
Chapter 15 Distribution and general characteristics

By L. W. Hinxman, with notes by B. N. Peach and E. Greenly

Area and scenery

The rocks included in the Torridonian series present a striking contrast to those of the Lewisian gneiss, inasmuch as they consist mainly of red sandstones and conglomerates which over much of their extent are gently inclined or horizontal. They stretch in a N.N.E.-S.S.W. direction along the western sides of the counties of Sutherland and Ross, forming a more or less broken belt that runs for 115 miles from Cape Wrath to the Point of Sleat in Skye, and attain a maximum breadth, measured between Gairloch and Strathcarron, of about 20 miles. In the extreme north of Sutherland they occupy the greater part of the wild region lying between Cape Wrath and Loch Inchar. Further south they occur in disconnected patches, forming the island of Handa, the flat promontory of the Rhu Stoer, and the strange isolated peaks of Quinag, Canisp, and Suilven that rise on either side of Loch Assynt. Across the northern boundary of Ross-shire they are more extensively developed, since they cover the whole of the Coigach district and the promontory between the two Lochs Broom, whence they stretch southwards in a gradually diminishing belt to the head of Loch Maree, where they rise into the imposing mass of Slioch; while another large isolated area in the west forms the Rudha Mòr and the low ground on either side of Loch Ewe.

But it is in the districts of Gairloch, Torridon, and Applecross that this formation reaches its maximum development, for it extends in almost unbroken continuity for twenty miles eastwards from the shores of the Applecross peninsula into Strathcarron. Nowhere are its sandstones more characteristically developed than in the mountainous country that surrounds the head of Upper Loch Torridon, a region which suggested the appropriate name of Torridon Sandstone, first applied to these rocks by Professor Nicol. The Applecross mountains, with their colossal escarpments and huge precipitous corries, likewise display on the grandest scale the characteristic scenery of these rocks. (See (Plate 3))

The most southerly extension of recognisable Torridonian strata detected up to this time on the mainland occupies the promontory between Loch Carron and Loch Alsh, and forms a narrow stripe along the eastern shore of the Kyle Rhea. Across the Kyle they pass into the Island of Skye, and are continued southwards through the peninsula of Sleat. That they once covered a far wider space than that to which they are now restricted is shown by the distribution of small outlying areas of these rocks among the Western Isles. They form the central portion of Raasay, the greater part of Scalpay, the Crowlin Islands, Soay, and the northern half of Rum.

The greater part of the ground covered by the Torridonian series is essentially a mountain region. The most striking features of the scenery of the North-West Highlands are due to the long line of red sandstone mountains that flank the western seaboard of Sutherland and Ross. At the northern end, though the Torridonian belt begins with the comparatively low hills of the Parph, it plunges into the Atlantic in a magnificent range of mural cliffs along the northern coast near Cape Wrath. Further south it reaches heights of 2400–2700 feet in the Assynt and Coigach districts, and culminates south of Loch Broom in the shapely cones of An Teallach in Dundonnell (3483 feet) and Liathach, at the head of Loch Torridon (3456 feet).

Most of these hills have a unique personality that at once distinguishes them from the ordinary mountain-forms found among the metamorphic rocks of the Highlands. They rarely coalesce into a continuous range, but rather tend to stand out in more or less detached masses isolated from their fellows. This isolation is most complete in the mountains of Assynt, where the greater part of the sandstone formation has been removed by denudation, leaving such solitary monolithic forms as the well-known and often-described peaks of Quinag, Canisp, and Suilven. The peculiar scenery of the Torridon Sandstone mountains has been referred to by various writers, particularly by Macculloch — *Geology of the Western Isles*, vol. ii., p. 90 *et seq.*; Macculloch — *Letters to Sir Walter Scott*, vol. ii., p. 344 *et seq.*; and by Hugh Miller — *The Old Red Sandstone*, 22nd edit. (1879), p. 53; *ibid.*, *On the Red Sandstone, Marble, and Quartz Deposits of Assynt*, p. 328 *et seq.* It is more fully described in Sir Archibald Geikie's *Scenery of Scotland*, 3rd edit., pp. 80, 127, 222, 246, 505, 508. (Plate 1) The successive stages in the process of sculpture may be impressively traced from south

