
Chapter 42 The Eastern Schists from Strath na Sheallag to Loch Alsh and in Skye

I. Strath na Sheallag to Loch Alsh

By J. Horne and B. N. Peach, with Notes from E. Greenly. The district described in this chapter is contained in Sheets 61, 71, 81, 82, and 92 of the Geological Survey Map of Scotland, on the scale of 1 inch to a mile

In the area between Strath na Sheallag and the lofty crag east of Loch an Nid the position of the Moine thrust-plane is clearly defined. It is noteworthy that the fine-grained, greenish-grey schist which immediately overlies the plane at the south end of that crag is a typical Moine-schist, being composed of a granulitic aggregate of quartz and felspar with scales of white mica and "eyes" of felspar. Southwards, however, on the ridge about 200 yards east of Loch a' Mheallain Odhair and about two miles and a half north of the Heights of Kinlochewe there is a development of green and streaky mylonites, the origin of which is difficult to determine. Some of these rocks may be due to the deformation of bands of Lewisian gneiss, others to the crushing of Torridon grit, and in one instance (Specimen No. [\(S4708\)](#) [NH 073 689]) the rock may not improbably be a member of the Moine series, the structure of which has been modified by the post-Cambrian movements.

From the Heights of Kinlochewe southwards to Loch Coulin a zone of green schist, with an apparent thickness of about 250 feet, lies along the base of the Eastern schists and immediately above the plane of disruption. It is composed of flaggy granulitic rocks, with which occur bands of the more siliceous grey flagstones and of the wavy mica-schist similar to the "oyster-shell" type of Loch Eireboll. At the base of this series, about half a mile east of Loch Clair, a highly-contorted platy schist with well-marked striping is evidently of sedimentary origin.

Garnetiferous muscovite-biotite schist or gneiss is remarkably developed on Meall Dubh and Meall ant-Sithe, about two miles east of Loch an Nid and about a mile and a half east of the Moine thrust-plane, the mapping of which has thrown much light on the geological structure of that and adjoining areas. The rock is variable in character, being composed, in places, mainly of biotite, in others of biotite and muscovite, with knots and lenticles of quartzo-felspathic material. Garnets are abundant, and sometimes form aggregates more than an inch broad.

A notable petrographical type, which has been traced for some distance on both sides of Glen Docherty, is an augen-schist with a normal granulitic matrix, enclosing numerous "eyes" of felspar about half an inch in breadth, which show the effects of crushing. An interesting feature in this rock is the well-rounded form of its felspar augen", which thus differs from the elongated or phacoidal shapes which have generally resulted from the dynamic movements of this region. Another remarkable zone of biotite-garnet augen-schist, which appears about a mile and a half east of the Heights of Kinlochewe and also on the Sron Dubh northeast of Leckie, is about 45 feet thick, and consists of a massive schist with flakes of dark mica arranged in phacoidal form. It includes fine granular bands with minute garnets. The petrological character of this rock has been described in detail by Dr. Teall.

Around Kinlochewe in the Moine-schists, quartz-bands and rods are numerous and important. Consisting wholly of white granulitic quartz they are exceedingly compact and uniform in texture, and are usually separated from the schists by films of mica. Their foliation-planes are frequently striped or fluted along the dip, the lineation being persistently from the E.S.E. In some places they form regular bands in the schist, elsewhere they appear as rods, and intermediately as flattened lenticles which are generally convoluted. Discordance can frequently be seen between their margins and the foliation-planes of the schists. From their greater durability they often form the crests and dip-slopes of the rock-bosses on the high plateaux. Fine examples of these features abound on the escarpment east of Abhuinn Bruachaig, north of Allt Dubh Leacaidh, and north of Carn na Garbh Lice, where all the stages between perfect rods and unfolded quartz-bands can be found. It is highly probable that these bands are of segregatory origin, and that the rod-structure and granulitisation have been produced by the post-Cambrian movements.

The double system of folding in the Moine-schists (Chapter 40) is beautifully illustrated in the area between the Heights of Kinlochewe and the plateau north of Glen Carron. The strike of the main folding, save where locally disturbed, is generally N.N.E. or north-east, and the dip varies from E.S.E. to southeast at angles ranging from 18° to 25°. But

notwithstanding this persistent inclination towards the E.S.E., the strata are probably reduplicated on an extensive scale, the crests of the folds having been removed by denudation.

