Bb) which overlie the thrust include some shale-bands like those in the Kinloch division below (Ba⁴).

The north-western limb of the Sgiath-bheinn Tokavaig thrust is well exposed in a little burn a third of a mile E.S.E. from Sron Daraich, where it is inclined at 50° in a direction slightly north of west. About 1000 yards south of Sron Daraich the inclination is 65° in an E. S. E. direction. At, and near, the top of the wood half a mile S.S.E. from Sron Daraich a siliceous breccia, at least ten feet thick, appears along the Sgiath-bheinn Tokavaig thrust, and covers several acres. Its matrix is hard, fine-grained, and contains drusy cavities. The fragments enclosed in the matrix are all angular, and in some exposures are nearly all of a cherty rock, in general finely-banded, and buff or pale-red in colour. Some are opalescent or dark-brown or almost black. The cherty pieces are often packed tightly together, and among them are cracked masses of banded chert, some of which are a yard long. Where the breccia overlies the quartzite and is seen lying along the thrust-plane the colour of the matrix is pale-grey, and the included pieces are then chiefly of quartzite. This breccia has obviously been produced by friction along the thrust. It includes, however, no pieces of Torridonian rocks, though a mass of such rocks occurs on the west side of the thrust, and no doubt once overlay the breccia. Included pieces of limestone are also absent, and the matrix is never calcareous, though it contains many pieces of cherty rock that might be supposed to have been derived from beds of limestone. The limestone which underlies a portion of the breccia belongs partly to the Ghrudaigh zone (in which there is very little chert), partly to the lower part of the Eilean Dubh division, in which chert is abundant, though rarely occurring there in such thick pieces as some of those in the breccia. The cherty rock might be supposed to have been dragged along from distant limestone areas now buried under the thrust, but this supposition would still leave unexplained the absence of limestone fragments. Perhaps the cherty rock may belong to some vein-stuff formed along the thrust and then broken up by renewed movement.

The south-eastern limb of the Sgiath-bheinn Tokavaig thrust-plane is tolerably distinct on the west side of Loch Doir' an Eich, where at one place near the north end of the loch a crushed surface of Applecross grit just below the plane dips E.S.E. at about 40°, and the colour of the rocks has been changed from red to grey. The beds exposed along the section in (Figure 64) above the west limb of this thrust consist of Applecross grits and basal quartzite, but in an inverted position. The quartzite can be traced along the coast from Ord Bay to Dun Scaich, a distance of nearly a mile and a half, always dipping below the grit, sometimes at as low an angle as 28°. The strata continue in this relative position far south of the line of section. When the quartzite comes near the Sgiath-bheinn Tokavaig thrust on the south side of Ord Bay it bends and assumes a south-easterly strike, but still dips below the Applecross grits. The outcrops of many of the more prominent bands of grit in the inverted upper portion of the Kinloch sub-division have been mapped, and they also are, found to take a similar south-easterly strike as they approach the thrust. All the strata, therefore, between the quartzite and these Kinloch grits form parts of a syncline, in which their normal position is inverted. They not improbably once formed the under limb of a great isocline with both limbs dipping towards south-east. When the Sgiath-bheinn Tokavaig thrust was arched into an anticline the under limb of this supposed isocline may have been folded and inclined towards south-west near the thrust. That the strata beyond the western limb of the thrust had already been inverted before Mesozoic time is proved by the occurrence of an outlier of the basal conglomerate of the Mesozoic series resting on the reversed beds near Tarskavaig. But these reversed beds may not have already received the tilt which caused them to dip towards southwest near the thrust. It is, therefore, not impossible that the fold which affects this thrust may be of Mesozoic or even later age.

The rocks above the south-eastern limb of the Sgiath-bheinn Tokavaig thrust consist of shales and grits like those of the Kinloch division, but they vary a good deal in strike and dip, and contain no bands which can be traced so as to show the physical structure of the ground. The intrusions shown in the section are all basaltic dykes which have directions not much different from that of the section itself. The oncoming of the Moine thrust-plane with its overlying gneisses is shown at the eastern end of the section above the hollow of Loch Mhic Charmhicheil.

