
Chapter 41 The Eastern Schists from the north coast of Sutherland southwards to Strath na Sheallag

I. Loch Eireboll to Loch More

By B. N. Peach and J. Horne, with notes supplied by H. M. Cadell. The district described in this chapter is represented in Sheets 92, 101, 102, 107, 108, and 114 of the Geological Survey Map of Scotland, on the scale of 1 inch to a mile (1:63360).

The best exposure of the Moine thrust-plane in the north of Sutherland is to be seen at the base of the Cleit an Seabhaig — a precipitous sea-cliff, about 600 feet high, nearly two miles east of the mouth of Loch Eireboll. Sheared gneiss and pegmatite form at that place the pavement or sole on which the displaced schists repose. Southwards the thrust-plane can be traced to the mouth of Loch Hope, and thence to the top of Creag na Faoilinn and Creag Earail, beyond which point to Loch More, though itself concealed, it gives rise to a conspicuous feature in the landscape.

At the base of the Eastern schists in Eireboll, green, platy, fissile mylonised rocks are followed by green, pink, and striped mylonites with alternations of gneiss, which, in places, has lost nearly all traces of its original structure. Immediately above the plane or in association with the lentils of deformed Lewisian gneiss, wedges of rolled-out quartzite appear, which probably belong to the basal division of the Cambrian system. Next in order above the belt of mylonised rocks come frilled or corrugated mica-schist and phyllites ("oyster-shell rock") with a thin band of limestone or calcareous zone near the top, visible on the Cleit an Seabhaig and along the ridge to the south-west of Loch Hope. Between Creag na Faoilinn and An Lean Charn the wavy phyllites alternate with bands of highly siliceous schist, the most prominent one being represented on Sheet 114, on the ridge to the south-east of the head of Loch Eireboll. Further to the east a lenticular belt of hornblendic and micaceous gneiss has been traced for a distance of eight miles from the west slope of Beinn Thutaig and across Loch Hope to Meall a' Bhaid Tharsuinn. This gneiss is followed by a great development of granulitic siliceous schist with occasional bands of garnetiferous mica-schist. The granulitic quartz-schists have a wide distribution over the eastern slope of the A' Mhoine and southwards to Loch Hope.

All the successive bands of rock lying above, the Moine displacement have been dragged into a general parallelism with that line of disruption, acquiring in consequence a strike to N.N.E. and a dip to E.S.E. But in the midst of the granulitic series frequent examples appear of folding along axes that trend W.N.W. and E.S.E. The most striking instance of this structure is to be seen on the south-east slope of Beinn Thutaig about three-quarters of a mile from the top of the hill. Here, as already alluded to, a series of rods, varying from two to four feet in length and from one to four inches in diameter, are composed of irregular grains of quartz with some flakes of white mica. These rods are associated with mica-schists of Moine type, which have there been thrown into sharp anticlines and synclines, with axes trending like the rods towards W. 12° N., and with a pitch towards the east. On exposed surfaces, where the mica-schist has been denuded into hollows, these siliceous ribs project and form conspicuous features in the landscape.

The same order of succession in the rocks above the Moine thrust-plane is observable in the Durness area on Fair-air Head, and in a less complete form in Sangomore Bay. The platy mylonites, the rolled-out lentils of quartzite, the frilled schist with the calcareous zone at the top, the reconstructed zoisite-gneiss, followed by the granulitic quartz-schists, are exposed partly at the one place and partly at the other. It is worthy of note that the fault-breccia along one of the normal dislocations north of Durine village, which have disconnected the Eastern schists at Durness from those at Eireboll, contains numerous fragments of these granulitic schists.

In the midst of the granulitic schists between the Kyle of Tongue and the River Borgie two inliers of gneiss contain types characteristic of the Lewisian rocks to the west. The more westerly, which has been traced from the village of Tongue southwards to Loch an Dithreibh, is bounded by siliceous schist, save on the north-west margin north of Lochan Hacoin, where it is in contact with platy hornblende-schist. The rocks consist mainly of grey banded biotite gneiss with pegmatites, whose strike roughly coincides with that of the adjacent schists of sedimentary origin. But in some places — as, for instance, near Ribigill Farm — masses of coarse-grained hornblende-gneiss appear which closely resemble a

type in the Cape Wrath area.