to north along the Torridonian belt. Almost the first stage may be seen where a portion of a high-level table-land is, as it were, just beginning to be detached as a separate mountain, such as Bheinn Bhan of Applecross. A further step is reached in such a mountain as Liathach, separated on every side by deep glens from its neighbours, but still forming part of a closely-serried group of similar masses. This individualisation becomes more and more marked towards the north until we reach completely isolated ridges and pyramids of sandstone standing alone on the bare platform of gneiss, as in the long, narrow, wall-like mass of Suilven, with its crest deeply cleft into successive peaks by gullies that have been carved out along vertical joints or lines of fault. But the process of decay still continues, and various stages in the degradation and demolition of the isolated sandstone cones and pyramids can be followed, as in the shattered knife-edge of Stack Polly, which has been splintered into fantastic pinnacles, and is now obviously wasting down to the general level of the surrounding country. It is thus manifest that these mountains remain as only the scattered fragments of a great formation which must once have risen much higher and extended much further than it does now.

The denuding forces, acting on a series of rocks very homogeneous in composition and arranged in gently-inclined or horizontal strata, tend to produce outlines at once simple and massive and more or less architectural in form. Hence the characteristic features of these sandstone mountains appear in regular cones, rounded bastions and buttresses, and flat-topped mural precipices, while the parallel lines of bedding which may be traced from base to summit of the cliffs look like piles of Cyclopean masonry. Where the strata are horizontal or nearly so, and are traversed by strong vertical joints or faults, the mountains assume on every side more or less precipitous shapes and rise abruptly in terraced escarpments or round castellated piles of flat cake-like masses, separated from each other and trenched by deep couloirs or rock-chimneys.

Along the landward side of the area, where the dip is usually regular and inclined gently towards the east, the escarpments look westward and north-westward to the sea, while the slopes follow the general direction of the dip. The latter, however, are rarely for any distance dip-slopes, the general angle of the hillsides being, as a rule, greater than the inclination of the strata. The smooth regular profile as seen from a distance seems often to be that on which the covering of Cambrian quartzite that has recently been stripped off them was laid down. A closer examination of these slopes shows also that their smoothness is more apparent than real, seeing that they consist of a series of alternating dip-slopes and basset edges, which give rise to the successive low terraces that follow one another in parallel lines along the hillsides, and form one of the most characteristic features of Torridonian scenery. On the high ground these terraces are usually bare and strewn with boulders, but lower down they become masked under a covering of thin peaty soil and rough herbage that gradually soften down their outlines into a uniform slope.

Reference has already been made to the deeply-incised features produced on the mountain sides by the vertical joints. These joints also play an important part in determining the course of the streams. When, in the lower part of their course, streams strike a joint, they often follow its trend as a line of least resistance for a considerable distance. They have thus been enabled to erode deep and narrow chasms with perpendicular sides which may run for half a mile or more in an absolutely straight line. These miniature *cañons* are also a marked feature of the eastern schists, where those rocks most closely resemble the Torridon Sandstone in its modified form. Besides these stream-gorges, the lines of fracture have given rise to dry gullies — locally known as "clashes" — which can often be traced for long distances, and even across existing watersheds. Similar features are also produced by the weathering-out of the less-resisting igneous material of intrusive dykes. Much of the characteristic coast-scenery of the north and west of Sutherland and Ross is due to the way in which the Torridonian rocks yield to the forces of marine and subaerial denudation. The horizontal and evenly-bedded strata, cut by vertical joints, rise in long lines of mural cliff, which by the action of the waves along these joints are hollowed out into caves and deep chasms known as "gloups" or "gyoes". These characteristic features are strikingly displayed on the range of sandstone precipices to the east of Cape Wrath<ref>*Scenery of Scotland*, p. 80.</ref>.

An increase in the general angle of dip produces a corresponding change in the scenery of the Torridonian rocks. Where the inclination of the beds exceeds that of the hill-slopes it gives rise to a series of parallel rib-shaped features, determined by the outcrops of successive beds of sandstone, with intervening hollows. The type of scenery thus produced is much more rugged and irregular than that which prevails in the normal denuded plateau area.