In the next section (Figure 65), drawn along a line about four miles to the south-west of that shown in (Figure 64), a different series of rocks is represented, together with another type of tectonic arrangement. The most striking feature in this line of traverse is the appearance of another major thrust which has carried forward a series of rocks unlike any that

lie to the north of them. Above this important line of dislocation, which has been named the Tarskavaig thrust, lies a series of sheared rocks undoubtedly belonging to the Lewisian gneiss; likewise a mass of altered sediments — the Tarskavaig-Moine schists (M■) — in a much more altered condition than the adjacent Torridonian materials. These schists represent what were originally false-bedded grits and sandy and gritty shales. They must have had some resemblance to the Diabaig sub-division of the Torridonian series, but they do not exactly match any members of that subdivision yet found in Skye or elsewhere. No conglomerates lie between them and the gneiss such as usually occur at the base of the Diabaig series. If they represent an altered Torridonian formation they must have been pushed from an area in which the conditions of deposition somewhat differed from those indicated by the known Torridonian groups elsewhere, and in which also the rocks were more altered than further to the northwest. The Tarskavaig-Moine schists are less altered than the Moine-schists on the east side of the Moine thrust, but in their relations to the Lewisian gneiss these two sets of schists closely resemble one another. Originally they probably had much the same lithological characters and stratigraphical sequence, the altered shales occurring chiefly near the gneiss rocks and the more siliceous rocks further away.

The mass of gneiss and schist on the Tarskavaig thrust was once pushed over the southerly continuation of the Torridonian and Cambrian rocks in (Figure 64), but it has been folded into a syncline with an axis striking N.N.E. and with its eastern limb often inverted, so that it sometimes dips below the Torridonian rocks. This axis is nearly parallel to, but about a mile west of, that of the anticline of the Sgiath-bheinn an Uird and Sgiath-bheinn Tokavaig thrusts, and is a continuation of the axis of the syncline of inverted strata between the western limb of the last-named thrust and the shore.

The line of section now to be considered crosses a considerable part of the Torridon area in a nearly easterly direction, almost parallel to the local strike and the south end of the folded Sgiath-bheinn Tokavaig thrust. The strata exposed belong partly to the Beinn na Seamraig grits (Ba³) and partly to the shaly Kinloch division. The Beinn na Seamraig grits form three separate patches which, a little south of the section, near the burn in Ghlinne Mheadhonnaich, unite and form parts of one exposure which extends south-eastward to the Moine thrust. In the middle and eastern patches, and in the parts which occur between them further south, the Beinn na Seamraig grits are inverted so as to lie above the Kinloch beds, but in the western patch they dip below these beds as if in their original order. This latter patch, however, lies close to the eastern limb of the Tarskavaig thrust — a limb which, though inclined in the same direction as it probably was originally, has yet been bent completely over, so that the Torridon beds which lay under now lie over the thrust. The eastern boundary of the west patch of grit may possibly have been bent over at the same time with the thrust at the western boundary, and perhaps before the eastern limb of the Tarskavaig thrust was reversed the beds in the west grit-patch were already in an inverted position, like those in the middle and eastern patches. It may be allowable to suppose that near the line of section the Torridon beds were first folded into a great isocline with its axial plane striking towards N.N.E. and hading towards E.S.E., and that the Beinn na Seamraig grits and Kinloch beds now exposed formed part of the reversed limb of this isocline. A subsequent plication may have folded the axial plane and also the Tarskavaig thrust.

No cleavage has been detected in any of the Torridon beds in this section, but the surfaces of the shales have often a glazed appearance like that often to be seen in Carboniferous shales in the neighbourhood of faults. At various places along the portion of the Tarskavaig thrust which outcrops north of the line of section thin bands of streaky crush-rock appear, which have perhaps been made out of the underlying Kinloch beds. In the north-east bank of Gillean Burn, nearly three-quarters of a mile west of Loch Dhugaill, a dark-grey shalt' rock contains oval bits of grit, from the size of a pea to that of a duck's egg, which are swathed round by the streaky laminae of the matrix.