From Achnashellach to the head of Loch Carron the Moine thrust-plane is concealed beneath the alluvium of the River Carron and by Loch Dhughail. The first rocks exposed on the slope south-east of Loch Dhughail above the position of that plane are frilled schists of phyllitic type, alternating with flaggy quartzose granulitic bands, passing south-eastwards into the typical siliceous flagstones of the Moine series. Further down the valley at Arinackaig and on the north-west declivity of Carn Mor two narrow belts of granulitic biotite-actinolite-gneiss may be inliers of Lewisian rocks, modified by the post-Cambrian movements. To the west of the alluvium around the head of Loch Carron the Moine-schists appear at Kirkton as siliceous flagstones and phyllites, which are let down by a fault against the thrust flaser-gneiss that overlies the Kishorn thrust-plane. ((Figure 54), Chapter 38) Southwards this plane of disruption visible in a stream, not far to the north of the bend of the road leading to Kishorn and about two miles and a half north-west of the village of Loch Carron, where the siliceous schists, much folded and crushed, override the flaser-gneiss.

On the east side of Loch Carron the Moine thrust, though not exposed, must crop out near the railway station at Stromeferry, for mylonites are seen at the pier to the west of the station, and granulitic siliceous schists occur not far to the east. Between Stromeferry and Attadale a narrow strip of siliceous schist, is followed (see Chapter 38) by a thin zone of mica-schist containing crystals of hornblende, which passes eastwards into a rock with a similar matrix, enclosing lenticles, a few inches long, of quartzo-felspathic material, together with pebbles and grains of quartz. The rock thus resembles a conglomerate. The largest of the lenticles, from eight to ten inches long, are all elongated in one direction. They may have been derived from the Lewisian gneisses to the east. This so-called conglomerate lies in immediate contact with an overlying mass of granulitic hornblende-biotite-gneiss, which occupies a broad area southwards to Loch Alsh. (Sheets 71 and 81)

Reference has already been made to the outcrop of the Moine thrust-plane between Stromeferry and Loch Alsh, where the granulitic siliceous Eastern schists have been driven westwards over the thrust flaser-gneiss. (Chapter 38) Both at Braeintra and in the hollow between Kirkton and Auchtertyre Hills evidence of the breaking down and crushing of the structures in these schists has been obtained.

The remarkable conglomeratic rock noticed in Chapter 38, which may possibly mark the base of the Moine series south of Braeintra, is exposed in two places. The first of these lies on the east margin of a belt or infold of siliceous schist about 300 yards west of the bend of the road leading across the ridge towards Gleann Udalain, where it forms an isolated knob peering through drift. The second exposure is visible about 100 yards further to the east in a knoll, where the conglomerate rests on granulitic hornblende-biotite gneiss, and passes eastwards underneath the Moine-schist. In both cases the matrix is holocrystalline, composed of quartz, feldspar, hornblende, biotite, muscovite, and epidote, and enclosing fragments of granulitic gneiss and quartz. It is noteworthy that the crystals of actinolite in the matrix pass into the included pebbles.

Eastwards from the Moine thrust-plane towards Gleann Udalain evidence is presented of increasing metamorphism in the Moine-schist on each successive infold. The rocks become more coarsely crystalline and the intervening belts of Lewisian gneiss are almost wholly granulitised. On the east side of the bay at Kirkton of Lochalsh, on the rocky headland south-west of Avernish, a "crush-conglomerate" appears within the area occupied by the Lewisian gneiss, which there consists of hard granulitic quartz-biotite gneiss, mica-schist, and hornblende-biotite-chlorite schist. By a complex system of overfolds, lenticles and knots of the hard siliceous gneiss have been pinched off and isolated in the green chloritic schist, the pseudo-pebbles being elongated in a direction parallel with the long axes of the folds.

E. The Eastern Schists in Skye

By C. T. Clough.

In Skye the Eastern schists are confined to the part of the peninsula of Sleat which lies south of Loch na Dal. On the mainland opposite to Kylerhea similar schists strike towards the north-east, and help to connect the Skye exposures with those to the north of Loch Alsh, described in the previous pages. In the area now under consideration these schists are

separated by thrusts from all the rocks which can be regarded with confidence as Torridonian, but many of their junctions with the Lewisian gneiss, though much folded, show no indications of thrusting.