The various aspects of the Torridonian landscape here described are all subject to the well-known modifications due to glacial action. These modifications are naturally most apparent on the lower hill-slopes and in the valleys, where the *roches moutonnées* and the wonderfully fresh appearance of the polished and grooved surfaces of bare sandstone cannot fail to strike the most casual observer.

Lithology and stratigraphy

The prevalent lithological and stratigraphical features of the Torridonian series are the uniformity of composition and fresh appearance of the rocks, and the regularity and generally undisturbed character of their disposition. Indeed, the observer who studies these rocks in the unmoved area west of the great line of dislocation finds it difficult to realise that such unaltered sediments, which he sees resting almost in the position in which they were originally laid down, are the oldest recognisable sedimentary deposits in the British Isles.

The great bulk of the formation consists of more or less coarse-grained arenaceous sediments in the form of felspathic grits and sandstones (arkose), with occasional thin intercalations of fine-grained micaceous shale and sandstone. Coarse angular breccia occurs as a local base, and numerous bands of pebbly grit, conglomerate, and scattered pebbles are found at different horizons, while the whole series is characterised by false bedding and other signs of current action. A slight decrease in the coarseness of the material is perceptible towards the southern limits of the area, accompanied by a corresponding increase in the number and thickness of the finer bands intercalated with the arkose. In the central portion of the belt, where they are best developed, the arkoses reach a thickness of 6000 feet, pointing to a long-continued uniformity in the conditions of deposit.

From the nature of the rocks it may be inferred that the conditions of deposit were probably those of a rapid accumulation in shallow water near a shore line, subject to violent currents and the influx of flood or stream-borne materials, with occasional intervals of quiescence during which the finer sediments were laid down; while the permanence of these conditions may be accounted for by a long-continued subsidence, taking place contemporaneously and at the same rate with the deposition of the sediments. The remarkable freshness of the feldspars in the arkose points to a disintegration of the rocks, carried on at a more rapid rate than the decomposition due to chemical action. It would also seem to indicate cold climatic conditions accompanied by periodic floods of great intensity.

Both at the top and bottom of the formation the rocks are finer-grained and more argillaceous in character, and include a considerable thickness of shales and flagstones with calcareous bands. As perhaps a great part of the highest visible group of the Torridonian series had been removed by denudation previous to the deposition of the overlying Cambrian strata, the argillaceous and calcareous portions of the whole may originally have borne a much larger proportion to the grits and sandstones which make up by far the greater part of what is now left of the formation. The rain-pitted and sun-cracked surfaces of the shales and mudstones seen on Loch Torridon and elsewhere show that the fine sediments of the lowest group are shore deposits, and cannot be regarded as due to deeper-water conditions.

The base of the Torridonian series is usually formed of a conglomerate or breccia, sometimes exceedingly coarse in texture, and derived from the Lewisian rocks in the immediate vicinity. In one instance, on the north side of Loch Maree, it has been observed that the blocks in the conglomerate have come from the hornblende-schist ridge of Ben Lair, and may have travelled a distance of three miles. The conglomeratic base appears to be a local deposit not confined to any one definite stratigraphical horizon, but appearing on successive levels for two or three thousand feet upward from the base of the whole series, according to the extremely accentuated surface of the subsiding region of gneiss on which the Torridonian formation was laid down.

Leaving out of account, however, these coarse basal deposits, an examination of the materials of the Torridonian series leads to the conclusion that they have in great part been derived from rocks not now visible in the region. The epidotic grits and other members of the lowest zone contain material such as plagioclase feldspar, that, like the breccias, may have been derived from local sources. But a microscopical examination of the sandstones, which make up the main mass of the series, shows that microcline, in a wonderfully fresh condition, forms an abundant constituent of and is the dominant feldspar in these rocks. Our knowledge of the lithological characters of the gneiss as developed in the North-West Highlands establishes the fact that over the greater part of the area microcline does not predominate, and only occurs in

any abundance in the district between Cape Wrath and Loch Laxford, where granitic gneisses and pegmatites are largely developed. Except in the local basal breccias, pebbles or even recognisable fragments of Lewisian Gneiss are rarely met with. Hence we may conclude that, while the existence of a further extension of rocks of the Cape Wrath type to the north may have to some extent supplied this characteristic constituent of the Torridon Sandstones,, it cannot have been derived from the bulk of the Lewisian Gneiss as we now know it on the mainland.