The Tarkavaig thrust-plane, where exposed both at the north end of the syncline and also in many places in the western limb, overlies Kinloch beds and is there inclined at gentle angles. The eastern limb is not often visible. Near the south side of Gillean Burn it is nearly vertical, and further east is often reversed. A quarter of a mile south of the place where it is cut by the line of section it inclines to the east at about 55°.

The rock-mass whence the materials that overlie this thrust were driven seems to have most readily broken either within, or just at the top of, the Lewisian gneiss. In nearly all the best sections of the thrust-plane some of the gneiss rock, even if only a few inches, may be seen still lying upon it. When the thrust took place the gneiss was probably already in a soft

granulitic and sheared condition, much as it is now, and formed part of a belt of weakness along which the displacement proceeded. That both the gneiss and the schists had been granulitised before the thrust took place may be inferred from the numerous small folds which are seen in them, and which do not fold the thrust. Many of these folds are isoclinal, and are crossed by foliation-planes parallel to the axial-planes. Near the north-west end of the section this foliation dips towards east or south-east at from 30° to 50°, and the thrust is inclined towards the south-east, probably nearly as it was originally, so that the dip of the axial planes of fold in the rocks above the thrust may also be nearly the same as it was originally. If this supposition be correct, the force which produced these folds must have proceeded from above from a south-easterly direction — the same direction as the force which subsequently thrust the schists forward and afterwards folded the thrust-plane.

In the eastern limb of the syncline the width of the else outcrop is generally considerably more than in the western, but the gneiss rocks often cannot be easily separated from the altered sediments, both having been intensely sheared along parallel planes, and perhaps also mixed in thin stripes in places. The phyllite near Loch Nighean Fhionnlaidh occurs on the down-throw side of a large north-easterly fault, which fades towards south-east, and on the north side of Gilleann Burn throws down the Tarskavaig thrust-plane in an easterly direction, displacing its outcrop about 300 yards.

The differences between the Tarskavaig–Moine schists and the Moine-schist east of the Moine thrust indicate that the latter have been more highly metamorphosed than the former. The Moine thrust overlies the Tarskavaig thrust, and the rocks brought forward on it have doubtless been driven for a greater distance from the south-east than those displaced by the latter thrust. It is the schists which once lay furthest to the southeast that are in the most altered condition. We may suppose that before the thrust movements began the rocks now overlying the Tarskavaig and Moine thrusts formed parts of one rock mass composed partly of Lewisian gneiss rocks and partly of altered shales and grits, and that the metamorphism of this mass increased in intensity in a south-easterly direction.

The Moine thrust is not clearly exposed near the line of section. Half a mile further south a basalt sill, about five feet thick, which has been injected along the thrust, dips to the south-east at 15°, and the inclination of the thrust is probably about the same.

The last section (Figure 66) of this series across the peninsula of Sleat has been drawn along a line still further to the south-west. It presents a much larger area of Lewisian gneiss (A), and of the schists of sedimentary origin associated with them (M'), than that shown in (Figure 65). These schists have here been carried forward over almost unaltered Torridonian rocks by three thrusts — the Tarskavaig thrust, the outcrop of which is not seen in the section; the Caradal thrust, lying above the Tarskavaig thrust; and the Loch Lamarscaig thrust, which lies partly on the Caradal and partly on the Tarskavaig thrust. These three thrusts have been folded into synclines with axial planes striking towards the north-east. The axis of the Loch Lamarscaig thrust runs some distance to the south-east of those of the others, and this thrust has perhaps been folded after the others, which may possibly have received their plication when the mass on the Loch Lamarscaig thrust was being driven over them, while that thrust in its turn may have been folded before the mass that was advancing on the Moine thrust.

In several places along the Caradal thrust, and in one place along the Loch Lamarscaig thrust, patches have been observed of the Torridonian epidiotic grits and conglomerates having phyllites, granulitic schists, or sheared gneiss on both sides. A certain amount of crushing has affected the adjoining Tarskavaig-Moine schists as well as the epidiotic beds, and has helped to obscure the earlier differences between these two sets of rocks. In a specimen ([S7649](#)) [NG 586 047] of granulitic schist collected near a patch of the epidiotic conglomerate, the granulitic lamina, are repeatedly crushed along lines which cross the foliation.