The most northerly exposure of the schists on the south-eastern side of the Moine thrust is to be seen in Camas a' Mhuilt, near Isle Ornsay, but is small in size, and wedges out in less than half a mile in a south-westerly direction. About a mile and three-quarters further in the same direction another thin strip of similar schist appears on the same side of the thrust. In Camas Croise, and between that bay and Isle Ornsay, a small much-folded patch is bounded on the west by a fault or thrust striking slightly east of north. South-east of Armadale Bay these rocks appear again, and form Rudha Phoill, Rudha Dubh, and the adjacent islands. South-west of the bay they extend some distance from the shore, but are so mixed with the Lewisian gneiss, partly by folding and partly by lines of crush, which have a prevalent north-easterly trend, that it is difficult to describe their distribution. The coast from 200 yards north of Bogha Charslice to half a mile south-west of Tormore is composed either of Moine-schists or of Tertiary intrusions. Starting from the road a third of a mile N.N.E. of Tormore one may walk in a westerly direction for nearly a mile and a half and keep on Moine-schists all the way. All these rocks within the limits here traced lie on the eastern side of the Moine thrust-plane.

A much larger area of these schists lies, however, to the west of that plane. It comes to the coast between Aird and the Point of Sleat, and, together with some small associated patches of gneiss, Torridonian and Mesozoic rocks, extends northward for six or seven miles from the Point of Sleat on the western side of the peninsula, its breadth near Rudh' an lasgaich being about two miles and a half. Its northern end forms a curve on the hill 700 yards south-east from the east end of Loch Gauscavaig, and is flanked on the north-eastern side by two small outliers, neither of them so much as 60 yards in length, which appear to rest on beds belonging to the Kinloch division of the Torridonian series. Near the north end of this area the boundary between these schists and the Torridonian series is the Tarskavaig thrust, which has been folded into a syncline with axial plane striking to N.N.E. and hading to south-east. (Figure 65), (Figure 66). Further south the eastern limb of the syncline becomes vertical, or even dips to south-east or east, so that the Torridonian rocks sometimes overlie the schists. The south-eastern portion of the area is divided from the north-western by the Caradal thrust, the outcrop of which can be traced along the west side of Sleat from Geur Rudha to near Inver Dalavil. It then bends towards east and south-east until it meets the Lamarscaig thrust a mile north of Sgurr nan Caorach. The Caradal thrust repeats the lower portions of the Moine series, which on either side of it present much the same state of alteration. Both portions of the large area now traced lie on the north-western side of, or below, the Moine thrust, whereas all the other areas lie above it. All the schists below that thrust are less altered than those above it, and show their sedimentary character more distinctly. Though the schists on both sides of the thrust must have been originally very similar in character, and in their relations to the Lewisian gneiss, the difference in the extent of their metamorphism will make it convenient to describe them separately.

(i.) Beginning with the rocks on the north-west side of the thrust, distinguished by the name of the Tarskavaig Moine-schists (Chapter 39), we have to remark at the outset that they are perhaps less altered than any other known Moine-schists. They are, therefore, of particular interest. They may be divided into two types, one chiefly of phyllitic character, the other more siliceous. The phyllitic portion is usually closely intermixed, sometimes in nearly equal proportions, with thin sandy or siliceous streaks. In most places — for instance, near Tarskavaig Bay — the materials next to the Lewisian gneiss consist chiefly of phyllite mixed with thin bands of fine siliceous schist, covered by an alternating series in which the siliceous bands, though in considerable excess of the phyllitic, have a finer grain and a paler grey colour than are usually found in the overlying schistose grits. Some considerable exposures of phyllite for instance, on the west side of Aird, near Loch Nigheann Fhionnlaidh, and on the north-east side of Sgurr Breac — appear at some distance from the gneiss, but they may nevertheless represent folded portions of the phyllitic beds usually seen near the gneiss.

The clearest junction between the Moine-schists and the gneiss is to be seen on the coast nearly two-thirds of a mile W.N.W. from Loch Nigheann Fhionnlaidh, where phyllite rests on an unctuous green schist which may represent a sheared form of one of the gneiss rocks. The line between the two rocks is slightly waved, but almost parallel to the bedding in the phyllite, the bedding being shown by some thin siliceous bands. The foliations of the two rocks are parallel to one another and slightly steeper than the bedding in the phyllite, and portions of the two rocks are, in places, united into one block. On the north side of Acarseid an Rudha some of the phyllitic bands are slightly calcareous. Thin gritty or pebbly bands, rarely more than an inch thick, are generally abundant in the phyllites, and some of them, even when they show distinct clastic

grains of opalescent quartz and red felspar, are calcareous. Good examples of these calcareous bands are exposed on the coast a mile east of Ard Thurinish, and on the north side of Aarseid an Rudha.