The pebbles that occur so abundantly throughout the arkose series afford, however, the strongest proof of the foreign origin of most of the Torridonian sediments. As a detailed description of the pebbles from various localities will be found in Chapter 16, it may be sufficient to state here that they include examples of sedimentary, metamorphic, and igneous rocks which are not found within the Lewisian area, and suggest the existence of a pre-Torridonian sedimentary and eruptive series as the source of the coarser materials of the Torridonian formation.

Tabular list of the groups of the Torridon Sandstone

Names of groups	Approximate thickness in feet	Nature of materials	Localities where typically developed
3. Aultbea Group	3000 to 4500	Sandstones, flags, dark and black shales and calcareous bands passing down into chocolate and red sandstones, and grey micaceous flags with partings of grey and green shale.	Cailleach Head; Loch Broom; Coigach; Aultbea; Applecross; Crowlin Islands; Coulin and Achnashellach Forests.
2. Applecross Group	6000 to 8000	Chocolate and red arkoses with pebbles of quartzite, quartz- schist, felsite, jasper, etc. Occasional chocolate and red shales.	Durness; Assynt; Stoer; Coigach; Ullapool; Gairloch; Dundonnell; Torridon; Applecross; Loch Carron and Loch Alsh; Skye.
1. Diabaig Group	500 in Gairloch. 7200 in parts of Skye	Hard, fine red sandstones at top, mixed with red mudstones and dark grey sandy shales with micaceous lenticles. At base, conglomerates made out of Lewisian gneiss. In Skye grey and buff arkoses are developed in great thickness, and the group has been divided into four zones.	Stoer; Dundonnell; Gairloch; Loch Maree; Diabaig and Loch Torridon; Loch Carron and Loch Alsh; Skye.

The Torridonian land-surface

The surface of Lewisian Gneiss on which the Torridonian series was laid down probably to a considerable extent resembled that of the existing surface of the older rock. It appears to have in great part presented the appearance of an undulating plateau, moulded into hollows and eminences more or less uniform in height, such as now meets the eye in the neighbourhood of Scourie or Gairloch. But the detailed investigation of the ground further to the south and east has revealed the existence of a much more diversified topography that has been exposed by the denudation of the sandstones under which it was buried. The gneiss is there found to have been carved into mountains and valleys, and testifies by the extreme irregularity of its contours that it underwent prolonged erosion as a terrestrial surface. The present lines of drainage still follow some of these old Torridonian river-valleys, while here and there an isolated peak or range of hills, preserved from the waste of time by the enveloping Torridonian sediments, remains as a fragment of the Archaean land.<ref>The existence and antiquity of this land-surface were noticed by Sir A. Geikie in his paper on: A

Detailed descriptions of the varieties of the Torridonian topography will be found in the successive chapters devoted to the districts in which these varieties are displayed. Only a brief reference to the more striking features need be given here.

Between Loch Inchard and Loch Carn Bhan the general surface of the gneiss has by subsequent denudation been cut below that of the ancient plateau, the only remains of which are seen on Ben Dreavie, where it has been preserved by a small capping of Torridonian conglomerate. Further south a good example of a pre-Torridonian bill rises from beneath the northwest peak of Quinag. (Plate 31) Here the successive beds of sandstone abut against the steep sides of an ancient hill of gneiss that must have reached a height of 1200 feet above the average level of the surrounding country, and may well have been considerably higher.<ref>A sketch of this Torridonian hill with its capping of sandstone is given *Scenery of Scotland*, p. 126.</ref>

In the Stoer peninsula the presence of 2000 feet of Torridonian strata lower than any found on Quinag shows that in Torridonian time the difference of level in the surface of the gneiss at these two points, ten miles apart, must at least have equalled the thickness of these lower strata. It should be pointed out, however, that this estimate of the fall in the ground between Quinag and Stoer depends in a great degree upon the correlation of the rocks at the latter locality with those of the Diabaig group, and does not rest upon such direct evidence as that for the Quinag hill referred to in the preceding paragraph, and for the still more remarkable topography to be seen further south.