Excepting along some special thrust-like lines the epidiotic beds are not granulitic, the outlines of the larger pebbles being generally distinct and showing no parallel elongation. Mixed with the epidiotic grits, in an area half a mile to the south-west of Loch Lamarscaig outlet, dark-grey gritty shales and purple and green sandy shales may be seen. None of these shales are lustrous, and in this respect they contrast greatly with the adjoining Tarskavaig-Moine phyllites.

Just under the Loch Lamarscaig thrust the Beinn na Seamraig grits and shales are a good deal crushed, but not otherwise appreciably altered. They only cover a small area between the eastern part of that thrust and the Moine thrust,

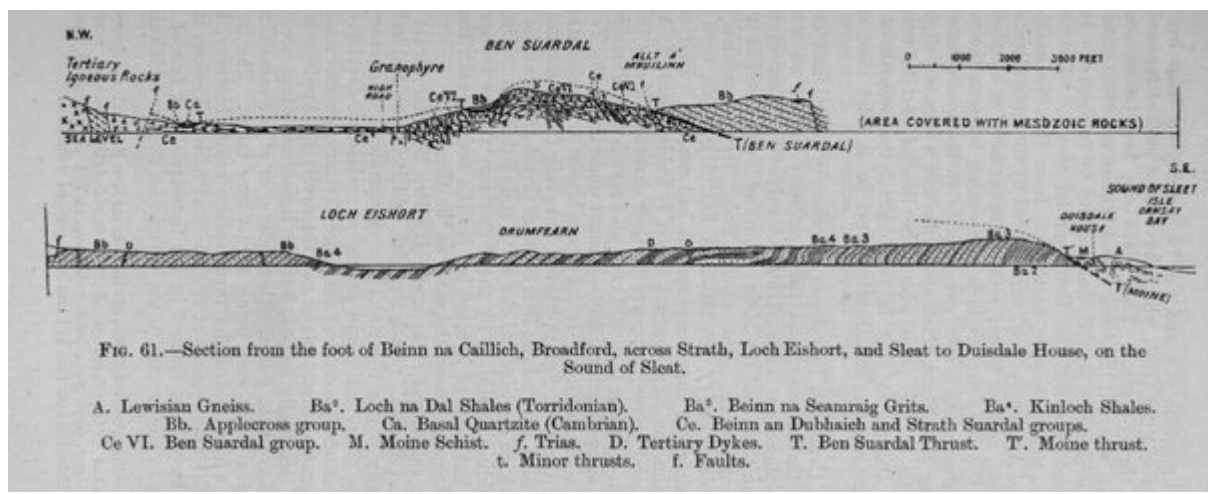
and are not clearly exposed. Further south their width becomes still narrower, and about a mile and a quarter north-west from Tormore the Moine thrust rests directly upon the gneiss on the Loch Lamarscaig thrust. The materials that overlie the Tarskavaig thrust are only exposed at the north-west end of the section, and consist of granulitic schistose grits, with a few subordinate beds of sandy phyllite which are not shown in the section: the foliation planes generally dip to south-east at between 28° and 50°, but near the Caradal thrust they are sometimes nearly flat, or strike to northwest. The phyllites and gneiss rocks which come below the schist on the west limb of the Tarskavaig thrust in (Figure 65) are probably hidden under the sea in this section.

The outcrop of the Tarskavaig thrust is overridden by the Loch Lamarscaig thrust at a place about half a mile south of the outlet of Loch a' Ghlinne, where the latter thrust is gently inclined towards south-east. The Tarskavaig thrust is not there distinct, but from the north side of Loch a' Ghlinne to within 200 yards of the Loch Lamarscaig thrust it strikes nearly north and south and is steeply inclined. Nearly a third of a mile south-east of the line of section the inclination of the western limb of the Caradal thrust is 29° to south-east, and a quarter of a mile further north-east it is 30° to south-east. The outcrop of this thrust is overridden by the Loch Lamarscaig thrust nearly half a mile slightly west of south of the Loch a' Ghlinne outlet, and the inclination here is gently westward.