A still larger belt to the west of the Borgie River is about two miles wide, and extends southwards from the north coast for a distance of seven miles to Loch Creagach. It consists mainly of hornblendic gneiss with masses of rudely-foliated diorite ([S3022](#)) [NC 629 575], ([S3023](#)) [NC 629 575], ([S3024](#)) [NC 629 575], ([S3025](#)) [NC 666 617], ([S3026](#)) [NC 666 617], ([S3027](#)) [NC 685 582] and dykes of ultra-basic materials, which present some of the features of the Lewisian masses to the west. These rocks are bounded by flaggy quartz-biotite schists or gneisses, which have been included with the Moine series. Bands of hornblende-schist are interleaved in that series between Strathan and the village of Tongue, but the most persistent zone of this type is that which has been traced from the head of the Kyle of Tongue round the northern and western slopes of Ben Hope. (Sheet 114).

The order of succession of the rocks above the Moine thrust-plane which obtains in the Eireboll and Durness district has not been traced further south than Creag Earail beyond the head of Loch Eireboll. Southwards to Loch More the plane is well defined, its average angle of inclination being about 6°, though in some places it is higher, while at Loch Vuckernich, about a mile north of Loch More, the plane becomes horizontal. Immediately above the plane of disruption a belt of green schist with felspar "eyes", intensely crumpled and contorted, has been produced, partly from the deformation of Lewisian gneiss and partly from sedimentary materials. Overlying this belt come the granulitic quartzose schists with partings of mica-schist.

II The Eastern Schists from Loch More to Loch Glencoul

By C. T. Clough.

Between Loch More and Gorm Loch Afar the Eastern schists comprise the zone of (1) mylonised rocks at the base, followed by (2) a group of "puckered" ("Stack") schists — extremely fine-grained much-puckered rocks, containing many streaks and thin bands of greenish-grey quartzose schist or slate — and then by (3) granulitic siliceous flagstones with thin micaceous schists.

South of Loch More the schists in some places lose their usual N.N.E.–S.S.W. strike and E.S.E. dip, and become approximately parallel to the adjacent portion of their curving western boundary. Between Loch na Creige Duibhe and Beinn Lice, for instance, they generally dip to northeast or E.N.E., while between Loch Strath nan Asinnteach and Meall na Leitreach they dip to south-east, and in the southern slopes of Gleann Dubh almost to due south. These different directions characterise different sides of a great fold into which the Eastern schists have once been thrown. The highest parts of the folded area have now been denuded away, but the lower parts on the north-east and south remain. The fold has not affected the Glencoul thrust, and has perhaps been formed while the higher thrusts were in progress.

(1) In this district, as in that of Eireboll and elsewhere, a belt of mylonised rock usually divides the other Eastern schists from the rocks which lie further to the west. Except on the hill between Loch More and Loch na Creige Duibhe — where its breadth is about a mile — it is never here as much as a quarter of a mile wide. Near Beinn Lice, Glen Coul, and Loch an Urchoil it seems generally to be only 10 or 20 feet thick, and in some places it perhaps does not exist. In one section near the head of Loch Strath nan Asinnteach it is certainly not present. Besides this most western outcrop, other bands of mylonised rock appear above or between portions of the "Stack" schist at the head of Loch Strath nan Asinnteach, rather more than one and a half miles south-east of Glendhu (house), near the head of Glen Coul, and at various other places.

About a mile and a half south-east of Glendhu a mylonised rock passes gradually into Lewisian rocks, which have been only partially mylonised, and which are overlain unconformably by the Cambrian quartzite. On the hillside between Loch More and Loch na Creige Duibhe a gradual transition appears to be traceable between a mylonised rock and the granulitic flagstones. But, nevertheless, the mylonised belt is in most places fairly well defined or separated by thrust-planes from the other rocks.

(2) The Puckered or "Stack" schists consist chiefly of rather dark-grey laminae mixed with others that are paler and more quartzose. Their material is throughout extremely fine-grained, and often appears as if its different parts had been kneaded together, individual laminae being not only intensely contorted, usually along axial planes which dip east,

E.S.E., or north-east, but also crossed by little thrust-like lines which had in the same direction as the axial planes. For instance, in the section on the north-east side of Loch Strath nan Asinnteach, about 250 yards from the head of the loch, some of the broader laminae are themselves divisible into minor laminae, partly of a very quartzose character, which are inclined at a considerable angle to the upper and lower surfaces of the broad laminae of which they form a part. It looks as if, perhaps, the rock had been piled up by a series of small thrusts, as some of the large rock-masses below the Glencoul thrust have been.