Further evidence of a considerable slope to westwards is found in the area between Loch Assynt and Loch Owskeich in Coigach.

Not a few of the larger valleys in this district can be shown to have been hollows in Torridonian times, as in the case of the two higher branches of the valley of the Kirkaig, above the Fionn Loch; of the hollow on the north side of Suilven; and of the deep glen under Cùl Mòr at the head of Loch Skinaskink. The region of which this loch is the centre is at present one of considerable irregularity of surface, and from the present relations of the sedimentary strata to the gneiss this irregularity was obviously still more marked in Torridonian times.

The small inliers of gneiss seen in the area to the north of Upper Loch Torridon point to the existence of a range of hills of considerable height concealed beneath the sandstones of Liathach and Beinn Dearg. The gneiss rises steeply from the glen between these two mountains, and at the point where it passes beneath the sandstone on the south face of Beinn Dearg it reaches a height of 1800 feet above sea-level and more than 1100 feet above the lowest place where it is seen in the Amhainn Mhic Nobuill. The distance between these points is less than half a mile, and the angle of the hill-slope about 20°. That the surface of the gneiss continues to fall steeply southwards to a point below sea-level is shown by the appearance of the Torridonian strata along the shore on the south side of Liathach, a mile and a half from the boundary of the gneiss inlier.

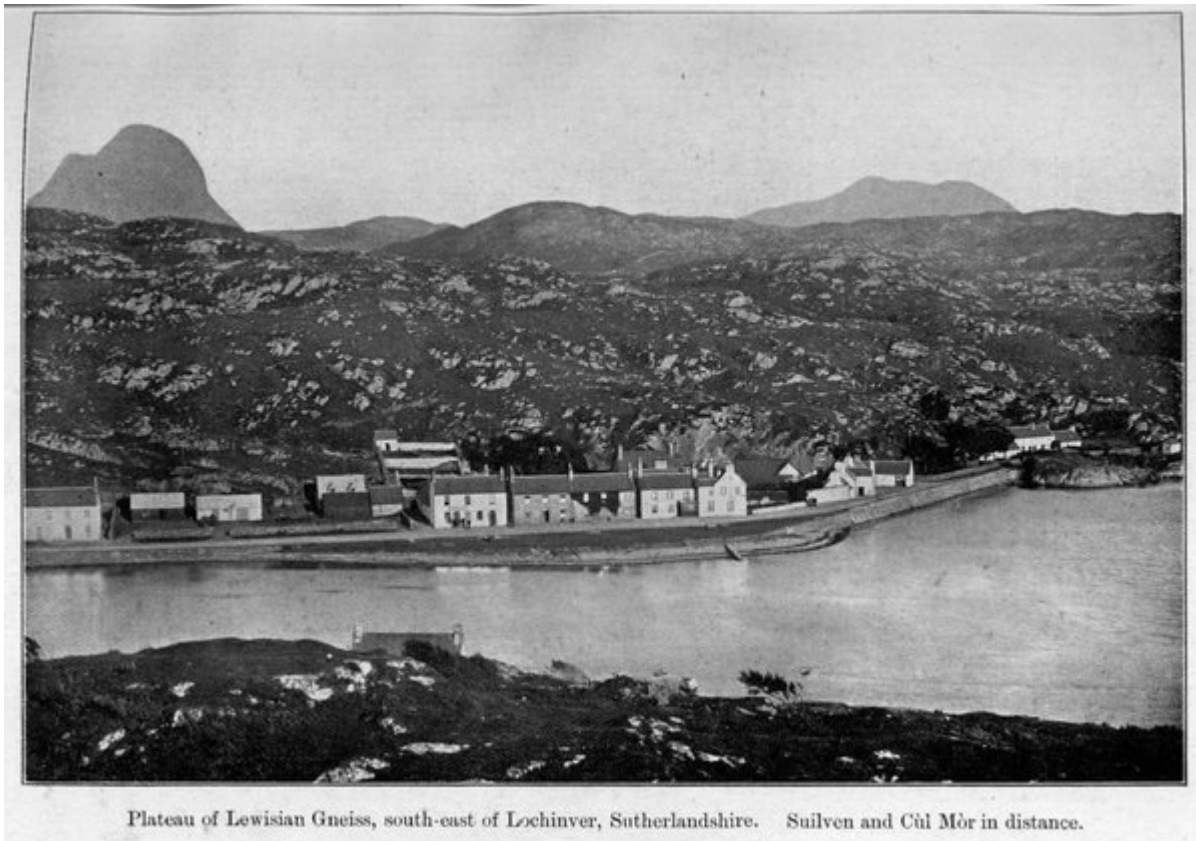
The ridge of Lewisian Gneiss which crosses Loch Torridon at the Narrows and forms the promontory of Shildaig may be regarded as another parallel range of ancient hills. That portion of it which rises immediately above the north side of the loch may owe its extremely rugged character to subsequent denudation, but further north there is evidence of the comparatively recent removal of the basal Torridonian strata that still rest up to 1000 feet on the slopes and in the hollows between hills that reach a height of 1750 feet above the sea. On the other side of Loch Torridon, where, as already stated, the ridge passes beneath the north end of Beinn Shildaig, the gneiss rises from sea-level on either side of a deep narrow valley filled with Torridonian rocks, and is overlapped by the sandstones at the 800-foot contour on each side of the mountain.