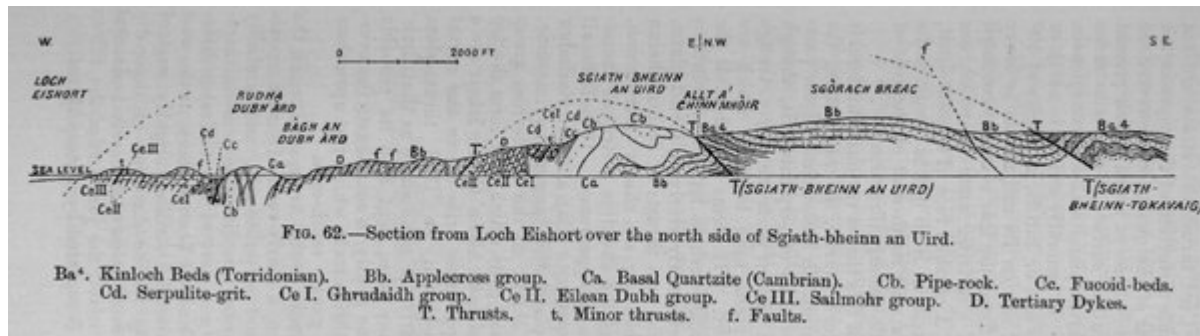
Above the western limb of the Caradal thrust in a few places thin stripes of rock have been noticed which may be regarded as sheared forms of Lewisian gneiss, but they cannot always be confidently separated from the overlying sandy phyllites. The patch of gneiss shown in the section is not more than 200 yards long, and no other gneiss can be seen for more than a mile to the south-west. The sandy phyllite above the sheared gneiss is about 100 yards broad and generally dips to south-east. About 100 yards east of the top of this phyllite another much thinner band of phyllite of similar material is succeeded by overlying granulitic schists which are generally somewhat pebbly and more massive than those below.

On the east side of the epidotic beds shown in the section, and probably separated from them by an obscure thrust, a flaggy pale-grey mylonised gneiss makes its appearance, the parallel planes of which are much crumpled but generally dip east or south-east. This gneiss may be separated by a minor thrust from the much broader exposure shown above the eastern portion of the Loch Lamarscaig thrust. The rock in this exposure is to a large extent composed of thin pale-green and red streaks, the former probably representing sheared basic laminae, and containing occasional round fragments and lenticles of hornblende and hornblende schist, while the red streaks represent the more felspathic laminae in the gneiss, or perhaps in some cases veins of pegmatite which have been sheared with the gneiss. Close to the Loch Lamarscaig thrust the planes of the sheared gneiss are in places so much broken that the rock loses its flaggy character.

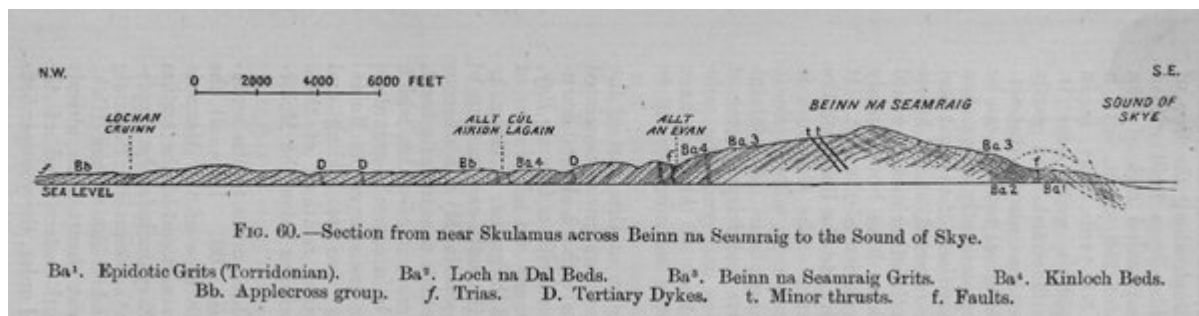
The rocks between the two exposures of sheared gneiss above the Loch Lamarscaig thrust consist of sandy phyllites and siliceous granulitic schists. Next to the gneiss on the east part of the thrust lies a thin band of granulitic schist, followed by a thick phyllite which is perhaps part of the band seen next to the gneiss in a good many other places on the Caradal and Tarskavaig thrusts. The Moine thrust is not distinct at the south-east end of the section, but in two places in Allt a' Chantaird some rocks in the thrust are exposed, and include a sheet of basalt and a band of mylonised rock, ten feet thick, which contains eye-shaped pieces swathed round by thin streaks resembling crushed shale. The mylonitic streaks generally dip to southeast at about 20°, and are probably parallel to the thrust.