The quartzose streaks in the schist are very numerous, but none of them, as a rule, is more than an inch or two thick. A specimen from one of the thickest bands, about 30 feet above the base of the group in the Stack of Glencoul, has been sliced, and examination shows it to be a sericite schist or slate. (Specimen No. [S3865](#) [NC 2 2])

The Stack schists are well seen on the north-east side of Loch Strath nan Asinnteach, where they overlie the quartzite. At the loch their outcrop has a width of perhaps about 20 yards, but further south it is generally much broader. At one place, about 1500 yards south-west from the outlet of the loch, these schists are, perhaps, not represented at all. Near Lochain Feith an Leothaid and the head of Glen Coul the breadth of the band averages about half a mile.

Near Loch Strath nan Asinnteach it is difficult to draw a sharp line between these schists and the Cambrian quartzite, but, on the other hand, near Lochain Feith an Leothaid and between that tarn and Glen Coul, they appear to pass gradually upwards into the granulitic flagstone series, the change taking place in a width of 30 or 40 yards.

Ugranulitised pegmatites, rarely more than about an inch broad and running usually along the foliation planes, are rather common in this group. In some places, as on the north-west side of Loch nan Caorach, about a quarter of a mile E.N.E. of the outlet, these pegmatites are disposed in sharp isoclinal folds, and appear to have been folded together with the rest of the rock.

Various planes, resembling thrust-planes, and nearly parallel to the adjacent thrusts in the Cambrian rocks, have been observed within the Stack schists. The most conspicuous of these planes crosses the hill between Loch Feith an Leothaid and Glen Coul, keeping near to, but slightly below, the line taken as the boundary between the Stack schists and the granulitic flagstones. A brecciated rock is excellently exposed along the plane over a large area on the south side of the lochan about three-quarters of a mile N.N.E. from Loch an iirchoil. It inclines to east or slightly south of east, usually at angles varying between 14° and 17° , and from the character of the schist fragments it contains, it is clear that at the time of its formation the neighbouring rocks must have had essentially the same characters as they now possess. Another similar plane of brecciation is seen about a mile north from Loch an Urchoil, and probably lies a little below the plane just described.

(3) The Granulitic Siliceous Schist series covers a much larger proportion of the area at present mapped than either of the other groups. Its western portion includes the hills of Beinn Lice (1485 feet), Meall na Leitreach (1852 feet), and Beinn Leoid (2597 feet), but it is much less diversified by steep valleys and fresh-water lochs than the Lewisian gneiss areas lying further to the west, and it is covered also in many places with great expanses of morainic drift.

These extensively-developed schists present a remarkably uniform petrographical character. In none of them have any grains been observed which could be confidently taken to be of clastic origin. Occasional scattered grains, usually about the size of small peas, of white ungranulitised felspar may be noticed, but these are possibly of secondary origin. They are seen in various parts of Meall Leitreach, and with special clearness about a quarter of a mile north-east from the Ordnance station. Besides these grains, others consist of felspar and quartz mixed. About 1500 yards E.N.E. from Beinn Leoid some of these compound spots are as much as half an inch in length, and are scattered irregularly through the different rock hands.

On the foliation-planes of these schists a faint lineation or stretching may often be noticed. It seems usually marked by the arrangement of the quartz-granules and mica-flakes in directions towards W.N.W., N.W., or N.N.W. more or less at right angles to the general foliation-strike of the district.

The more micaceous schists intercalated among the granulitic schists generally contain many small garnets, and are characterised by a certain irregularity in their foliation, probably due to gentle puckering and occasional intersection by

lines of strain-slip. In other places they have been thrown into a series of sharp little folds which do not show themselves in the adjacent quartzose schists. The mica-flakes — chiefly of a white, but partly of a black or brown, colour — vary in size in different districts, but can everywhere be distinguished fairly well by the unaided eye. Some of the bands effervesce with dilute hydrochloric acid, but no calcite streaks appear sufficiently large to be discerned in hand specimens.