In the area between Loch na Sheallag and Loch Maree, and again on the south side of the latter loch, six or seven distinct hills of Archaean gneiss, some of them of considerable size, can be demonstrated by the disposition of the sediments around them to be of older date than the Torridonian series. Perhaps the most remarkable of these are the hills which underlie Beinn Dearg Mhor and Beinn Dearg Bheag. The gneiss rises from the shores of Loch na Sheallag towards each of these mountains, and reaches its highest elevation-2300 feet above sea-level immediately under the

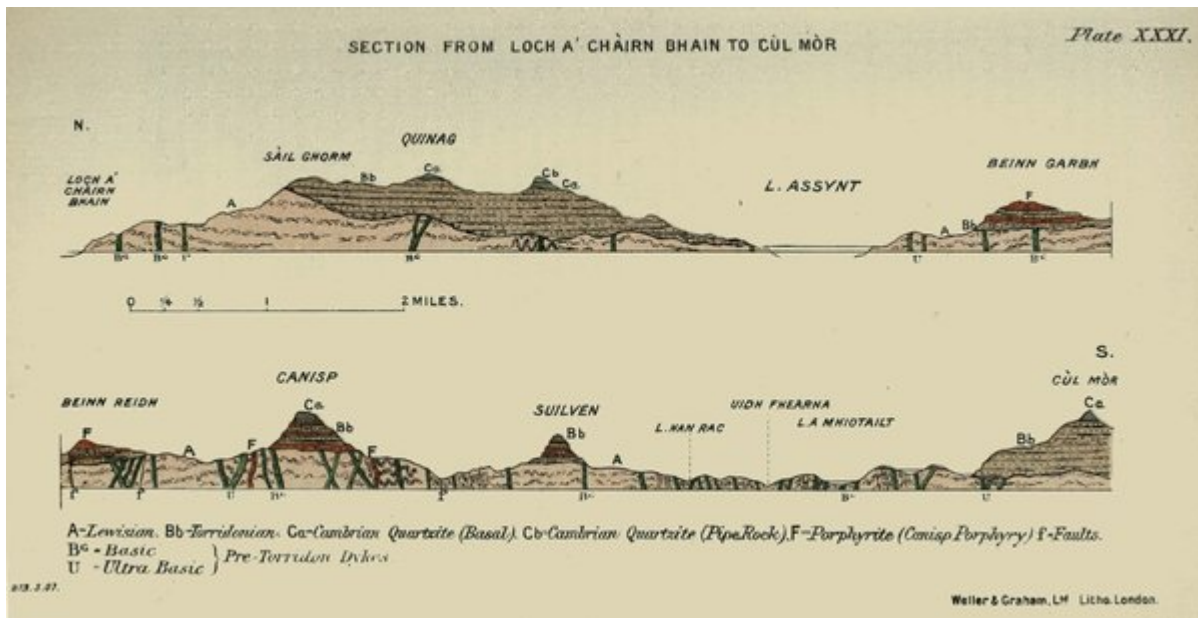
south end of Beinn Dearg Bheag. The great hollow to the north of that mountain is also of older date than the Torridonian strata.