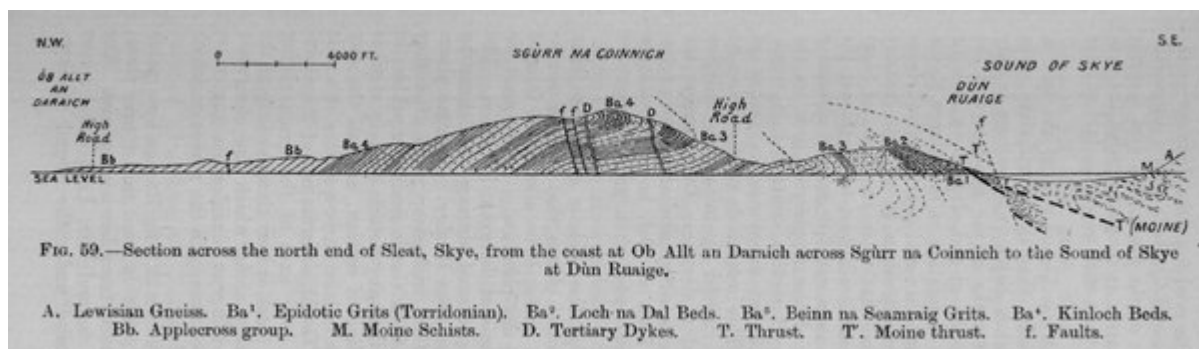
(Figure 61) Section from the foot of Beinn na Caillich, Broadford, across Strath, Loch Eishort, and Sleat to Duisdale House, on the Sound of Sleat. A. Lewisian Gneiss. Ba². Loch na Dal Shales (Torridonian). Ba³. Beinn na Seamraig Grits. Ba⁴. Kinloch Shales. Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Ce. Beinn an Dubhaich and Strath Suardal groups. Ce VI. Ben Suardal group. M. Moine Schist. f. Trias. D. Tertiary Dykes. T. Ben Suardal Thrust. T'. Moine thrust. t. Minor thrusts. f. Faults.



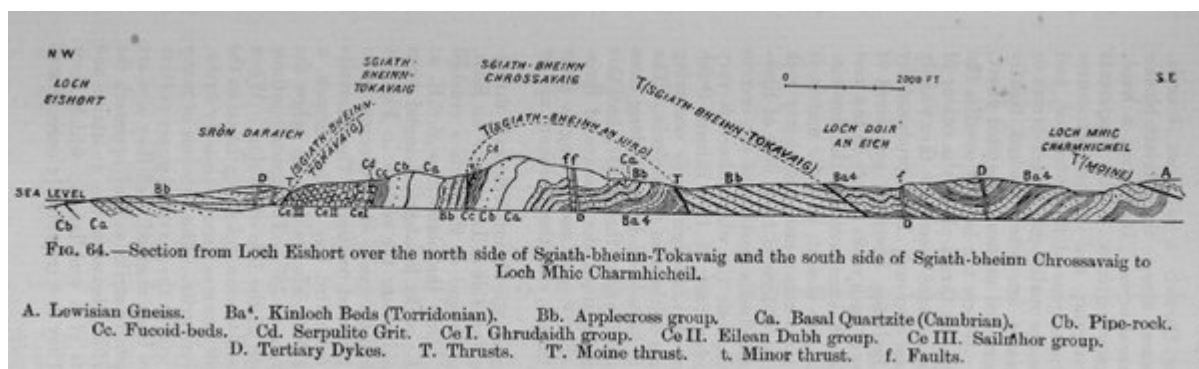
(Figure 62) Section from Loch Eishort over the north side of Sgiath-bheinn an Uird. Ba⁴. Kinloch Beds (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Ghrudaigh group. Ce II. Eilean Dubh group. Ce III. Sailmohr group. D. Tertiary Dykes. T. Thrusts. t. Minor thrusts. f. Faults.