Few of these more micaceous intercalations are sufficiently thick to be traced far. Perhaps the thickest band noticed in this district is about 30 feet thick. It occurs about half a mile slightly east of south of Beinn Lice, and seems to run in a N.N.E. direction for about half a mile. Certain portions of it effervesce with dilute hydrochloric acid. It is also mixed with thin bands of more siliceous character.

Many thin pegmatites are observable in this series of schists, most of them approximately parallel to the foliation. They rarely exceed an inch or two in thickness. We do not remember to have noticed granulitisation in any of them, either in the quartz or the felspar. Some thin quartz-veins, however, which appear a mile and a half N.N.W. and half a mile slightly west of north of Beinn Leoid, run parallel to the foliation, and are somewhat schistose parallel to their sides. The granulitic schist series between Loch Strath nan Asinnteach and Gorm Loch Mor includes a set of intrusions which show great variety both in chemical composition and structure. Some of them are granitic, while others are chiefly composed of hornblende and black mica. Different parts of one mass often differ greatly in the proportions of the pale and dark constituents, and occasionally — as, for instance, on the north side of Loch nam Breac Mora, and about a third of a mile N.N.E. of the foot of Loch an Urchoil — dark hornblendic rocks are closely associated with others of granitic type as if possibly both were parts of one intrusion. In large exposures of these rocks indications of foliation are always observable, but the degree in which this structure has been developed greatly varies in different parts. The rocks also display great variety in their modes of occurrence, some of them occurring as sills, others as short irregular dykes, and others small bosses, but none of them are fine-grained at their margins. As a general rule the granitic intrusions form the bosses and dykes, while the basic rocks have a greater tendency to take the shape of sills. No evidence has been obtained to show that the intrusions are of different ages.

In various places — as, for instance, at the east end of the granitic mass a mile slightly west of south of the foot of Loch Strath nan Asinnteach, and at the sides of dykes near Loch Dubh—the different bands of the granulitic schist series are distinctly cut by the edges of the granitic intrusions. It seems certain that the rock into which the granite was intruded must at the time of the intrusion have been composed of bands having much the same chemical composition as those we now see.

It is quite possible, however, that the material in the different bands may have been recrystallised during, or subsequently to, the time of the intrusions. The quartz in the granitic rocks, even those which show but little foliation, appears to be always in a granulitic condition, and it may have acquired this character while the siliceous schists were being granulitised. The felspar grains in the granites have frequently also a clear zone of recrystallised material around their margins (Specimen No. [\(S2948\)](#) [NC 335 290], from 300 yards south of Loch Dubh, and No. [\(S2949\)](#) [NC 304 287], from about a third of a mile north of the foot of Loch an Urchoil), or they "tail off" into thin granulitic streaks. Further, the foliation-planes in some of the more perfectly foliated granitic gneisses are parallel to those in the neighbouring siliceous schists, and they display "stretching" lines in about the same direction.

The question of what has led to the recrystallisation of the schists and of the intrusions in them is not easily answered. The quartz and felspar of the thin pegmatites which occur so abundantly in the district have not been observed in a granulitic condition. Perhaps these pegmatites were introduced during the period when the quartzose schists and the quartzose parts of the intrusions were undergoing the process of granulitisation. Pegmatites are at least as common in the intrusions as in the schists, and pegmatites have been traced from the schists into an intrusion. Some of the intrusive sills — for instance, the dark hornblendic bands on the north side of Loch nam Breac Mora and in Fionn Allt (about 1000 yards slightly north of east of that lake) — have been sharply contorted together with the schists in which they occur. Both rocks probably suffered some alteration during the time of contortion. The whole region may at that time have conceivably been under such conditions of pressure, depth, and temperature that recrystallisation necessarily ensued in nearly all the rocks.

III The Eastern Schists in Assynt

By B. N. Peach and J. Horne.