The hollow of Gleann na Muich, south of Beinn Dearg Mhor, coincides with the edge of an ancient valley, now filled with the sandstones of Beinn Tarsuinn, Sgùrr Bàn, and Beinn a' Chlaidheimh. Two tributary glens of the same antiquity can also be traced coming in from the west and joining this valley opposite Sgùrr Bàn. The small patch of Torridonian sediment on the summit of A' Mhaigdean conceals a hollow that probably represents the head of one of these glens. Another well-marked eminence belonging to the same old topography rises from beneath the grits of Beinn Tarsuinn on the north side of Loch Fada. The deep hollow of Glen Tulacha and the great cliff of Ben Lair also date back to the same remote period, as is proved by the patch of horizontally-bedded breccia and sandstone which rests on the face of the cliff.

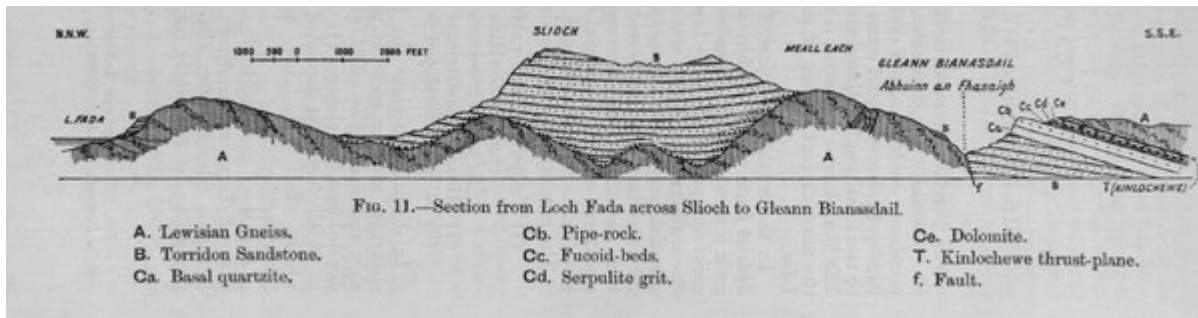
A still more conspicuous example of the irregularity of the ancient land surface is found on the flanks of Slioch, which rises above the northern shore of Loch Maree. This great mountain can be shown to partially envelope three distinct lulls and to fill up two valleys of pre-Torridonian age. Over 2000 feet of Meall Each, the most easterly of these elevations, are still visible, and the disposition of the surrounding strata shows that it may well have reached 3000 feet. The original sides of this hill were very steep, for their scree-slopes, now compacted into Torridonian breccia, are still distinctly visible. Meall Riabhach, the central hill, forms a conspicuous feature as seen from the further side of the loch Owing to the contrast of the light-gray gneiss of which it consists with the dark-purple sandstones that abut against its sides. (Figure 11)



(Plate 1) Plateau of Lewisian gneiss, south-east of Lochinver, Sutherlandshire; Sulven and Cùl Mòr in distance. B40.



(Plate 31) Coloured section from Loch a' Chairn Bhain to Cùl Mòr, showing denudation of the Torridon sandstone on the plateau of Lewisian gneiss.



(Figure 11) Section from Loch Fada across Slioch to Gleann Bianasdail. A. Lewisian Gneiss. B. Torridonian Sandstone. Ca. Basal quartzite. Cb. Pipe-rock. Cc. Fucoid beds. Cd. Serpulite grit. Ce. Dolomite. T. Kinlochewe thrust-plane. f. fault.