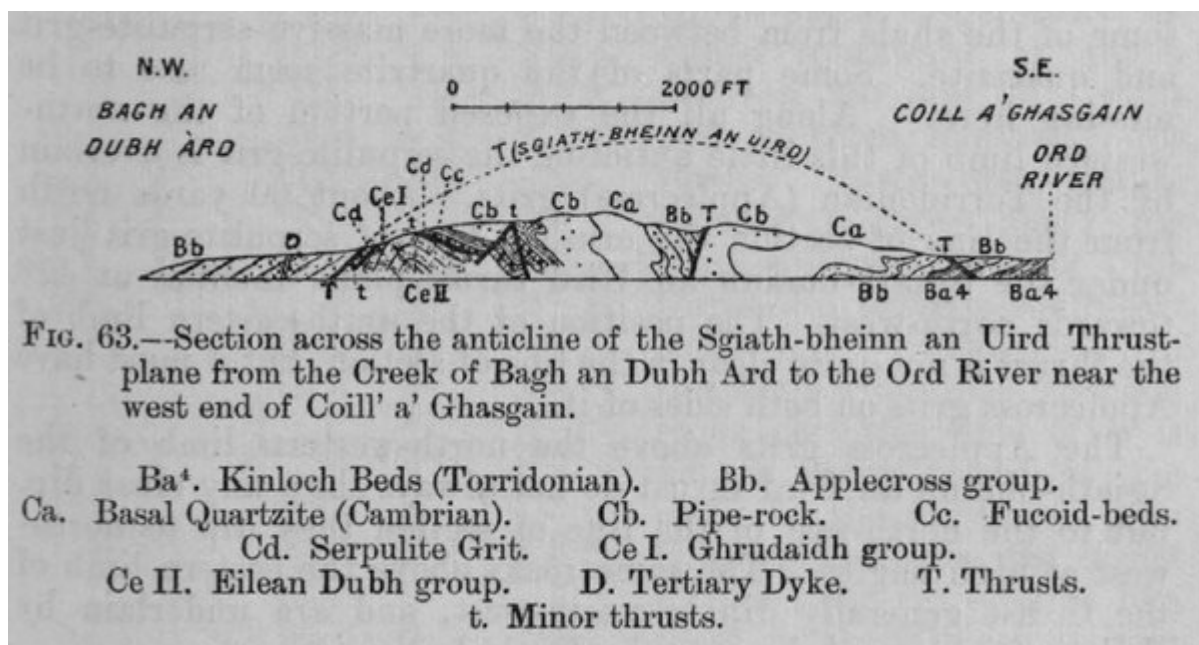
(Figure 60) Section from near Skulamus across Beinn na Seamraig to the Sound of Skye. Ba¹. Epidotic Grits (Torridonian). Ba². Loch na Dal Beds. Ba³. Beinn na Seamraig Grits. Ba⁴. Kinloch Beds. Bb. Applecross group. f. Trias. D. Tertiary Dykes. t. Minor thrusts. f. Faults.