On the coast from Port na Long to within a mile of the Point of Sleat the phyllite and the intermixed gritty beds, but perhaps the latter especially, contain many round spots, some as large as small peas, of black mica or chlorite. The rocks containing these spots do not split readily along the foliation-planes, and they "clink" under the hammer. They are also perhaps less lustrous than the phyllites in most parts of the district. Some of the bands of purer phyllite also contain garnets, about the size of mustard seeds, together with little plates of some hard black undetermined mineral lying across the foliation-planes. The spots are evidently of secondary origin, and when examined under the microscope (Nos. [\(S7348\)](#) [NG 586 002] and [\(S7349\)](#) [NG 586 002]) the flakes in them are seen to contain many inclusions of the granulitic constituents of the rock, and also to be repeatedly twisted. In some spots they are composed of biotite, in others of chlorite or of chlorite intergrown with biotite. In addition to these minerals many small brownish-red spots, of low refractive index, may perhaps be albite. Similar micaceous spots characterise the schists for a little distance inland from the coast, but further north they become gradually less prominent.

We suppose the spots to have existed before the schists containing them were thrust into their present positions. The flakes in them were perhaps twisted while the thrusts were in progress. As the flakes are later than the granulitic constituents of the rock, it would seem that these Moine rocks were granulitised and essentially in their present condition before the thrusts took place. If this conclusion be admitted, the differences in extent of metamorphism between the Tarskavaig-Moine schists below and the Moine-schists above the Moine thrust existed prior to the thrust. We may suppose that these rocks were pushed from an area in which the metamorphism increased in a south-easterly direction. The metamorphism which produced the micaceous spots, though probably earlier than the thrusts, must have been later than the regional metamorphism — which was perhaps induced during the isoclinal folding — and may have been developed near some igneous intrusion.

The variations in breadth of the outcrop of phyllite next the gneiss are perhaps in part due to the varying original thicknesses of the bed in different localities. In some places there is no phyllite

in this position, and its entire absence could not be explained by folding. The facts seem to suggest that, though we see no clear unconformity between Moine-schists and the gneiss rocks in any particular section, there may yet be a discordance there, the apparent conformity being due to the dragging into parallelism of the structures of the two rocks.

The schistose grits which come above the phyllites next the gneiss make up much the largest part of the area. They were probably thicker than the phyllites originally. Their quartz grains and pebbles have usually either "run together" to form a granulitic matrix, or else they have been greatly deformed and pulled out into parallel streaks. A bluish opalescent tint, like that of the quartz in the Lewisian gneiss, is still shown by many of the larger grains, even by some which are considerably elongated. Half a mile E.S.E. from Camas Daraich the quartz-pebbles are crossed, in a direction at right angles to that of elongation, by many thin rather opaque white streaks, which are more distinctly granulitic than the other parts of the pebbles. Some of these pebbles are as much as three inches long, though only half an inch broad. Most of the clastic grains and pebbles of felspar consist of red microcline. They are generally much less deformed than the quartz pebbles, and are traversed by cleavage-planes that cross their whole breadth without any noticeable crack or elongation. The difference in the behaviour under shearing of the quartz and felspar grains is particularly prominent in Camas Daraich and 300 yards south of Aarseid an Rudha. In a few places pebbles have been found compounded of red felspar and opalescent quartz. Small grains of epidote are common, sometimes so large and abundant as to be recognisable by the unaided eye, and to give a yellowish-green tint to the rock-matrix. They are usually congregated into streaks parallel with the other stretched constituents of the rock. The micaceous flakes on the foliation-planes are, as in the phyllites, too small to be discerned macroscopically, but in all parts of the district larger flakes, of biotite or chlorite, are usually found to cross these planes at various angles. The average size of the larger clastic grains varies in different bands. It is possible to recognise that in many places the schists are very false-bedded.

Short veins of quartz, or of quartz with a certain proportion of red felspar and chlorite, are common both in the phyllites and more siliceous bands, but are seldom more than an inch or two thick. In a specimen (No. [\(S7354\)](#) [NG 578 062]), obtained a quarter of a mile north of Inver Dalavil, the felspar is albite or a closely-allied species, accompanied with some

little strings and specks of carbonate. Some of the veins show a rodded structure on the outside, or are crossed by a foliation which also affects the beds in which they occur. The direction of stretching is sometimes — as, for instance, on Rudha Caradal — parallel to the direction of dip, but more usually differs somewhat from it. Between the Point of Sleat and Geur Rudha, and on the coast half a mile north of Inver Dalavil — places where the usual dip is slightly south of east — the stretching is often 35° or 40° more south of east. Rather more than a third of a mile E.N.E. from the centre of Camas Daraich the dip is towards E.S.E., and the elongation almost at right angles to it.