Except in certain places, the position of the Moine thrust-plane in Assynt is well defined. From a point near Gorm Loch Mor it has been traced southwards to the eastern shore of Loch Ailsh, whence, crossing the River Oykeell and Allt Ealag, it sweeps westwards to the Knockan Crag south of Elphin. The sequence of rocks above this great line of disruption begins here, as in the ground already described, with mylonised materials, consisting chiefly of quartzose rocks and including a sheared igneous sill. These rocks exposed to the east of Gorm Loch More are followed by fine-grained, flaggy, granulitic schists containing quartz, biotite, and muscovite. They are eventually succeeded by the siliceous flagstones with sills of foliated granite. At this part of the district the normal type of quartz-schists appears within 300 yards to the east of the Moine thrust-plane.

The sheared arkose is not continuous along the strike, but occurs in lenticular form. It is next seen in Allt Chnaip Ghuhhais near the head of Allt Loch Carn nan Conbhairean, where the deformation is equally marked. Among the rocks which have here shared in the movements that affected the Moine schists intrusive sheets of igneous material deserve notice. About 500 yards east of the line of disruption, in one of the branches of Amhainn Gleann na Muic, a tributary of the River Cassley, a thin sill appears in those schists, both having common foliation-planes. It contains greenish-brown biotite, with needles of actinolite in a granular mosaic of felspar, the rock being regarded by Dr. Flett as possibly a sheared kersantite. Again, at the foot of Allt na Cailliche, which drains into Loch Ailsh, several thin sills of sheared syenite porphyry make their appearance, which are characterised by the abundance of porphyritic felspars and of biotite in their ground mass, together with a little quartz.

One stream-section may here be referred to in further illustration of the extreme difficulty of sometimes locating the exact position of the Moine thrust-plane. In a little burn east of Allt na Cailliche, that joins the River Oykeell about three-quarters of a mile S.S.E. of Loch Ailsh, where the rocks are continuously exposed, a passage can be traced from recognisable Cambrian zones eastwards into siliceous (Moine) schists without any apparent disruption line. In the lower part of the section sheared pipe-rock with sills of foliated porphyry are succeeded by schistose feldspathic arkose, partly granulitised, with streaks of sericitic mica on the divisional planes. The lines of heavy minerals in the original sediment are still apparent, and the pebbles of quartz and felspar have not been effaced. These beds of arkose are traversed by sills of sheared porphyrite with porphyritic orthoclase and crystals of orthite. Eastwards a mylonised quartzite with parallel films of white mica is followed by a band of hornblende-schist, and eventually by siliceous Moine-schist. All these strata including the sheared pipe-rock have a common dip and strike and common planes of schistosity which are more or less parallel with the plane of the Moine thrust. In the River Oykeell the beds overlying this line of disruption consist of partly mylonised and partly granulitised rocks which have been driven over sheared fucoid-beds with a sill of foliated syenite porphyry.

Interesting evidence is obtained in the Knockan Burn that deformed grits and sills of igneous material, resembling some of those in the Cambrian strata of Assynt, appear among the Eastern schists. About 100 yards up that stream from the Moine thrust-plane and about a mile south from the Knockan village these schists include a thick sheet of foliated granitic rock, together with thin intrusions sometimes less than an inch thick. These intercalations occur along the foliation-planes of the schists, the parallelism between the two rocks being well marked. Microscopic examination shows that the sediments into which the sills were intruded have not been much altered. One specimen (No. [\(S9758\)](#) [NC 212 090]) is a mylonised arkose in which the pebbly structure is not yet destroyed. The sill ([\(S9756\)](#) [NC 212 090], [\(S9757\)](#) [NC 212 090]) associated with this arkose shows, according to Dr. Flett, phenocrysts of orthoclase, plagioclase, and microcline, which are broken and partly granulitised. The ground-mass contains much biotite with chlorite, and is considerably granulitised. Such cumulative evidence seems to point to the conclusion that beds of arkose, resembling the Torridon rocks to the west and intrusive rocks like those in the thrust masses in Assynt, have shared in the movements that affected the Moine-schists and now form an integral part of these schists.

IV The Eastern Schists between Knoch and Strath Kanaird

By L. W. Hinxman.