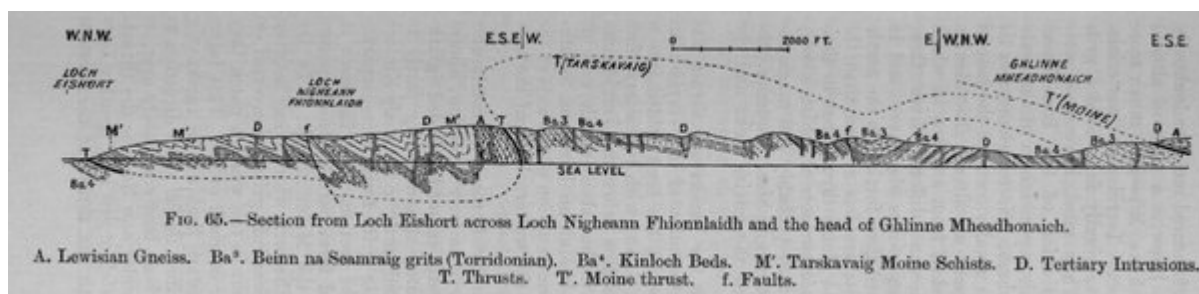
(Figure 59) Section across the north end of Sleat, Skye, from the coast at Ob Allt an Daraich across Sgùrr na Coinnich to the Sound of Skye at Dùn Ruaige. A. Lewisian Gneiss. Ba¹. Epidotic Grits (Torridonian). Ba². Loch na Dal Beds. Ba³. Beinn na Seamraig Grits. Ba⁴. Kinloch Beds. Bb. Applecross group. M. Moine Schists. D. Tertiary Dykes. T. Thrust. T'. Moine thrust. f. Faults.



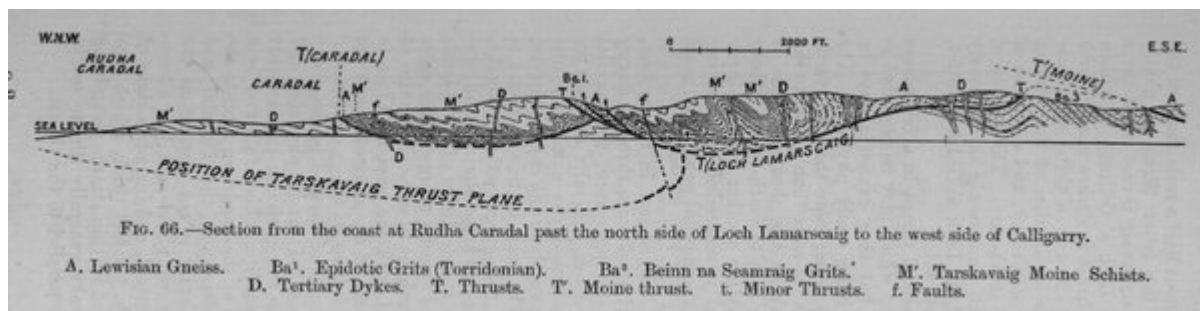
(Figure 64) Section from Loch Eishort over the north side of Sgiath-bheinn-Tokavaig and the south side of Sgiath-bheinn Chrossavaig to Loch Mhic Charmhicheil. A. Lewisian Gneiss. Ba⁴. Kinloch Beds (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Furoid-beds. Cd. Serpulite Grit. Ce I. Ghrudaidh group. Ce II. Eilean Dubh group. Ce III. Sailithor group. D. Tertiary Dykes. T. Thrusts. T'. Moine thrust. t. Minor thrust. f. Faults.



(Figure 63) Section across the anticline of the Sgiath-bheinn an Uird Thrust-plane from the Creek of Bagh an Dubh Ard to the Ord River near the west end of Coill' a' Ghasgain. Ba⁴. Kinloch Beds (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Furoid-beds. Cd. Serpulite Grit. Ce I. Ghrudaidh group. Ce II. Eilean Dubh group. D. Tertiary Dyke. T. Thrusts. t. Minor thrusts.



(Figure 65) Section from Loch Eishort across Loch Nigheann Fhionnlaidh and the head of Ghlinne Mheadhonaich. A. Lewisian Gneiss. Ba³. Beinn na Seamraig grits (Torridonian). Ba⁴. Kinloch Beds. M'. Tarskavaig Moine Schists. D. Tertiary Intrusions. T. Thrusts. T'. Moine thrust. f. Faults.



(Figure 66) Section from the coast at Rudha Caradal past the north side of Loch Lamarscaig to the west side of Calligarry. A. Lewisian Gneiss. Ba¹. Epidotic Grits (Torridonian). Ba³. Beinn na Seamraig Grits. M'. Tarskavaig Moine Schists. D. Tertiary Dykes. T. Thrusts. T'. Moine thrust. t. Minor Thrusts. f. Faults.