(ii.) Sections of the schists that stretch to the east of the Moine-thrust and overlie it, may be seen on the north side of Camas Croise, on the south side of Rudha Phoil, and from near Bogha Charslice to about half a mile south-west of Tormore. The siliceous schists, representing altered sandstones or grits, are, as already stated, in a more altered state than the corresponding rocks on the north-western side of the thrust. We may search long among them without detecting any clastic grains, nearly the whole of the quartz and felspar being of an authigenic character. Besides this difference the average size of the granules in the granulitic mosaic is greater than in the Tarskavaig-Moine schists, the white mica-flakes on the foliation-planes are larger, and are mixed with many flakes of biotite, while garnets are both more common and of larger size. Veins of quartz and felspar are also thicker and more numerous. Moreover, the specially micaceous schists are much more lustrous than the corresponding rocks — the phyllites — on the other side of the thrust, and the mica-flakes in them are often large enough to be easily distinguished by the unaided eye.

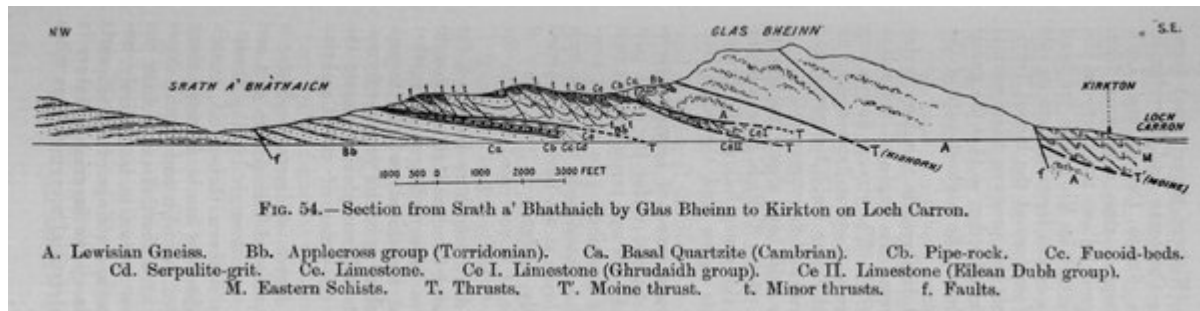
On the east side of Kyle Rhea, and near Camas a' Mhuilt and Allt Bealach na Coise, the rocks next the Lewisian gneiss are granulitic siliceous flagstones. In the schist areas further to the south-west the material lying next the gneiss is in most places a thin pale siliceous schist, covered by a considerable thickness of more micaceous schist with subordinate siliceous beds. A distance of only six or seven miles intervenes between the tracts in which these two types of rock next the gneiss are found, and no great fault or thrust is known to exist in the interspace. It may be suggested that the Moine-schists may overlap the gneiss, and that those portions of them which lie next the gneiss in the south-western part of the district gradually thin away in a northeasterly direction. No conglomerate or breccia has been detected at the undisturbed junctions of the schists and the gneiss. The clearest of these junctions are to be seen near Tormore and Meall Buidhe. The foliations of the two rocks are parallel, and no structure-lines have been observed in the one rock that cannot be paralleled in the other. The gneiss disintegrates more readily than the Moine-schist, and recedes from it in weathered scars. It also displays somewhat brighter colours, sub-parallel streaks of red and green being common, so that the line between the two rocks can usually be fixed within a few inches.

The rocks which crop out on the coast to the north-west of Bogha Charslice and continue thence to beyond Tormore, extending also for varying distances inland, include a considerable proportion of highly micaceous schists. In some places the siliceous bands preponderate, but none of them have been mapped out except that which lies next to the gneiss. As the more micaceous schists are repeatedly seen near the gneiss, while the more massive siliceous rocks of Rudha Phoil and Rudha Dubh never are, it seems probable that these last rocks come above the former. They may lie on the same stratigraphical horizon as the gritty rocks which form so large a proportion of the Tarskavaig-Moine schists.