The rock that immediately succeeds the Eilean Dubh dolomite above the Moine thrust-plane on the Knockan cliff is a greenish platy quartzo-felspathic flagstone, including thin intercalations of a more schistose -rock with crumpled folia. (See (Figure 40)) Between Lochan Fada and Drumrunie (old) Lodge, in the area west of the Ullapool road, these green corrugated, schists, which are there the predominant rocks, exhibit the peculiar structure to which the name of "oyster-shell" or "frilled" schist has been applied in the area where they are typically developed on the east side of Loch Eireboll (*ante* p. 604). Two hundred yards south from the point where the county boundary between Sutherland and Ross crosses the Knockan cliff, a lenticular mass of comparatively unaltered Lewisian gneiss intervenes between the dolomite and the thrust-plane. A short distance further south a lenticle of Cambrian quartzite occupies a similar position. Another lenticular mass of gneiss, which likewise exhibits little deformation, is seen to rest upon the serpulite-grit at the roadside half a mile north of Achendrean, and immediately south of a small burn that here crosses the road. These intercalated masses may be regarded as phacoids, which have to a large extent escaped the deformation that has destroyed the original structures in the surrounding rocks.

Eastwards from the thrust-plane the siliceous flagstones become more crystalline in character and greyer in colour. White mica has been developed in more or less abundance on their divisional planes. Bands of thin fissile mica-schist are associated with the more siliceous variety. Several such highly micaceous bands, containing abundant small garnets, have been traced through the flagstones a mile to the east of Drumrunie Lodge.

The Moine schists in this district have a persistent easterly dip at angles varying from 8° to 15°, but this dip cannot be regarded as in any way indicating the original disposition of the strata. The rocks have been thrown into a series of isoclinal folds, and their dip at any point merely represents their inclination along either limb of one of these folds. Hence no satisfactory computation can be made of the thickness of the materials that have been piled up above the Moine thrust-plane. (Figure 40) The low angle of inclination of this thrust-plane causes its surface to approximate in many places to that of the ground, and to run for a considerable distance up into Strath Kanaird, where denudation, by exposing the rocks that lie beneath the thrust-plane, has shown the comparatively small thickness of the overlying cake of Eastern schists in this part of the district.

V The Eastern Schists from Strath Kanaird to Strath na Sheallag

By the late W. Gunn.

The Eastern schists in this district offer few points of interest. They do not rise to a greater height than 1830 feet in the highest point, Beinn Eilideach, to the south-east of Ullapool. Their general surface forms plateau-like ground, from about 600 to 1600 feet in elevation, deeply trenched by the valleys of the River Kanaird, the Ullapool River, Loch Broom, and the Strathbeg River. Many of the smaller streams that traverse these rocks have formed in them remarkably narrow, deep, and often quite impassable gorges. Good examples of this feature may be seen near Leckmelm and Ardcharnich on Loch Broom, and a specially striking instance on the larger stream of Strathbeg above Corryhallie. Lochs and lochans are extremely numerous, as in the area north of Loch Achall, and on the plateau between the valleys of Loch Broom and Strathbeg. Most of these waters lie in rock basins, each often occupying a separate depression of the ground, so that without a careful scrutiny of the district many lochs would escape notice. The overlooking of this necessity has doubtless led to the omission of lakes in various places from the Ordnance maps.

The prevailing type among the Eastern schists of this district is the typical granulitic, flaggy, light-coloured quartzose rock, not conspicuously foliated, generally presenting a moderate amount of white mica on the foliation-planes. Scattered through the rock are specks of dark mica or biotite, but these become rarer in the most quartzose varieties. Felspar is generally present, and in some cases forms a considerable portion of the schist. The next most marked type is a dark-coloured biotite-schist with abundant wavy or wrinkled foliation-planes. It is comparatively poor in quartz, but contains also white mica like the siliceous variety, and both rocks often contain small garnets.

The biotite-schist occurs as bands in the quartz-schist, the bands varying in thickness from mere partings of a few inches up to beds that form distinct features, and are traceable for some distance. Between these two distinct varieties of rock

many gradations may be observed. There are also highly siliceous and massive kinds which approach the nature of quartzite, and contain little mica of any kind. Although the dark biotiteschist forms but a small part of the total thickness of these rocks, it often spreads over an area very disproportioned to its bulk.