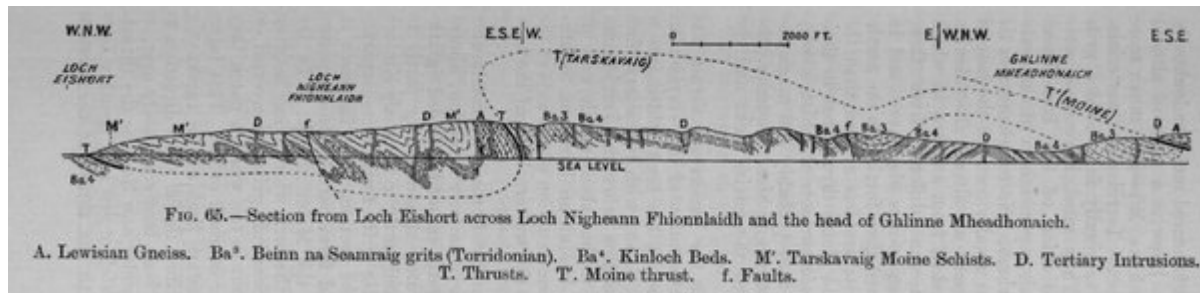
The more micaceous schists are usually of a dark-grey or leaden colour. Most of the thin interbedded siliceous bands vary in thickness from one to six inches, and being harder than the micaceous bands they project on the weathered face, where they show the numberless isoclinal folds into which the rocks have been folded. At different places, distant respectively from Tormore half a mile north-east, 300 yards E.S.E., and a quarter of a mile east, some of the siliceous laminae contain specks of red felspar, about the size of small peas, which show cleavage-planes right across. These are probably clastic grains. A quarter of a mile east of Tormore some large blocks, tumbled from the cliffs above, show alternating thin bands, some of which, as much as six inches thick, are slightly calcareous, and also contain specks, about the size of small peas, of granulitic quartz, more rarely of felspar. The different granules of the granulitic quartz specks adhere together in the weathered face and project somewhat from the calcareous areas around, so that they still resemble pebbles, though thoroughly granulitic. They are also nearly free from mica-flakes, so common in the matrix. Neither the quartz nor the felspar specks are, as a rule, much elongated at this place. Some of the bands which look like old pebbly strata gradually diminish in thickness until they are represented merely by rows of scattered quartz-specks, embedded in a micaceous matrix. The original sediments out of which these metamorphic rocks have been produced appear to have consisted of a close association of fine and coarse materials.

Veins of quartz and felspar, common both in the siliceous and more micaceous schists, occasionally, as, for instance, in Camas a' Mhuilt, have a thickness of as much as 18 inches. The felspar in these veins is generally red, and free from granulitisation. In Specimen No. [\(S7343\)](#) [NG 642 043], from a vein at the north-east end of Eilean Maol, the felspar is plagioclase, either oligoclase or albite. Small specks of carbonate abound in the veins which contain felspar. In some places also large flakes of black mica or chlorite may be observed either within, or at the sides of, the veins.

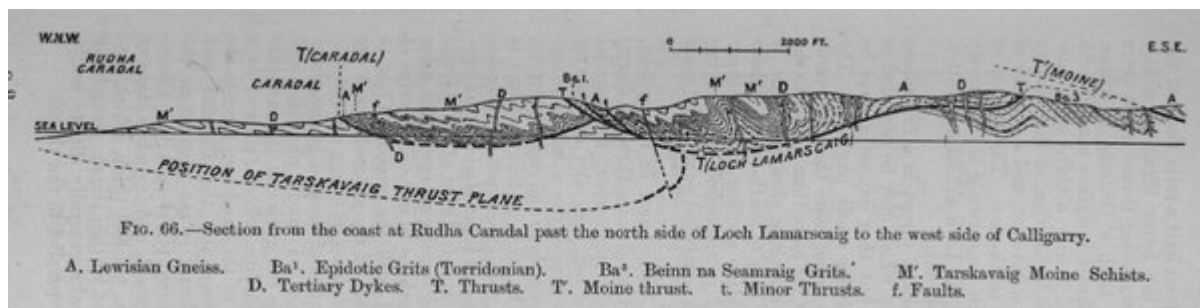
The directions of stretching often make considerable angles with those of the dip. In Camas a' Mhuilt and Camas Croise, when the dip is towards south-east or east, the stretching is E.N.E., and as the observer looks towards the quarter opposite to that of the dip the stretching lines appear to incline down towards his right hand. In other parts of Camas Croise, moreover, where the foliation-planes are vertical and strike nearly east and west, as one looks towards the north the stretching lines again incline down towards the right.



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



(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.