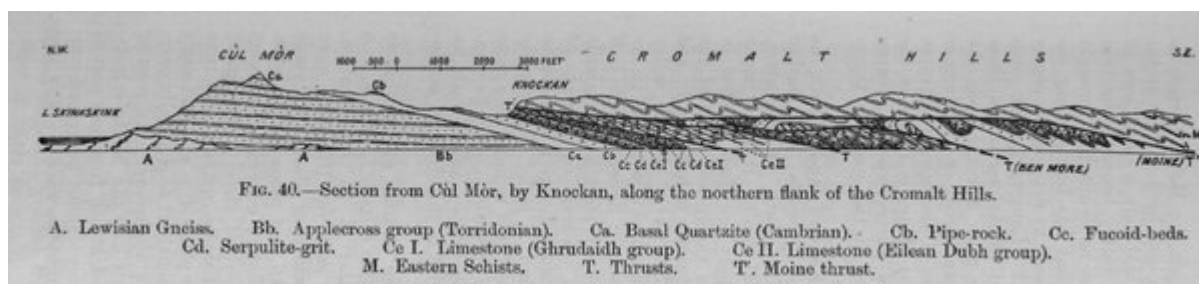
In places where the two principal varieties of schist frequently alternate the siliceous kind almost invariably forms the small crags and prominent features, while the biotite-schist, lying as a thin cake on the top of the crag, spreads out over the dip slope.

Probably the finest section of the Eastern schists in this district is to be seen in the great scar on the east side of the Strathbeg River, called Creag Dhuibh Coill a Bhun. From 700 to 900 feet in height it is almost entirely -made up of rocks of the siliceous type, here and there banded with beds of biotite-schist two to three feet thick. The foliation dip of these rocks is for the most part regular at angles of 10° to 20°, sometimes rising to as much as 30°. The direction of dip is generally to the southeast. Few *signs* of much plication can be detected; only gentle undulations are observable. Between Strath Kanaird and the Achall Valley, however, the inclination becomes less regular, being in many places nearly due south, and near Loch Achall north-east. Along certain lines, also, the schists have been much ridged up and contorted, as in the marked example already (*ante* p. 536) described as traceable for several miles in an E.N.E. direction on either side of Loch Broom.

Signs have been observed not infrequently of another kind of deformation in these rocks, where a differential movement has produced friction-marks. In the district north of the Rhidorroch River this movement appears to have been directed towards the north-west or W.N.W. Occasionally also another type of foliation may be noticed, in which, for example, between two slabs of flaggy, regularly-foliated and gently-inclined schist, a bed may intervene, in which the foliation shows a steep dip and is much puckered. This arrangement may be the remnant of an original structure elsewhere destroyed, or it may be that the puckered slab was subjected to differential movement while the adjacent beds remained comparatively motionless.

Segregation veins and pegmatites of a white or pink colour are common in some parts of the Eastern schists of this district. perhaps more abundantly where the rocks have been folded or puckered. Where biotite-schist and quartzose-schist frequently alternate pegmatites appear in the former rock, while in the latter quartz-veins appear to represent the pegmatites. That the crystalline Moine-schists of this district have mainly a clastic origin may be confidently inferred from the traces of clastic material occasionally met with among them. The age of the original sedimentary masses, however, still remains in doubt. In some places, as in the example from the cliffs east of Dundonnell, good evidence can be adduced that altered Torridon Sandstone has entered largely into the composition of the Eastern schists.

The amount of undoubted igneous material in the Eastern schists of this district is small. East of Ullapool a narrow band or sill of granite, among the schists not far east from the Moine thrust-plane, has been traced almost continuously northward to Loch Achall. Intrusive material of the same character occurs north of Glastullich and half a mile south of Loch Achall on the eastern side of the main stream which enters the loch from the south, where the sill is ten feet thick. The rock is a red biotite-granite which contains microcline and white mica, and is often traversed by veins of fine-grained quartz-rock. The shore at Loch Broom, near the south end of Leckmelm Wood, displays a narrow band of similar rock, but as it is distinctly foliated it has become an irregularly-foliated biotite-gneiss.



(Figure 40) Section from Cùl Mòr, by Knockan, along the northern flank of the Cromalt Hills. A. Lewisian Gneiss. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoïd-beds. Cd. Serpulite-grit. Ce I.

Limestone (Ghrudaidh group). Ce II. Limestone (Eilean Dubh group). M. Eastern Schists. T. Thrusts. T'. Moine thrust.